

## Proposed HD Radio Test Procedures to Determine D/U Criteria

As approved by the RABC Radio Subcommittee, November 22, 2017.

### 1. Introduction

The following plan has been developed by the RABC's Radio Subcommittee, a subcommittee of RABC's Broadcast Committee. The plan highlights a test procedure to evaluate critical answers relative the HD parameters. The RABC subcommittee has tried to be as exhaustive as possible in defining this plan, but, once the evaluation starts, adjustments may be required (some parts may be redundant, or some new parts may be added). The implementer is welcomed to discuss any changes to the plan with the RABC Radio Subcommittee members.

*Note: through the proposed test plan, we have identified tests (with an asterisks \*) that are considered as "extras" and might prove to provide redundant results from existing situations (e.g.. testing both upper 1<sup>st</sup> adjacent and lower 1<sup>st</sup> adjacent). Consequently, we are inviting the experimenter to perform basic evaluation using a subset of receivers before ruling those out.*

### 2. Test receivers

Two categories of test receivers should be utilised: analog FM receivers and HD Radio receivers. One must note that HD Radio receivers should also be used in analog tuning mode.

The subcommittee suggests that at least 3 receivers of each of the following categories are tested:

- 2.1 Analog FM Car Receivers
- 2.2 Analog HI-FI table top receivers
- 2.3 Analog others: kitchen counter receivers (including boom box, alarm clock, portable, and if possible a cellphone with FM receiver)
- 2.4 HD Radio car receivers
- 2.5 HD Radio table top receivers
- 2.6 HD Radio Test Receiver

The receivers should have the following minimum characteristics:

- Having an external antenna connection
- Having an external audio output

### 3. FM Test Parameters

Unless otherwise specified, the analog FM test parameters should reflect the Canadian Emission standards BETS-6, with a modulation of 100%, an pre-emphasis of 75  $\mu$ s, etc.

During the D/U testing, the audio should not be processed: using the test output of the Audio Precision test system and ensuring a modulation not exceeding 100%.

For audio content testing, the audio should be processed while using a pre-defined basic setup in the processor (to be determined).

