Industry Canada Industrie Canada

RSS-137
Issue 1, Rev. 1
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Spectrum Management and Telecommunications Policy

Radio Standards Specification

Location and Monitoring Service (902 - 928 MHz)

Canada

Aussi disponible en français - CNR-137

PREFACE

This Issue 1, Revision 1, replaces Issue 1 (Provisional) of RSS-137.

Changes:

The following are the main changes:

1. Table 1 of section 5.4 and its notes have been amended to permit non-multilateral devices in the band 919.75-921.75 MHz.

2. Frequency stability method of measurement has been revised (section 7).

3. Permissible receiver spurious emission levels have been revised (section 8).

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1. Scope

1.1 This document sets out standards for equipment for the location and monitoring service (LMS) that is permitted to operate in the 902-928 MHz band.

A technical acceptance certificate (TAC) is required, pursuant to subsection 4(2) of the *Radiocommunication Act* and the *Radiocommunication Regulations*. Before certification is granted, the applicant shall show that the applicable standards have been complied with.

1.2 The equipment is subject to licensing, pursuant to subsection 4(1) of the *Radiocommunication Act*.

2. General

2.1 Quality Control

Periodic sample testing shall be carried out by the manufacturer or importer to ensure continuing compliance (with standards) of the newly manufactured/imported apparatus intended for sale in Canada. Non-compliance problems shall be corrected by the manufacturer or importer. Industry Canada (the Department) will conduct audit checks from time to time to ensure compliance.

2.2 Inquiries about this Standard

Inquiries about this Standard may be directed to Industry Canada's local office or to:

Manager, Radio Equipment Standards
Industry Canada
300 Slater Street
Ottawa, Ontario
Canada K1A 0C8
Tel: (613) 990-4699 / Fax: (613) 990-3158
E-mail: Lum.kwai@ic.gc.ca

However, inquiries concerning **equipment certification** matters should be directed to Chief, Certification and Engineering Bureau (see address in section 11).

3. Related Documents

The following are related documents. Radio Standards Procedure 100 (RSP-100) and Telecommunications Regulation Circular 49 (TRC-49) provide guidance when applying for equipment certification.

3.1 RSP-100: "Radio Equipment Certification Procedure".
3.2 TRC-49: "Certification Service Fees".
3.3 RSS-102: "Evaluation Procedure for Mobile and Portable Radio Transmitters with respect to Health Canada's Safety Code 6 for Exposure of Humans to Radio Frequency Fields"
3.4 RSS-212: "Test Facilities and Test Methods for Radio Equipment"
3.5 RIC 66: "Addresses and Telephone Numbers of Regional and District Offices of Industry Canada"

The above documents are available in English and French on the Internet at:

http://strategis.ic.gc.ca/spectrum (English)
http://strategis.ic.gc.ca/spectre (French)

For assistance regarding this web site, please contact: DOSP-P, 300 Slater Street, Ottawa, Ontario, K1A 0C8, telephone: (613) 990-4761/fax: (613) 952-9871, e-mail: spectrum_pubs@ic.gc.ca.

A hard copy version of the documents is available, for a fee, from:

Tyrell Press Ltd.
2714 Fenton Road
Gloucester, Ontario
K1T 3T7

Canada toll-free no.: 1-800-267-4862
U.S. toll-free no. : 1-800-574-0137
Wordwide tel. no. : (613) 822-0740
Fax number : (613) 822-1089

Canada Communication Group
45 Sacré-Coeur Blvd.
Hull, Quebec
K1A 0S9

Canada toll-free no. : 1-888-562-5561
Worldwide tel. no. : (819) 779-4335
Fax number : (819) 779-2833

4. Test Instruments

The test report shall list all test instruments used. The list shall identify instruments by manufacturers, type and model numbers.

5. Equipment Requirements

5.1 Equipment Labels

Equipment that is certified under this Specification shall be permanently labelled on each item or inseparable combination. The label shall contain the following information:

(a) The certification number, prefixed by the name "Canada".
(b) The manufacturer's name or trade name or brand name.
(c) A model name or number.

Equipment for which a certificate has been issued is not considered certified if it is not properly labelled. **Note:** The information on the Canadian label can be combined with the manufacturer's other labelling requirements.

5.2 Transmitter External Controls

The transmitter shall not have any external controls accessible to the user that can be adjusted and operated in violation of this Standard. A high/low power switch is, however, permitted provided that it is set to maximum power for all tests, and noted in the test report.

