



Spectrum Management and Telecommunications

Broadcasting Circular

Experimental Operation of In-Band On-Channel (IBOC) Digital Radio in the FM Broadcasting Band

Preface

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1. Foreword

HD Radio¹ in the FM band is a digital extension of the existing analog FM broadcasting system and is based on In-Band On-Channel (IBOC) emissions. The reference industry standard for IBOC in the FM band is reflected in the National Radio Systems Committee (NRSC) document entitled [*IBOC Digital Radio Broadcasting Standard*](#) April 2017.

2. Purpose

The purpose of this circular is to inform the applicants wishing to experiment with either hybrid or extended hybrid IBOC in the FM band on how to file applications to Innovation, Science and Economic Development Canada (ISED) and to the Canadian Radio-television and Telecommunications Commission (CRTC), and what technical criteria will apply in those circumstances.

3. System characteristics

3.1 Primary FM IBOC spectrum

The Primary FM IBOC sideband spectrum is located at ± 101.744 kHz to 198.402 kHz from the centre frequency of the FM channel. This spectrum is further subdivided equally in 14 sub-bands or partitions. The service mode selected will determine how this spectrum is used.

3.2 Primary service modes (MP)

3.2.1 Hybrid service mode

In the MP1 service mode, only that part of the Primary HD Radio spectrum (also identified as Primary Main sidebands) located between ± 129.361 kHz and 198.402 kHz from the centre frequency of the FM channel is used for the digital signal, which means that 10 of the 14 partitions are used. The four remaining partitions are identified as Primary Extended sidebands.

3.2.2 Extended hybrid service modes

The extended hybrid service modes are created by adding frequency partitions to the Primary Main sidebands and comprise the following service modes:

- Mode 2 (MP2): uses the Primary Main sidebands plus a single extended frequency partition; located between ± 122.457 kHz and 198.402 kHz from the centre frequency of the FM channel

¹ HD Radio is a brand name for the digital radio broadcast technology developed by iBiquity Digital Corporation and its affiliates.

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- Mode 3 (MP3): uses the Primary Main sidebands plus two extended frequency partitions; located between ± 115.553 kHz and 198.402 kHz from the centre frequency of the FM channel
- Modes 5, 6 and 11 (MP5, MP6 and MP11): use the Primary Main sidebands plus four extended frequency partitions; in this mode, the total sideband spectrum between ± 101.744 kHz and 198.402 kHz from the centre frequency of the FM channel is used

A graphical representation of these modes is provided in annex A.

3.3 Maximum digital ERP ratio for hybrid and extended hybrid service modes

The maximum operating effective radiated power (ERP) of the digital sidebands expressed in dBc (dB below the reference unmodulated analog carrier) for each service modes are as follows:

- MP1: -13.0 dBc per sideband or -10 dBc total
- MP2: -12.6 dBc per sideband or -9.6 dBc total
- MP3: -12.2 dBc per sideband or -9.2 dBc total
- MP5/MP6/MP11: -11.5 dBc per sideband or -8.5 dBc total

To limit interference to a closely spaced first adjacent station, asymmetrical sideband power levels (i.e. use of lower power level in a sideband) may also be requested.

4. Application to ISED

4.1 General

Applicants wishing to experiment with either hybrid or extended hybrid IBOC in the FM band need an experimental authorization from ISED and must file an application.

4.2 Application information required

The application must contain the following:

- the call sign, channel, class, city, antenna coordinates, transmitter model, service mode, absolute and relative ERP of the digital component for the lower and upper sideband and complete specification of the antenna systems used for both the analog and digital signals
 - where both signals are combined into a single antenna, a complete description of the combining system shall be provided
- description of the proposed digital coverage
- requested starting date and duration of the experimental authorization

4.3 Notification to short-spaced Canadian stations operating on the first-adjacent channel

The applicant must notify all Canadian stations operating on the first-adjacent channels that are short-spaced relative to the proposed IBOC station. The following procedures should be used to identify the Canadian stations operating on the first-adjacent channels:

1. Identify all first adjacent short-spaced stations with the corresponding analog transmitter of the IBOC station (as per [BPR-3](#) rules).
2. Determine the equivalent MP1 absolute digital ERP for each sideband using the following conversion factors:
 - MP1: No conversion needed
 - MP2 to MP1 conversion: -0.4 dB (or multiply by 0.912)
 - MP3 to MP1 conversion: -0.8 dB (or multiply by 0.832)
 - MP5/MP6/MP11 to MP1 conversion: -1.5 dB (or multiply by 0.708)
3. The 34 dB μ V/m F(50,10) contour (or a desired-to-undesired protection ratio of 20 dB) of the closest digital sideband using the equivalent MP1 absolute digital ERP shall be plotted on a map along with the protected 54 dB μ V/m F(50,50) contour of each analog first adjacent station (lower digital sideband with first adjacent below and upper sideband with first adjacent stations above the channel being considered).
4. If the 34 dB μ V/m contour overlaps the 54 dB μ V/m contour of any first adjacent station identified in step 1), a coordination letter shall be sent to the existing station. This will trigger a requirement to perform a test plan, unless the power level of that side-band is equal to the level specified in section 4.4.

4.4 Test plan requirement

A test plan describing the measurements to be taken shall be provided if a potential interference zone was identified in section 4.3 and the proposed relative digital ERP exceed the following:

- MP1: -23.0 dBc per sideband or -20 dBc total
- MP2: -22.6 dBc per sideband or -19.6 dBc total
- MP3: -22.2 dBc per sideband or -19.2 dBc total
- MP5/MP6/MP11: -21.5 dBc per sideband or -18.5 dBc total

This test plan will first verify the reception quality (as defined per the methodology in section 3.6.2 of [BPR-3](#)) in the potential interference zone to the incumbent station before and after IBOC implementation.