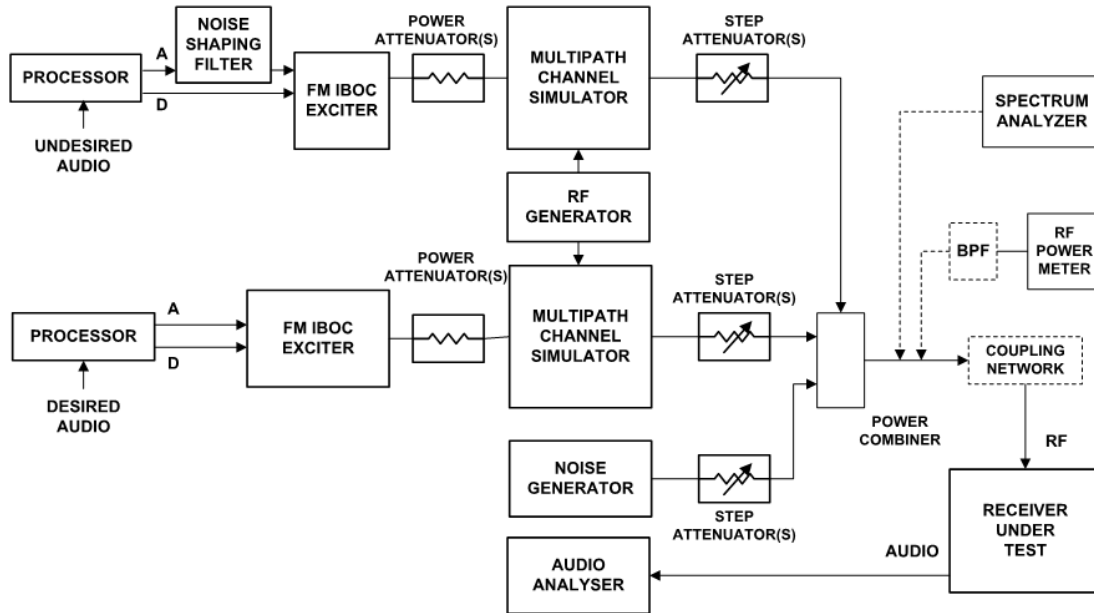
### 4. Laboratory Tests

#### 4.1 List of equipment required (other than receivers):

- 4.1.1 1 FM Analog Modulator
- 4.1.2 2 HD Radio Digital Modulators (having analog FM capability and HD Radio MP3 capability)
- 4.1.3 2 sets of variable attenuators (0 to 50 dB)
- 4.1.4 2 X 3 dB power combiner
- 4.1.5 2 sets of power meters
- 4.1.6 Noise Generator
- 4.1.7 Noise shaping filter
- 4.1.8 1 Channel simulator (2 channels)
- 4.1.9 1 Audio Precision with SNR measurement capability (Dynamic Range)
- 4.1.10 RDS Test receiver
- 4.1.11 PPM Encoder and Decoder

## 4.2 D/U Test for FM Analog Protection from HD Radio:

### 4.2.1 Test Setup (add: RDS components):



- 4.2.2 Test Procedure: Test for FM Equivalent Field Strength levels of -54, -70 and -80 dBuV/m
- 4.2.3 Set the first FM Analog level (frequencies to be tested: 90.1\*, 98.1\*, 106.1\* : make sure to use a Faraday cage or avoid any influence from surrounding existing frequencies)
- 4.2.3.1 Note: at least one frequency need to be selected for the test. The experimenter should first evaluate if the receivers can be judge has linear across the band.
- 4.2.4 Use the channel simulator in "clean mode"
- 4.2.5 Select a first test receiver
- 4.2.6 Make sure that a Dynamic Range with a minimum audio SNR of 56 dB is found (as per ITU-R BS.641). For receivers that cannot meet 56 dB, a minimum level of 50 dB should be achieved.
- 4.2.7 Add the digital HD Radio modulator on the co-channel (First MP1 Mode, second test MP3 Mode) at -20 dBc on the interfere side (second test at -14 dBc, and third at -10 dBc)
- 4.2.8 Raise the HD Radio signal until a first degradation of 3 dB of SNR is found: note the equivalent field strength for HD Radio and note the equivalent D/U
- 4.2.9 Record the RDS BER
- 4.2.10 Raise the HD Radio signal until a degradation of 6 dB of SNR is found: Not FS, D/U
- 4.2.11 Record the RDS BER
- 4.2.12 Restart with MP3 (\* MP3 might have no impact on the tests, it should be characterised with a couple of receivers)
- 4.2.13 Redo the test with the following configurations:

- 4.2.13.1 HD Radio at Co-channel
- 4.2.13.2 HD Radio at +1<sup>st</sup> adjacent
- 4.2.13.3 HD Radio at + 2<sup>nd</sup> adjacent
- 4.2.13.4 HD Radio at -1<sup>st</sup> adjacent (\* additional test)
- 4.2.13.5 HD Radio at -2<sup>nd</sup> adjacent (\* additional test)
- 4.2.14 Change the channel the simulator for the following (and redo the tests):
  - 4.2.14.1 Rural channel
  - 4.2.14.2 Sub-urban channel (\* addition test)
  - 4.2.14.3 Urban Channel
- 4.2.15 Change FM analog Host frequency to next (98.1, 106.1 MHz...) and redo the tests
- 4.2.16 Change the FM receiver and redo the tests
- 4.2.17 Time to complete de tests (based on the following evaluation):
  - 4.2.17.1 Testing 1 receiver: 2 minutes
  - 4.2.17.2 Maximum number of receiver to test: 18
  - 4.2.17.3 Maximum Individual tests: 3X frequency, 5X HD Radio adjacent separations, 3X HD Radio ratio, 4X Channel simulator, 2X HD Radio mode = Total individual tests: 360 tests X 18 receivers = 6480 individual tests = 12960 minutes = **216h = 27 days**
  - 4.2.17.4 Minimum Individual Tests: 1X frequency, 3X HD Radio adjacent separations, 3X Channel simulator (including clean), 1X HD Radio Mode = Total Individual tests: 9 X 18 receivers = 162 tests = 324 minutes = **5.4 h**

