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Technical requirements and measurement methods for VHF/UHF frequency band radio monitoring receiver

VHF/UHF 频段无线电监测接收机技术要求及测试方法

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Technical requirements and measurement methods for VHF/UHF frequency band radio monitoring receiver

1 Scope

This standard specifies the general requirements for VHF/UHF frequency band radio monitoring receiver, as well as the main technical parameters, indicator requirements and test methods for electrical performance, electromagnetic compatibility, electrical safety, and environmental adaptability.

This standard applies to VHF/UHF frequency band radio monitoring receiver.

2 Normative references

The following documents are essential to the application of this document. For the dated documents, only the versions with the dates indicated are applicable to this document; for the undated documents, only the latest version (including all the amendments) are applicable to this standard.

GB/T 2423.1 Environmental testing for electric and electronic and electronic products - Part 2: Test methods - Tests A: Cold

GB/T 2423.2 Environmental testing for electric and electronic products - Part 2: Test methods - Tests B: Dry heat

GB/T 2423.3 Environmental testing for electric and electronic products - Part 2: Testing method - Test Cab: Damp heat steady state

GB/T 2423.5 Environmental testing for electric and electronic products - Part 2: Test methods - Test Ea and guidance: Shock

GB/T 2423.10 Environmental testing for electric and electronic products - Part 2: Tests methods - Test Fc: Vibration (sinusoidal)

GB/T 2423.22 Environmental testing - Part 2: Tests methods - Test N: Change of temperature

GB/T 2423.38 Environmental testing for electric and electronic products Part 2: Test methods Test R: Water test methods and guidelines

GB 4793.1 Safety requirements for electrical device for measurement,

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control, and laboratory use - Part 1: General requirements

GB 4824-2013 Industrial, scientific and medical device - Radio-frequency disturbance characteristics - Limits and methods of measurement

GB 9254 Information technology device - Radio disturbance characteristics - Limits and methods of measurement

ITU-T P.53 ITU-T Recommendation P.53 Psophometers - Apparatus for the objective measurement of circuit noise

3 Terms and definitions, abbreviations, and symbols

3.1 Terms and definitions

The following terms and definitions apply to this document.

3.1.1

VHF/UHF frequency band radio monitoring receiver

A receiver operating in the VHF or UHF band for radio spectrum monitoring and having certain demodulation analysis functions.

3.1.2

Standard SINAD

The ratio of the sum of power of signal, noise and distortion on the test load to the sum of power of noise and distortion:

$$\mathrm{SINAD} = 10\log\frac{S+N+D}{N+D}$$

Where:

S - The power of the useful audio signal produced by standard test modulation, in milliwatts (mW);

N - The power of the noise under standard test modulation, in milliwatts (mW);

D - The distorted power under standard test modulation, in milliwatts (mW).

Signal-to-noise-and-distortion (SINAD), in decibels (dB).

The standard signal-to-noise-and-distortion value is defined as 12 dB for

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4.1 General requirements

4.1.1 Operating frequency

VHF/UHF frequency band radio monitoring receiver operating frequency: 20 MHz ~ 3000 MHz.

4.1.2 Working mode

The VHF/UHF frequency band radio monitoring receiver can have multiple operating modes to suit different application environment requirements, such as low noise mode of high sensitivity requirements, normal mode of high dynamic range requirements, and low distortion mode of high noise immunity requirements and so on.

4.1.3 Monitoring mode

The VHF/UHF frequency band radio monitoring receiver can be equipped with various monitoring modes to suit different functional requirements, such as fixed frequency monitoring mode (FFM), panoramic scanning monitoring mode (PSCAN) and so on.

4.1.4 Demodulation mode requirements

The VHF/UHF frequency band radio monitoring receiver shall have the analog demodulation function of frequency modulation, amplitude modulation and continuous wave signals, but is not limited to these three items.

4.1.5 Operating voltage and power supply mode

The VHF/UHF frequency band radio monitoring receiver can be powered by external AC and DC power supplies, rechargeable battery packs or disposable battery packs. The power supply operating voltage is determined by the product itself.