To prevent radio interference caused by end-users' (operators') transmissions in unauthorized frequencies, the following measures are instituted:

(a) Users of transmitters with external frequency selection controls shall not be able to operate on channels other than those for which the apparatus has been preset by the manufacturer, equipment supplier or service/maintenance personnel.

(b) Transmitters having frequency programming capability are exempt from clause (a) if the design of such transmitters:

(1) Is such that transmitters with external controls normally available to the operator must be internally modified to place the equipment in the programmable mode. Further, while in the programmable mode, the equipment shall not be capable of transmitting. The procedures for making the modification and altering the frequency program shall NOT be made available to the end user of the equipment; or

(2) Requires the transmitter to be programmed for frequencies through controls normally inaccessible to the operator; or

(3) Requires equipment to be programmed for frequencies through use of external devices or specifically programmed modules made available only to service/maintenance personnel; or

(4) Requires equipment to be programmed through cloning (copying a program directly from another transmitter) using devices and procedures made available only to service/maintenance personnel.

5.3 Supply Voltage and Temperature

Tests shall be performed at ambient temperature and at the manufacturer's rated supply voltage, except for the frequency stability test. The test voltage shall be stated in the test report.

5.4 Frequency Bands and Permissible Output Powers

5.4.1 The frequency bands and effective radiated power (ERP) permissible limits are listed in Table 1.

Table 1 : Maximum Power and Frequency Bands

Sub-Band	Frequency (MHz)	Band Size (MHz)	Type Designation	ERP/EIRP Watts (note 1)
A	902-904	2	Non-Multilat.	30/50
B	904-909.75	5.75	Multilat.	30/50
C	909.75-919.75	10	Non-Multilat.	30/50
D	919.75-921.75	2	Multilat. and Non-Multilat.	30/50
E	921.75-927.25	5.5	Multilat.	30/50
F	927.25-927.5	0.25	Multilat.	300/500
G	927.5-927.75	0.25	Multilat.	300/500
H	927.75-928	0.25	Multilat.	300/500

Note 1: For equipment certification, the maximum power (P_{max}) output shall not exceed numerically the ERP watts of Table 1 (i.e. 30 and 300 watts).

5.4.2 The sub-bands F, G, and H are for forward links (base to mobile) whereas sub-bands B, D and E can be for either forward or reverse links. It is intended that sub-band F be paired with sub-band E, sub-band G with D and sub-band H with B.

5.4.3 Sub-band aggregating is permitted if wider bandwidth devices are justified, e.g. sub-bands D and E (and similarly F and G) could be aggregated. However, the device's permissible equivalent isotropically radiated power (EIRP) is not increased due to sub-band aggregating.

5.4.4 Systems requiring bandwidths of 2 MHz or less should use the narrower sub-band segments (A or D, as appropriate), wherever possible.

5.5 Types of Modulation

The devices may employ any type of modulation: FM, AM, or digital. The type of modulation used shall be reported. If the modulation is digital, a brief description from the manufacturer is required, giving the bit rate, symbol rate, emission bandwidth (99% power), and any information useful for the understanding of the device.

5.6 Authorized Bandwidth and 20 dB Bandwidth

The certification applicant or the test report shall declare the emission bandwidth *(B)* required for the equipment. This bandwidth, when used in the emission mask equations of section 6.4, shall comply with the attenuation requirements. This emission bandwidth *B* then becomes the authorized bandwidth for the purposes of equipment certification and licensing. *B* shall take into account the masks given in section 6.4 but shall not exceed the sub-band (or aggregated) sizes given in section 5.4.

Wherever specified, the 20 dB bandwidth is when the spectral density has decreased by at least 20 dB relative to the **inband** spectral density. An alternative to the 20 dB bandwidth is the 99% emission bandwidth: this bandwidth is determined such that below the lower and above the upper frequency limits, the mean powers emitted are each equal to 0.5% of the total mean power of the emission.

5.7 Multilateral and Non-Multilateral Types

5.7.1 Multilateral (M-LMS) systems are systems that employ several base stations to locate a mobile station by triangulation. They are primarily intended for locating vehicles but the service may be used for other locating functions provided that vehicle locating is the primary function of the system.

5.7.2 Non-multilateral (N-LMS) systems are systems that use one transmitter for their operation. Sub-bands A and C can be used for forward (base to mobile) or reverse (mobile to base) links. They are primarily intended for the transmission of data signals to and from vehicles, such as for road toll collection. See also section 5.8.

