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Radiocommunication Information Circular

Information for Operators of Digitally Modulated Radio Systems in Licence-Exempt Radio Frequency Bands

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Canada

Preface

Radiocommunication Information Circulars are issued for the guidance of those engaged in radiocommunications in Canada. The information contained in these circulars is subject to change without notice. It is therefore suggested that interested persons consult the nearest district office of Industry Canada for additional details. While every reasonable effort has been made to ensure accuracy, no warranty is expressed or implied. As well, these circulars have no status in law.

Comments and suggestions may be directed to the following address:

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All Spectrum Management and Telecommunications publications are available on the following website: http://www.ic.gc.ca/spectrum.

Contents

1. Intent

The intent of this document is to provide general information to operators of digitally modulated radio systems within the licence-exempt radio frequency bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz. Both consumers and businesses alike prefer the convenience and low cost of licence-exempt radio devices, and Industry Canada recognizes their benefit to Canadians. The Department strives to provide a radio environment in which both licensed and licence-exempt radio devices can operate harmoniously, and therefore it is important for consumers to understand the benefits and limitations of licence-exempt radio equipment in order to make informed decisions.

2. Background: Digitally Modulated Radio Systems in Licence-Exempt Frequency Bands

In accordance with the *Radiocommunication Act* and the *Radiocommunication Regulations*, operators of licence-exempt radio devices are exempted only from the requirement to obtain a radio station licence. All other requirements of the Act and the Regulations still apply.

Accordingly, operators of digitally modulated radio systems in the licence-exempt radio frequency bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz are not required to obtain a radio station licence from Industry Canada. However, associated radio equipment must still comply with all other relevant regulatory requirements, as well as technical standards outlined in Radio Standards Specification 210 (RSS-210), *Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment.* RSS-210 sets out the certification requirements for licence-exempt low-power radiocommunication devices defined as Category I equipment, as well as the technical requirements, such as transmitter power output limitations.

Unlike licensed radio systems that are afforded some assurance of protection by Industry Canada, licence-exempt digitally modulated radio systems must operate on a strict “no-interference, no-protection” basis in relation to other radio systems. Accordingly, licence-exempt radio devices are not permitted to cause interference to licensed radio systems, and operators are not permitted to claim protection from potential interference.

In general:

- Industry Canada does not normally investigate reports of radio interference affecting licence-exempt radio systems or devices, nor does it maintain an information database of licence-exempt radio systems operating in these bands.

- All users operating in licence-exempt radio frequency bands have equal status and may deploy their certified radio equipment anytime and anywhere. Being the first to deploy a digitally modulated radio system in one of these bands does not confer any rights to continued operation without interference. For example, new entrants into a licence-exempt band may, as a result of their recent arrival, cause disruption into an existing nearby digitally modulated system that has been in operation for many years. As stated above, the Department will not intervene on behalf of incumbent licence-exempt radio system operators.

- The resolution of any interference problem is solely the responsibility of the licence-exempt radio equipment operators. The Department strongly encourages negotiation between affected licence-exempt radio operators to resolve interference problems, but it will not normally facilitate the process.

3. Advantages and Disadvantages of Using Licence-Exempt Radio Systems

The use of licence-exempt radio frequency bands offers operators the advantages of easy access to radio frequency spectrum for rapid deployment of radio systems and potential cost savings given that radio station licencing is not required. However, these benefits must be weighed against the disadvantage of potentially receiving unacceptable interference at anytime. Therefore, the decision to deploy digitally modulated radio equipment in a licence-exempt radio frequency band must take into account the potential impacts of interference that could detrimentally affect the proposed radio system. If reliable service is crucial to the radio system's operation, and no contingency plan is in place, then the operator is encouraged to consider other options. Despite the drawbacks of operating in licence-exempt radio frequency bands, they remain a popular choice with a variety of spectrum users.

A brief summary of the advantages and disadvantages associated with operating in licence-exempt radio frequency bands are listed below.

Advantages:

- Rapid deployment of certified licence-exempt radio equipment anywhere in Canada.

- Radio station licences and associated fees are not required.

- Operators of licence-exempt radio systems are not required to provide Industry Canada with any technical information.

- Preliminary frequency coordination with other spectrum users is not required, but operators are urged to coordinate with other users to avoid causing or receiving interference.