4.1.6 Device auxiliary interface

The VHF/UHF frequency band radio monitoring receiver shall be equipped with an external earphone or microphone interface with an impedance of 600 Ω and a final intermediate frequency signal output interface. It can be configured with control and storage interfaces such as LAN, GPIB, and USB. It can be

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5.1.4 Requirements of the sample under test

The sample to be tested may be the product that the manufacturer's testing application or testing department makes spot check as required. For samples submitted for testing or spot check, the manufacturer shall provide the technical documents and testing assistance devices required for the testing before it can be tested. Testing assistance devices include: RF adapters or RF cables that can be connected to standard test instruments; power supply cables that can be connected to an external power supply; audio cables that can connect to the receiver's audio output ports. During the entire testing process, it should not open the enclosure for testing. If it needs to open the enclosure for testing, it shall be stated in the test report.

5.1.5 Electrical performance test frequency

When the VHF/UHF frequency band radio monitoring receiver is subject to electrical performance tests, it shall select a representative test frequency within its entire operating frequency range. Usually at least two test frequencies are selected per octave to ensure that the tested sample is, in its working frequency band, meeting the specified technical requirements.

5.1.6 Test signal

5.1.6.1 Frequency modulation signals

The standard test input signal for the VHF/UHF frequency band radio monitoring receiver test is a frequency modulation RF signal the signal frequency, modulation, and signal level of which are in accordance with the following requirements:

a) The signal frequency is the nominal operating frequency of the receiver of the sample under test;

b) The modulation signal has a frequency of 1 kHz and a frequency offset of 5 kHz;

c) The signal level is variable in accordance with actual test requirements.

5.1.6.2 Amplitude modulation signal

The standard test input signal for the VHF/UHF frequency band radio monitoring receiver test is an amplitude modulation RF signal the signal frequency, modulation, and signal level of which are in accordance with the following requirements:

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b) TURN on signal generator 1, in accordance with the selected test frequency, SET the signal generator to output the standard continuous wave test signal;

c) ADJUST the output level of the signal generator, so that the signal displayed on the display of the radio monitor receiver is stable at 30 dB above the noise floor;

d) DECREASE the output level of the signal generator until the signal displayed on the display of the radio monitor receiver is stable at 10 dB above the noise floor. RECORD the input level of the receiver at this time. This level is the monitoring sensitivity of the receiver panoramic scanning monitoring mode, which is expressed in units of dB μV or dBm. The test results shall comply with the requirements of the monitoring sensitivity specified in 4.2, TURN off the signal generator 1;

e) In accordance with the test requirements, CHANGE the test frequency, REPEAT the test procedure from b) ~ d).

5.2.4 Frequency tuning resolution

5.2.4.1 Overview

Frequency tuning resolution refers to the minimum frequency interval of the frequency tuning step when the receiver under test uses a digital frequency synthesis local oscillator, expressed in units of Hz.

5.2.4.2 Test methods

CONNECT the test device in accordance with the connection method shown in Figure 1. The measurement device shall use a spectrum analyzer with a 1 Hz resolution bandwidth. The test procedure is as follows:

a) SET the working mode of the radio monitoring receiver, TURN off the automatic frequency control (AFC), SET the resolution bandwidth to a minimum;

b) SET the receiver signal receiving frequency to the test frequency; TURN on signal generator 1, in accordance with the selected test frequency, SET the signal generator to output the standard continuous wave test signal, ADJUST the signal generator output level, to make the receiver input level 30 dB higher above the monitoring sensitivity at the fixed frequency monitoring mode;

c) READ the intermediate frequency output frequency f_1 in the spectrum analyzer;

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b) READ out the frequency value f_1 on the frequency counter, TURN off the signal generator;

c) CONNECT the device in accordance with Figure 3, SET the radio monitoring receiver to a fixed frequency monitoring mode, TURN off the automatic frequency control (AFC), SET the resolution bandwidth to a minimum;

d) SET the receiver signal receiving frequency to the test frequency, TURN on the signal generator, in accordance with the selected test frequency, SET the signal generator to output the standard continuous wave test signal, ADJUST the signal generator output level to be 30 dB higher than the monitoring sensitivity of the fixed frequency monitor mode; READ out the frequency f_2 of the signal received by the receiver at this time, TURN off the signal generator;

e) Frequency accuracy $=|f_2 - f_1| / f_1$, expressed as a relative value of 10^{-6}, the test results shall meet the requirements of the frequency accuracy indicator specified in 4.2;

f) In accordance with the test requirements, CHANGE the test frequency, REPEAT the test procedure from a) ~ f).

5.2.6 Intermediate frequency selectivity

5.2.6.1 Overview

Intermediate frequency selectivity refers to the ability of the receiver to suppress signals beyond the intermediate frequency 6 dB passband, which is expressed as relative waveform factor measurement value.