5.7.3 A detailed description of the system (base and mobile stations) shall accompany the certification application.

5.8 Usage Restrictions

Provided that the primary functions are as per section 5.7, signals (voice or data) to indicate emergencies via a dispatch point (i.e. non real-time) are permitted. Other usage may be considered on a case-by-case basis.

5.9 Accommodation of Secondary Users

Since the 902-928 MHz band is also allocated to many other primary and secondary users, the latter governed by the licence-exempt standard RSS-210, *Low Power Licence-Exempt Radiocommunication Devices*, multilateral and non-multilateral systems should be of robust design and be able to tolerate some general interference from other users. They should also use the minimum output powers required for successful communication.

5.10 New Technologies

Systems that cannot conform to this Standard, especially those using new technologies, may be evaluated on a case-by-case basis by the Manager, Radio Equipment Standards (see section 2.2).

6. Transmitter Standards and Tests

6.1 Testing Methods

(a) Tests are to be conducted in accordance with good engineering practices.

(b) Test results are to be presented in graphical form wherever possible. The graph shall also include the specification limits.

(c) Associated equipment that is normally used with the equipment shall be so connected.

(d) If the RF output power is internally adjustable or remotely controllable, set or control it to the maximum rated power of the range for which equipment certification is sought.

(e) The transmitter shall be modulated with signals representative of those encountered in a real system operation.

(f) If, in measuring emission power, the spectrum analyser selectivity is insufficient, a resolution bandwidth narrower than that specified, plus numerical integration to sum the power, is permitted. The method used shall be described in the test report.

(g) When the antenna is detachable, the transmitter output power may be measured by replacing the antenna with a spectrum analyser of internal resistance equal to the impedance specified for the antenna. Alternatively, impedance matching can be used with the network loss accounted for.

When the antenna is not detachable, field strength measurement should be made using a calibrated open-area test site.

The following formula may be used to convert field strength (FS) in volts/metre to transmitter output power (TP) in watts:

$$TP = \frac{(FS \times D)^2}{30 \times G}$$

where D is the distance in metres between the two antennas and G is the antenna numerical gain referenced to isotropic gain. (**Note:** In an open-area test measurement, the effect due to the metal ground reflecting plane should be subtracted from the maximum field strength value in order to reference it to free space, before calculating TP.

(h) Where a test method specified in this document cannot be followed, an alternative appropriate method may be used provided that it is fully described in the test report.

(i) If the transmitter is capable of tuning over several bands of Table 1, testing at more than one carrier frequency may be required to verify any change in RF characteristics.

6.2 Output Power

The output power shall be measured when the transmitter is operating at the manufacturer's rated power and modulated with signals representative of those encountered in a real system operation. This measurement shall be carried out before the other tests.

The power shall be averaged over any individual 100 millisecond period, or over the burst duration, if the burst is shorter than 100 milliseconds.

Record the output power as P_{max} .

As an alternative, the peak power (P_{pk}) may be measured. The test report shall state which power is measured, P_{max} or P_{pk}.

Minimum Standard

The output power shall not exceed by more than 1.0 dB the manufacturer's rated power output, nor exceed the values in Table 1, note 1.

6.3 Unwanted Emissions

Unwanted emissions comprise out-of-band emissions in the vicinity of the passband, spurious emissions and harmonics. They are to be measured when the transmitter is operating at the manufacturer's rated power and modulated as in section 6.2.

6.3.1 Method of Measurement

Using the manufacturer's information on emission bandwidth:

Set the spectrum analyser in power averaging mode and the resolution bandwidth as close to 1.0% of the emission bandwidth as possible. See section 5.6 on emission bandwidth. Alternatively, the 26 dB emission bandwidth may be used. This 26 dB emission bandwidth is defined as the width of the signal between two points, one below the carrier centre frequency and one above the carrier centre frequency, outside of which all emissions are attenuated by at least 26 dB below the transmitter power.

Set video bandwidth wider than the resolution bandwidth.

Set the sweep span to cover at least ±250% of the emission bandwidth.
Number of sweeps = 10.
Record the spectrum plot.

Change the frequency sweep span to cover the spurious emissions frequency search from the lowest frequency internally generated or used in the device (local oscillator, intermediate or carrier frequency), or from 30 MHz, whichever is the lowest frequency, to the 5th harmonic of the highest frequency generated or used, without exceeding 40 GHz. The resolution bandwidths are given in section 6.4.

Minimum Standard

The permissible emission masks of the RF spectrum, which depend on the type of service and the sub-bands used, are given in section 6.4.