- Licence-exempt radio equipment can be less expensive than that of licensed radio equipment.

Disadvantages:

- Industry Canada considers licensed radio systems to have priority over licence-exempt radio systems. Should a licence-exempt radio system or device cause harmful interference to a licensed radio system, the Department will require the licence-exempt radio user to cease operation until the interference is resolved.

- Licence-exempt radio systems may be subject to potential interference from both licensed and licence-exempt radio systems anytime. A licence-exempt radio system may successfully operate in an area for many years and then suddenly experience unacceptable interference from a new system.

- There is no right of tenure for incumbent licence-exempt radio system operators, as both new and existing operators have equal rights to the spectrum being used.

- Industry Canada does not protect licence-exempt radio systems from interference, nor does it maintain a database of licence-exempt radio systems.

- The licence-exempt radio system operator is solely responsible for resolving interference problems. If the source of interference is known, it is the responsibility of these operators to negotiate a mutually acceptable resolution, which at times may not be possible.

- There is no way of predicting whether a proposed licence-exempt radio system will experience disruption prior to installation.

- Because of their popularity, encryption protocols for license-exempt radio systems are well known. If radio links are improperly secured, others can intercept messages or hijack links. Proper encryption techniques are strongly recommended to prevent this occurrence.

Appendix A contains technical information on radio system reliability and interference reduction techniques.

Despite these and other potential drawbacks, licence-exempt radio frequency bands remain a popular choice for many operators of digitally modulated radio systems, who consider the overall benefits to outweigh any potential disadvantages.

4. Compliance with CPC-2-0-03, Radiocommunication and Broadcasting Antenna Systems

Industry Canada recognizes the importance of considering the potential impacts of antennas and their supporting structures on the local surroundings and has, therefore, instituted procedures outlined in Client Procedures Circular CPC-2-0-03, *Radiocommunication and Broadcasting Antenna Systems*, as amended from time to time, for proponents of antenna systems to follow. Please note that CPC-2-0-03 applies to licensed and licence-exempt radio systems.

In general, these procedures require proponents of antenna systems to:

- investigate sharing or using existing infrastructure before proposing new antenna-supporting structures;

- contact the land-use authority (LUA) to determine local requirements regarding antenna systems;

- undertake public notification and address relevant concerns, whether by following local LUA requirements or Industry Canada's default process; and

- satisfy Industry Canada's general and technical requirements with respect to addressing environmental concerns, radio frequency (RF) emission safety and aeronautical safety requirements.

5. Technical Requirements for Licence-Exempt Radio Systems

Radio equipment used for digitally modulated radio systems require appropriate certification. RSS-210 sets out technical requirements for the certification of licence-exempt, low-power radiocommunication devices (LPD), including digitally modulated radio equipment, which are defined as Category I equipment.

Category I equipment comprises radio devices for which a technical acceptance certificate, issued by the Certification and Engineering Bureau of Industry Canada, or a certificate, issued by a recognized Certification Body, is required pursuant to section 4(2) of the *Radiocommunication Act* and section 21(1) of the *Radiocommunication Regulations*.

Although LPDs emit very low radio signal levels (intentional and unwanted) such that they can normally co-exist with other radio services, they are still required to operate on a "no-interference, no-protection" basis (i.e. they may not cause radio interference and cannot claim protection from interference).

All digitally modulated radio equipment must adhere to the technical requirements set out in RSS-210, which outlines requirements such as modulation types, maximum transmitter power output and equivalent isotropically radiated power (e.i.r.p.) limits, etc.

6. Other Spectrum Users in the Bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz

It is important to note that there are many types of radio services and other devices that also operate within the licence-exempt 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz frequency bands. The following is a list of some radio services and other devices:

- Other licence-exempt wireless service providers
- Momentarily Operated Devices and Remote Control
- Field Disturbance Sensors
- Amateur Radio Service
- Automatic Meter Reading Devices
- Cordless Telephones
- Location and Monitoring Services
- Electronic News Gathering (ENG) TV Pickup Links
- Local Area Network Devices

7. Other Options for Digitally Modulated Radio System Operators

Digitally modulated radio system operators may also consider the advantages of operating in a licensed radio frequency band. There are many frequency bands available for both point-to-point and point-to-multipoint operations. For further information on radio system licensing, please contact your local Industry Canada Spectrum Management Office. A complete listing of Industry Canada's regional and district offices is provided in Radiocommunication Information Circular 66 (RIC-66), available at the departmental website at http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf01742.html.