5.2.6.2 Test methods

CONNECT the test device as shown in Figure 1. The test procedure is as follows:

a) SET the radio monitoring receiver's operating mode, SET the gain control mode, TURN off the automatic gain control (AGC), TURN off the automatic frequency control (AFC), SET the resolution bandwidth to 25 kHz, if the device under test does not have 25 kHz resolution bandwidth, it shall select the smallest of all resolution bandwidths greater than 25 kHz;

b) SET the radio monitor receiver signal's receiving frequency to the test frequency, TURN on the signal generator 1, in accordance with the selected test frequency, SET the signal generator to output the standard continuous wave test signal, the signal level is the fixed frequency

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frequency control (AFC), SET the resolution bandwidth to 25 kHz, if the device under test does not have a resolution bandwidth of 25 kHz, it shall select the smallest of all resolution bandwidths greater than 25 kHz for the device;

b) SET the radio monitor receiver signal reception frequency to the test frequency, TURN on the signal generator 1, SET the frequency to be the first intermediate frequency $f_{1st\ IF}$, the second intermediate frequency $f_{2nd\ IF}$ or the third intermediate frequency $f_{3rd\ IF}$ of the measured radio monitoring receiver, respectively. The signal generator signal type is continuous wave;

c) ADJUST the output level of the signal generator so that the intermediate frequency interference signal displayed on the radio monitoring receiver display is stable higher above the noise floor 10 dB radio monitoring receiver. CALCULATE the difference α between the input intermediate frequency signal and the output signal level, whichever is smaller, this is the intermediate frequency interference rejection ratio, expressed in dB. The test result shall meet the requirements of the intermediate frequency interference suppression ratio specified in 4.2, TURN off the signal generator 1.

d) In accordance with the test requirements, CHANGE the test frequency, REPEAT the test procedure from b) ~ c);

e) CHANGE the working mode of the receiver, REPEAT the test procedure from a) ~ d).

5.2.10 Mirror image frequency interference suppression ratio

5.2.10.1 Overview

The mirror image interference suppression ratio is a measure of the receiver's ability to suppress interference signals whose frequency is the mirror image frequency.

5.2.10.2 Test method

CONNECT the test device as shown in Figure 1. The test procedure is as follows:

a) SET the radio monitor receiver operating mode, SET the gain control mode, TURN off the automatic gain control (AGC), TURN off the automatic frequency control (AFC), SET the resolution bandwidth to 25 kHz, if the device under test does not have a resolution bandwidth of 25 kHz, it shall select the smallest of all resolution bandwidths greater than 25 kHz for the

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the entire receiver operating frequency band;

c) TURN on signal generator 1, SET signal generator 1 to output a single burst signal, SET its frequency within the working frequency band of the receiver, ADJUST the burst signal level, so that the signal to noise ratio as displayed on the display of the radio monitoring receiver is greater than 30 dB, ADJUST the dwell time T_0 of the burst signal, so that the radio monitoring receiver can effectively display the signal in the frequency sweep process, and that the level error shall be less than 5 dB, the frequency error is less than one resolution bandwidth;

d) SET the signal generator 1 to output burst signals with no less than 20 signals, SET the dwell time to T_0. OBSERVE whether the radio monitoring receiver can display all burst signals and satisfy the requirements that level error is less than 5dB, the frequency error is less than one resolution bandwidth condition, TURN off signal generator 1;

e) If the requirements of step c) are not satisfied, ADJUST the dwell time T_0, REPEAT the procedures from b) ~ c) until requirements are met;

f) The scanning speed of the radio monitoring receiver $V = (f_2 - f_1) / T_0$, expressed in MHz/s. The test results shall comply with the requirements of the scanning speed specified in 4.2.

5.2.13 Level measurement error

5.2.13.1 Overview

The level measurement error refers to the difference between the input signal level value measured by the receiver within the specified level measurement range and the actual signal level value, which is represented by the maximum value of the error.

5.2.13.2 Test methods

CONNECT the test device in accordance with the connection method shown in Figure 1. The measurement device can use a spectrum analyzer. The test procedure is as follows:

a) SET the radio monitoring receiver to a normal mode with a high dynamic range, TURN on the automatic gain control (AGC);

b) SET the receiver signal receiving frequency to the test frequency; TURN on the signal generator 1, in accordance with the selected test frequency, SET the signal generator to output the standard continuous wave test signal. The output level range is within the receiver's level measurement

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