6.3.2 In lieu of the average power of unwanted emissions, the peak power may be measured by using the spectrum analyser in the peak hold mode, provided that the P_{pk} transmitter output power measurement is used in section 6.2. Thus, emission masks A to D will be in terms of average or peak values, provided that the transmitter output powers are expressed in average or peak values respectively.

6.4 Emission Masks

6.4(a) Emission Mask A - Multilateral Wideband Transmitters

Except as provided in 6.4(d), for wideband multilateral transmitters (i.e. those **not** for sub-bands F, G and H), forward or reverse links, operating in any of the sub-bands within 902-927.25 MHz (listed in Table 1), the power of any emission shall be attenuated below the maximum permitted transmitter output power P_{max}, in accordance with the following schedule:

(1) On any frequency removed **from the carrier frequency** by a displacement frequency (f_d) of more than 50% but not more than 250% of the authorized bandwidth B: At least $16 + 0.4(f_d - 50) + 10 \log_{10} B$ dB, or 31 dB, whichever is more stringent. Attenuation greater than 66 dB is not required. A resolution bandwidth of 100 kHz is to be used (or narrower resolution bandwidth with power integration, **refer to 6.1(f)**). In the formula, B is in MHz and f_d is expressed as a percentage of the authorized bandwidth B: it applies for f_d = 50 to 250.

(2) On any frequency removed **from the carrier frequency** by more than 250% of the authorized bandwidth: At least $43 + 10 \log_{10} P_{max}$ dB, measured with a resolution bandwidth of 100 kHz.

6.4(b) Emission Mask B - Multilateral Narrowband Forward Link Transmitters

For multilateral narrowband forward link transmitters operating in the 927.25-928 MHz band, the power of any emission shall be attenuated below the maximum permitted transmitter output power P_{max} in accordance with the following schedule:

(1) On any frequency removed **from the edge** of the authorized bandwidth by a displacement frequency f_{ed} (in kHz) of more than 0 kHz but not more than 200% of the authorized bandwidth: At least 116 $\log_{10}((f_{ed}+10)/6.1)$ dB or 50 + 10 $\log_{10} P_{max}$ dB, or *70 dB*, whichever is the less stringent, measured with a resolution bandwidth of 300 Hz.

(2) On any frequency removed **from the carrier frequency** by more than 250% of the authorized bandwidth: At least 43 + 10 $\log_{10} P_{max}$ dB, measured with a resolution bandwidth of 100 kHz.

6.4(c) Emission Mask C - Non-Multilateral Transmitters

Except as provided in 6.4(d), for non-multilateral transmitters operating in the 902-904 MHz, the 909.75-919.75 MHz and the 919.75-921.75 MHz bands, the power of any emission shall be attenuated below the maximum permitted transmitter output power P_{max} in accordance with the following schedule:

(1) On any frequency *outside* of the authorized bandwidth *B*:
At least 55 + 10 $\log_{10} P_{max}$ dB, measured with a resolution bandwidth of 100 kHz.

(2) On any frequency removed **from the carrier frequency** by more than 250% of the authorized bandwidth: at least 43 + 10 $\log_{10} P_{max}$ dB, measured with a bandwidth of 100 kHz.

Note: As an alternative, devices may comply with the emission mask A of section 6.4(a).

6.4(d) Emission mask D - Intermittent Transmitters

In the 902-928 MHz band, mobile transponders with integral antennas (i.e. transmitters that only respond to a received radio signal and cease transmission within a reasonable period of time) and intermittently operated handheld transmitters are *not* required to comply with the above emission masks (A and C) provided that their 20 dB bandwidth (see section 5.6) does not exceed the authorized bandwidth *B*. In addition, on any frequency removed **from the carrier frequency** by more than 250% of the authorized bandwidth: The power of any emission shall be attenuated below the maximum permitted transmitter output power P_{max} by at least 43 + 10 $\log_{10} P_{max}$ dB, measured with a bandwidth of 100 kHz.

7. Frequency Stability

Frequency stability is a measure of the frequency drift due to temperature and supply voltage variations, with reference to the frequency measured at +20ºC and rated supply voltage.

The operating carrier frequency shall be set up in accordance with the manufacturer's published operation and instruction manual prior to the commencement of these tests. No adjustment of any frequency determining circuit element shall be made subsequent to this initial set-up.

The unmodulated carrier frequency shall be measured under the conditions specified below. A sufficient stabilization period at each temperature shall be allowed prior to each frequency measurement:

(a) at temperatures of -30ºC, +20ºC and +50ºC at the manufacturer's rated supply voltage, and
(b) at 85% and at 115% of the manufacturer's rated supply voltage, when the temperature is at 20ºC.