Operators of subscriber-based broadband Internet services in remote areas may consider the licensed 512-698 MHz frequency band. For more information, see CPC-2-1-24, *Licensing Procedure for Remote Rural Broadband Systems (RRBS) Operating in the Band 512-698 MHz (TV channels 21 to 51)*, and GL-05, *Interim Technical Guidelines for Remote Rural Broadband Systems (RRBS) Operating in the Band 512-698 MHz (TV Channels 21 to 51)*, available at the following website: http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf08739.html.

8. Frequency Management Among Digitally Modulated Radio System Operators

The Department encourages open communication and cooperation among digitally modulated system operators, on a voluntary basis, to minimize interference and maximize spectrum usage. Given the growing number of digitally modulated services being deployed and the rapid technological development of radio equipment being used in licence-exempt bands, it is in the best interests of all vested parties to mutually coordinate their frequency usage.

References

RA	*Radiocommunication Act*
RSS-210	*Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment*
CPC 2-0-03	*Radiocommunication and Broadcasting Antenna Systems*
EMCAB-2	*Criteria for Resolution of Immunity Complaints Involving Fundamental Emissions of Radiocommunications Transmitters*
RSS-137	*Location and Monitoring Service in the Band 902-928 MHz*
RIC-66	*Addresses and Telephone Numbers of Regional and District Offices*
CPC-2-1-24	*Licensing Procedure for Remote Rural Broadband Systems (RRBS) Operating in the Band 512-698 MHz (TV channels 21 to 51)*
GL-05	*Interim Technical Guidelines for Remote Rural Broadband Systems (RRBS) Operating in the Band 512-698 MHz (TV Channels 21 to 51)*
Doble, John	*Introduction to Radio Propagation for Fixed and Mobile Communications*, Artech House
Freeman, Roger L.	Low-power Licence-exempt Radiocommunication Devices: Frequently Asked Questions, *Telecommunications Transmission Handbook*, Fourth Edition, Wiley Publishing
GTE Lenkurt Inc.	*Engineering Considerations for Microwave Systems*, originally published by GTE Lenkurt Inc. (an industry standard, but may be out of print)

Appendix A

Interference and System Reliability

All radios require a minimum receive carrier-to-interference-plus-noise level [C/(I + N)] to function properly. Problems occur when the C/(I + N) drops below this minimum value, either because of inadequate receive carrier level (C) or excessive interference (I) or both. The received carrier level may drop due to multipath fading created by atmospheric conditions or obstructions to the line of sight (e.g. due to foliage); or interference may occur because another transmitter is being received at too high a level. Unfortunately, when an outage occurs, it may be difficult to distinguish between a low-level carrier signal and a high-level of interference.

An analysis of the system design may reveal whether fading or interference is the problem. If the received carrier level is too low, an inadequate fade margin may result, which will cause excessive fading. The received signal level of any radio system fluctuates below its median level because of fading. However, as long as the received signal is high enough above the interference-plus-noise level (I + N), sufficient fade margin is present to ensure that the C/(I + N) is adequate. Normally, microwave radio links in the 900 MHz to 5 GHz range are designed with approximately 20 to 30 dB of fade margin. If a digitally modulated system has a lower fade margin, excessive outages from fading may occur. Generally, this type of outage will be seasonally dependent, with the most fading occurring in the spring and summer months.

Excessive interference may also lower the C/(I + N), causing system disruptions. Unlike the fading outages described above, which tend to be seasonal, other interference outages may be sporadic, according to the time of day that the interfering devices are in operation, or constant if the interference comes from another digitally modulated system that is in constant operation. To overcome interference, several techniques may be employed, as described below.

Interference Reduction Techniques

This section provides information on techniques that may be helpful to licence-exempt radio operators to reduce outages and/or minimize the likelihood of experiencing interference.

Change of operating frequencies

- If the radio operates in only a portion of the licence-exempt frequency band, it may be possible to avoid interference by shifting the operating frequency to another frequency within the band.