### 4.3 HD Radio Self Interference

- 4.3.1 Test Setup [TBD Using only the HD Radio exciter]
- 4.3.2 Testing the audio on the analog portion of the HD Radio chain
- 4.3.3 Testing at 54 dBu, 70 dBu and 80 dBu (\* additional test)
- 4.3.4 Testing multiple receivers
- 4.3.5 Evaluate the SNR without HD Radio present
- 4.3.6 Evaluate SNR with HD Radio present at MP1 for: -20 dBc, -14 dBc, -10 dBc, unequal: (-20,-14), (-20,-10), (-14,10)\*, (-10,-20)\*, (-14,-20)\*
  - 4.3.6.1 Evaluate SNR with HD Radio present at MP3 for: -20 dBc, etc
  - 4.3.6.2 Channel simulator: clean, rural, sub-urban (\* additional test), urban
  - 4.3.6.3 Additional test: RDS, PPM (analog and digital audio components)
  - 4.3.6.4 Time to complete the tests:
    - 4.3.6.4.1 Testing 1 receiver = 2 minutes
    - 4.3.6.4.2 Maximum number of receiver: 9 (HD receivers only)
    - 4.3.6.4.3 Individual tests: 4X channel simulator, 8X HD Radio Ratio, 2X AD Radio modes = 576 individual tests = 1152 minutes = **19.2 h**
    - 4.3.6.4.4 Minimum Individual tests: 3X channel simulator, 5X HD Radio Ratio, 2X AD Radio modes = 30 individual tests = 60 minutes = **1.0 h**

#### 4.4 Bit rate HD PPM survival

- 4.4.1 Test SETUP [HD Radio exciter, audio codec, no channel simulators, PPMs encoder / decoder]
- 4.4.2 Test all different bit rate setup (or start from the lowest) and verify PPM survivability
- 4.4.3 Time to complete the tests = **approx. 8h**

#### 4.5 Interference HD to HD

- 4.5.1 Test SETUP: USING 2 HD Radio Modulator
- 4.5.2 Test using HD Radio test decoder, until: Threshold of Audibility, audio loss, HD unlock
- 4.5.3 Audio material: Glockenspiel (or other well-known test sequence that highlights the Threshold of Audibility)
- 4.5.4 Test: co-channel, lower 1<sup>st</sup>, 2<sup>nd</sup>, upper 1<sup>st</sup> (\*additional test), 2<sup>nd</sup> (\*additional test)
- 4.5.5 Tests for a center channel of 90.1 and 106.1 MHz (\* additional test)
- 4.5.6 HD Modes: MP1, MP11
- 4.5.7 HD insertions (for desired signal): -20 dBc, -14 dBc, -10 dBc, unequal: (-20,-14), (-20,-10), (-14,10)\*, (-10,-20)\*, (-14,-20)\*
- 4.5.8 Change the channel the simulator for the following (and redo the tests):
  - 4.5.8.1 Rural channel
  - 4.5.8.2 Sub-urban channel (\* additional test)
  - 4.5.8.3 Urban Channel
- 4.5.9 Always use (-10,-10) for the interferer (we can mathematically derived the other levels)
- 4.5.10 Time to complete the tests:
  - 4.5.10.1 Testing 1 receiver = 2 minutes
  - 4.5.10.2 Maximum number of receiver: 9 (HD receivers only)
  - 4.5.10.3 Individual tests: 5X adjacent separations, 2X frequencies, 8X HD Ratios, 4X channel simulator = 2880 tests = 5760 minutes = **96 h = 12 days**
  - 4.5.10.4 Minimum Individual tests: 3X adjacent separations, 1X frequencies, 5X HD Ratios, 3X channel simulator = 45 tests = 90 minutes = **1.5 h**

### 5. Field Interference Tests

- 5.1 Find a test site (Cogeco Sherbrooke)
- 5.2 Broadcast at a frequency that can “cause problems” to an existing first adjacent or identify a zone where the protection ratio to a 1<sup>st</sup> adjacent can be compromised
- 5.3 Evaluate the HD coverage for -20 dBc, -14 dBc, -10 dBc, (-20,-14), (-20,-10), (-14,10), (-10,-20), (-14,-20)
- 5.4 Evaluate the interference on the 1<sup>st</sup> adjacent analog in the problematic zone, for -20, -14 and -10 dBc
- 5.5 Single frequency network test
- 5.6 BER RDS
- 5.7 Test Audio with real program
- 5.8 Self noise test : put only the program on the left channel, evaluate noise on right.
- 5.9 Time to complete the tests = TBD