

RECOMMENDATION ITU-R SM.1838

**Test procedure for measuring the noise figure
of radio monitoring receivers**

(2007)

Scope

This Recommendation belongs to a set of Recommendations describing the test methods to determine technical parameters of radio monitoring receivers that are important for the users of these receivers. When the described methods are followed by manufacturers, comparing different receivers is made easier. This Recommendation specifies the test procedure for the determination of the noise figure of a monitoring receiver. This test procedure definition is recommended to all the manufacturers with the advantage for the users of such receivers, that an easier and more objective assessment of product quality is possible.

The ITU Radiocommunication Assembly,

considering

- a) that ITU-R has published the Typical recommended specifications for analogue and digital monitoring receivers in the Spectrum Monitoring Handbook (2002), but that nothing is said about the test procedures behind such specifications;
- b) that the specification of the noise figure (NF) strongly depends on the test procedures applied;
- c) that the noise figure of a receiver is a parameter which determines its ability to receive weak signals and to produce output signals with a usable level and an acceptable quality;
- d) that the noise figure specified in the data sheet of a receiver depends extremely on the test frequencies used, the receiver operating conditions and the ambient temperature prevailing during the tests;
- e) that the noise figure characteristic has a direct influence on the suitability of a receiver to fulfil certain monitoring tasks;
- f) that a unique test procedure for the measurement of the noise figure is required to make the specifications published by various manufacturers comparable because it will not be possible to convert specifications based on different test procedures with arguable effort;
- g) that a defined test procedure for the noise figure must be independent of the receiver design;
- h) that a well-defined test procedure for the noise figure, if adopted by all the manufacturers of radio monitoring receivers, will have the advantage for the users of such receivers, that an easier and more objective assessment of products from different manufacturers is possible;
- j) that supplementary information about these noise figure measurements can be found in Report ITU-R SM.2125 – Parameters of and measurement procedures on H/V/UHF monitoring receivers and stations,

recommends

- 1** that the measurement method in Annex 1 should be used to specify the noise figure of a radio monitoring receiver.

Annex 1

Test procedure for measuring the noise figure of radio monitoring receivers

1 General aspects

The noise figure depends mainly on the following parameters:

- the frequencies used for the test;
- the receiver settings (e.g. preamplifier, attenuator);
- the temperature prevailing during the tests.

Furthermore, to correctly assess the noise figure:

- the measurements have to be done over the whole frequency range of the receiver;
- a maximum value for the noise figure must be specified and published by the manufacturer in the data sheet over the receiver's whole operating range. Since noise figure values are frequency dependent the manufacturer can choose to additionally specify the noise figure for selected frequency bands or ranges;
- a *mean value* (the arithmetic mean of a number of test measurements) may also be indicated;
- the published noise figure values have to be valid over the entire temperature range indicated in the data sheet. Limitations, if any, have to be mentioned in the data sheet.

2 Basics of the noise figure measurements

The noise figure is one of the main specifications of a monitoring receiver. The noise figure is closely tied to the sensitivity of the monitoring receiver.

The noise figure of a monitoring receiver is the factor by which the noise power delivered by the monitoring receiver increases when a reference noise is applied to the input. The noise figure is referenced to the input of the monitoring receiver and is measured at the output.

The noise figure of a monitoring receiver can be measured by several methods:

- “gain” method
- “Y-factor” method (noise source method)
- “sensitivity” method.

The measurements must be done over the whole frequency range by tuning the receiver to the test signals with the frequencies $f_1, f_2, \dots, f_n$. Per octave at least two frequencies being evenly distributed over the full frequency range of the receiver have to be chosen.

The receiver must be set up under normal operating conditions. All the attenuators of the monitoring receiver, if any, are to be set to their minimum attenuation.

The automatic gain control (AGC) must be switched off during the tests.

If a switchable preamplifier exists, the measurements must be done in the condition “preamplifier on”. Additionally the measurements can be done in the condition “preamplifier off”. The condition “preamplifier on” may also be expressed as “high sensitivity mode” or “low noise mode”.