Change of polarization

- If the antenna characteristics offer any significant cross-polarization discrimination, changing the polarization may reduce the level of the interfering signal (unless the interfering signal is already on the opposite polarization, in which case the interference will worsen).

Higher gain transmit antenna

- A transmit antenna with higher gain will increase the equivalent isotropically radiated power (e.i.r.p.), which increases the received signal level resulting in an improved carrier-to-interference-plus-noise [C/(I + N)] ratio at the receiver. Note that a licence-exempt radio system is not permitted to exceed transmitter power or antenna gain limits specified in RSS-210.

- If interference is a problem, an increased C/(I + N) ratio may be high enough to overcome the effects of an interfering signal.

- If receiver fading is a problem, an increase in received signal level will provide a higher fade margin, which will reduce the effects of multipath fading.

Adjusting the receive antenna to minimize interference

- To overcome interference, it may be possible to orient the receive antenna so that the interference arrives near or within one of the nulls in the antenna's pattern while still pointing the antenna in the general direction of the wanted signal. Figure 1 below illustrates this technique.

- If the antenna does not have sufficiently deep nulls to minimize the interference, a higher gain antenna with a more focussed beamwidth may be necessary.

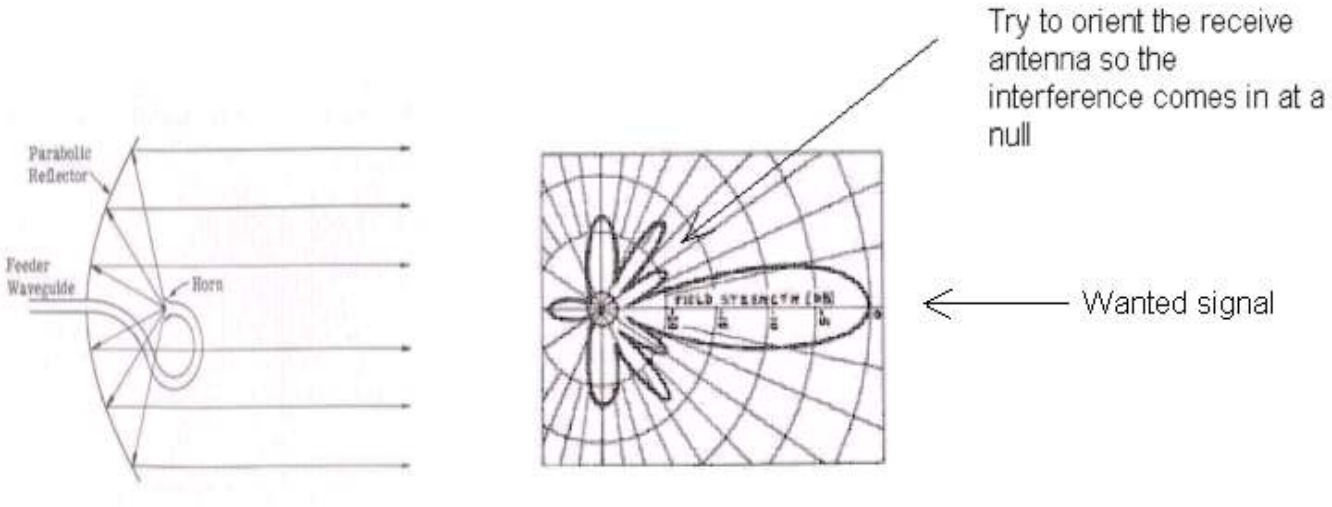

Figure 1: Orienting the receive antenna to minimize interference

Higher gain receive antenna

- Increasing the receive antenna gain will provide a higher receive signal level, which increases the fade margin and reduces multipath fading.

- A higher gain receive antenna will have a more focussed beamwidth and therefore deeper nulls. The increased gain will also improve the carrier-to-interference (C/I) ratio and reduce interference.

Blocking interference at the receive antenna

- Another way to reduce the level of interference is to create a barrier between the interfering signal and the receive antenna. For example, if the antenna is mounted on a building and receives interference, it may be possible to move it to another location where the interfering signal is blocked while maintaining a clear line-of-sight to the wanted signal.

- It may also be possible to construct a shroud near one side of the antenna, which will block an interfering signal. The shroud can be made of any material that effectively attenuates RF signals.