The itinerary of the measurement campaign shall run through the potential interference zone (as defined in section 4.3) which shall be extended by at least one kilometre from the edge of the interference zone.

4.5 Information on authorized experimentations

All experimental authorizations will be published on ISED's [Broadcasting Services](#) website.

5. Technical requirements for experimental authorization

5.1 Transmission standard

Experimental authorizations for IBOC in the FM band in Canada will be based on using systems that implement the NRSC-5-D standard referenced in section 1 above.

5.2 Antenna requirements

As a norm, the digital signals and the analog FM will be combined and then fed into the same antenna. Broadcasters may opt to use a separate antenna and/or a different tower for their digital signals. In such cases, the tower for the digital antenna must be within 3 seconds of latitude and longitude of the analog antenna. Moreover, the effective antenna height above average terrain (EHAAT) of the digital antenna must be within 70-100% of the authorized EHAAT of the analog antenna.

If a separate antenna is proposed, the applicant must comply with the requirements on antenna siting outlined in section 2 of [BPR-1](#).

ISED will evaluate the proposed system design on a case-by-case basis.

5.3 Compatibility with NAV/COM

Each application is subject to an FM/NAV/COM compatibility analysis as per section 2.6 of BPR-3.

5.4 On-air testing period

An on-air testing period shall be coordinated with the appropriate ISED district office (refer to section 1.4 of [BPR-1](#)).

5.5 Responsibilities for remedying interference

Should the IBOC broadcasting operation cause harmful interference, the broadcaster is to cooperate with ISED to take immediate remedial action. This action could include reducing power, altering the radiation pattern of the antenna, as well as cessation of the digital emissions if necessary.

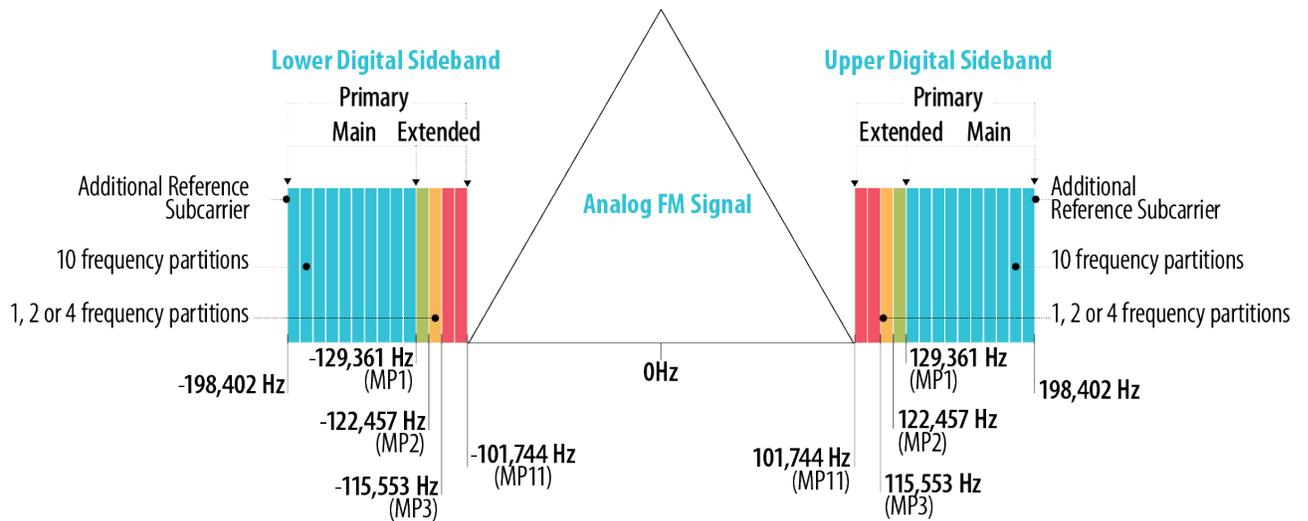
6. Application to the CRTC

An application to the CRTC is required to obtain the authorization to operate a programming undertaking.

Annex A: Relative Power to FM IBOC Digital Radio Sidebands

The following highlights the relative IBOC digital power ratio and frequency ranges relative to the analog FM carrier.²

Figure A1: Sideband detail of IBOC



² HD Radio FM Transmission System Specifications, DOC SY_SSS_1026s, iBiquity Digital, REV. G, December 14, 2016.

Table A1: Power ratios of IBOC

The table below shows the total integrated digital power and single sideband power for the four hybrid service modes (i.e. MP1, MP2, MP3 and MP11) and various digital to analog power ratios.

Nominal digital-to-analog power ratio (dBc) service mode MP1	Single subcarrier power (dBc)	Total integrated power of both sidebands (dBc)				Total Integrated Power of One Sidebands (dBc)			
		MP1 100% of MP1 power	MP2 110% of MP1 power	MP3 120% of MP1 power	MP11 140% of MP1 power	MP1 100% of MP1 power	MP2 110% of MP1 power	MP3 120% of MP1 power	MP11 140% of MP1 power
-20	-45.8	-20	-19.6	-19.2	-18.5	-23	-22.6	-22.2	-21.5
-14	-39.8	-14	-13.6	-13.2	-12.5	-17	-16.6	-16.2	-15.5
-13	-38.8	-13	-12.6	-12.2	-11.5	-16	-15.6	-15.2	-14.5
-12	-37.8	-12	-11.6	-11.2	-10.5	-15	-14.6	-14.2	-13.5
-11	-36.8	-11	-10.6	-10.2	-9.5	-14	-13.6	-13.2	-12.5
-10	-35.8	-10	-9.6	-9.2	-8.5	-13	-12.6	-12.2	-11.5