The frequency stabilities can be maintained to a lesser temperature range provided that the transmitter is automatically inhibited from operating outside the lesser temperature range.

For handheld equipment that is only capable of operating from internal batteries, the frequency stability tests shall be performed using a new battery without any further requirement to vary the supply voltage. Alternatively, an external supply voltage can be used and set at the battery nominal voltage, and again at the battery operating end point voltage which shall be specified by the equipment manufacturer.

If an unmodulated carrier is not available, the mean frequency of a modulated carrier can be obtained by using a frequency counter with gating time set to an appropriately large multiple of symbol periods (gating time depending on the required accuracy). Full details on the choice of values shall be included in the test report.

Categories of frequency stability requirements

1. Mobile transponders and handheld transmitters are exempt from any frequency stability limits provided that their nominal emission bandwidths are set within the authorized bands.

2. Multilateral transmitters (except handheld or mobile transponders) shall comply with the specified frequency stability limit given in the “Minimum Standard” below.

3. For the remainder types (multilateral and non-multilateral), their 20 dB emission bandwidths shall be demonstrated (by temperature and supply voltage variation tests) to lie within the authorized bands as defined in section 5.6, i.e. 20 dB bandwidth $+2Y \leq$ authorized bandwidth, where $\pm Y$ = frequency drift.

Minimum Standard

The frequency stability shall be maintained to within ± 2.5 ppm in the case of the following transmitters:

(i) multilateral wideband base station transmitters;

(ii) multilateral narrowband (base station) transmitters.

8. Exposure of Humans to RF Fields

Before equipment certification is granted, the procedures of RSS-102 must be followed concerning exposure of humans to RF fields.

9. Receiver Spurious Emissions

Radiation measurement is the standard method (with the device's antenna in place) for receiver spurious emissions, with the measurement performed using a calibrated open-area test site. Description of a suitable open-area test site is found in RSS-212.

However, if the antenna is detachable, the receiver spurious signal may be measured by replacing the antenna with a spectrum analyser of internal resistance equal to the impedance specified for the antenna. Even though antenna conducted measurement is permitted, if a receiver’s radiated emissions cause harmful interference, Industry Canada may require that the receiver be modified to comply with the radiated limits. Therefore, manufacturers should check the radiated limit wherever possible.

The receiver shall be operated in the normal receive mode near the mid-point of the band over which the receiver is designed to operate.
The search for spurious emissions shall be from the lowest frequency internally generated or used in the receiver (local oscillator frequency, intermediate frequency or carrier frequency), or 30 MHz, whichever is the higher, to at least 3 times the highest tunable or local oscillator frequency, whichever is the higher frequency without exceeding 40 GHz.

If the receiver incorporates a scanning mode of operation, refer to document RSS-135, *Digital Scanner Receivers*, since there are certain restrictions on their certification.

Minimum Standard

(i) The field strength of any spurious frequency generated by the receiver, in each polarization (vertical and horizontal) measured at a distance of 3 metres, shall not exceed 100 microvolt/m (in the band 30-88 MHz), 150 microvolts/m (88-216 MHz), 200 microvolts/m (216-960 MHz), 500 microvolts/m (960 - 1610 MHz), or 1000 microvolts/m (above 1610 MHz). The resolution bandwidth of the spectrum analyser shall be 100 kHz for measuring spurious emissions below 1.0 GHz, and 1.0 MHz for above 1.0 GHz.

(ii) If spurious emissions are to be measured at the antenna connector, the emission power in any 4 kHz shall not exceed 2 nanowatts (316 microvolts across 50 ohms) in the band 30-1000 MHz or 5 nanowatts above 1.0 GHz.

10. Licensing Requirements

In addition to equipment certification, a licence is required for the installation and operation of these devices. Sections 5.8 and 5.9 should be noted. For additional information regarding licensing, please contact the local Industry Canada office.

11. Equipment Certification and Test Report Submission

The test report, complete with measurement results, that addresses the requirements of this Standard, is to be submitted with the application for certification of a transmitter. For receiver certification, a detailed test report is not necessary; it is only required to report the receiver tuning range or ranges, and the spurious emission levels.

The application for certification should be prepared in accordance with RSP-100 and sent to:

Chief, Certification and Engineering Bureau
Industry Canada
1241 Clyde Avenue
Ottawa, Ontario
Canada K2C 1Y3
Tel: (613) 952-3200 / Fax: (613) 952-1088
E-mail: Corey.bob@ic.gc.ca

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