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TEST REQUIREMENTS FOR EQUIPMENT INTEGRATED WITH FREQUENCY HOPPING SPREAD SPECTRUM (FHSS) SYSTEMS V20.1

1. Scope

The equipment that has at least one interface that uses the frequency hopping spreading technique must comply with the requirements indicated in the following test protocol.

Since systems known as "hybrids" use frequency hopping as part of their operation, the specifications that they must meet have been added at the end of this document.

2. Definitions

Module (transmitter / transceiver): Device composed of a radio frequency transmitter / transceiver, an adaptation circuit for antenna connection and a power supply stabilization circuit, whose operation can be evaluated in autonomous mode (stand-alone) under the required conditions under this test protocol, designed primarily to be incorporated into other equipment.

Broadband Digital Modulation Systems (SMDBA): Systems that use modulation techniques that use digital codes to broaden the spectrum of the signals to be transmitted. Examples are direct sequence spread spectrum (DSSS) or mutually orthogonal multiple carrier (OFDM) techniques. Frequency hopping systems are expressly excluded from this category.

Frequency Hopping Systems (SSF): Systems that use the spectrum spreading technique in which the equipment uses a certain number of carrier frequencies within the operating band, selected in a pseudo-random way, each one for a certain period of time, referred to as residence time.

Hybrid Systems: Systems that use a combination of modulation techniques that use digital codes to expand the spectrum of the signals to be transmitted, and the technique of spreading the spectrum by frequency hopping, at the same time and on the same carrier.

Ente Nacional de Comunicaciones

3. Allocated Bands

The allocated bands are the following:

Band	Regulatory Framework
902 – 915 MHz	Resolution SC 302/1998 Resolution SC 226/2008
915 – 928 MHz	Resolution ENACOM 4653/2019
2.400 – 2.483,5 MHz	Resolution ENACOM 4653/2019
5.725 – 5.850 MHz	Resolution ENACOM 4653/2019

Table 1 – Frequency bands

4. Document identification

In "identification of the normative body" (point 7 of the test report) it should be indicated: ***"Protocolo de ensayos para Sistemas de Salto de Frecuencia V20.1"***.

5. General Considerations

The type of approved equipment must comply with the specifications of this regulation for all operating conditions in which it is expected to be marketed. However, to simplify the measurements, the following will be taken into account:

5.1. A complete and independent test report will be presented for each operating band of the equipment.

5.2. Tests will be carried out with the EUT transmitting at the maximum operating power specified by the manufacturer for the production model.

5.3. In each test, the applicant will adjust the modulation, transmission speed and / or any other variable parameter by software, selecting the operating scheme that he considers representative for the measurement.

5.4. For equipment that has the possibility of configuring different transmission bandwidths, the specifications for the minimum and maximum configurable bandwidths will be checked.

5.5. The laboratory will report the adjustments in the description of the corresponding test.

5.6. In all cases, and especially in homologated modules, it must be ensured that after their installation, the emissions emitted comply with the limits indicated in this test protocol.

6. Requirements for Frequency Hoping Systems

The equipments that integrate Frequency Hopping Systems must meet the specifications established in the following sections.

6.1. Operation bands

The operating bands of the equipment covered by this regulation, defined by the range of frequencies that are intentionally emitted by the transmitter, must be contained within at least one of the bands indicated in Table 1.

6.2. Trasmitter Conducted Peak Power

The conducted peak power shall comply with the following limits:

Band	Limit [W]	Observations
902 – 928 MHz	1	Devices with 50 or more hopping frequencies.
	0,250	Devices with 25 to 49 hopping frequencies
2.400 – 2.483,5 MHz	1	Devices with 75 or more hopping frequencies.
	0,125	Devices with 15 to 74 hopping frequencies
5.725 – 5.850 MHz	1	Devices with 75 or more hopping frequencies.

Table 2 – Transmitter Conducted Peak Power Specifications

6.3. Hopping channel bandwidth

Bandwidth of hopping channel, measured at 20 dB below the maximum level, shall comply with the following limits:

Band	Limit [MHz]	Observations
902 – 928 MHz	≤ 0,5	
2.400 – 2.483,5 MHz	- - -	Without restrictions
5.725 – 5.850 MHz	≤ 1	

Table 3 – Hopping channel bandwidth specifications

6.4. Hopping frequency separation

Hopping frequencies should be separated from each other by a minimum of 25 kHz or the hopping channel bandwidth (BW), whichever is greater.

Equipment operating in 2,400 to 2,483.5 MHz band may have hopping frequencies separated from each other by a minimum of 25 kHz or two thirds of the hop channel bandwidth (BW), but its power shall be limited to 125 mW.

Band	Limit	Observations
902 – 928 MHz	≥ 25 kHz y ≥ BW	
2.400 – 2.483,5 MHz	≥ 25 kHz y ≥ BW	
	≥ 25 kHz y ≥ 2/3 BW	Limited power to 125 mW
5.725 – 5.850 MHz	≥ 25 kHz y ≥ BW	

Table 4 – Hopping frequency separation specifications

6.5. Number of Hopping Frequencies and Average Dwell Time

- ***Band 902 - 928 MHz***

For equipment operating in 902 to 928 MHz band, if the hopping channel bandwidth is less than 250 kHz, the system must use at least 50 hopping frequencies and the average dwell time on any channel should not exceed 0.4 seconds within a 20 second period.

If the bandwidth of the hopping channel is greater than or equal to 250 kHz, the system shall use at least 25 hopping frequencies and the average dwell time on any channel shall not exceed 0.4 seconds within a period of 10 seconds.

- ***Band 2.400 - 2.483,5 MHz***

Equipment operating in the 2,400 to 2,483.5 MHz band must use at least 15 hopping frequencies. The average dwell time on any channel shall not exceed 0.4 seconds within a 0.4 second period multiplied by the number of hopping frequencies.

- ***Band 5.725 - 5.850 MHz***

Equipment operating in the 5,725 to 5,850 MHz band must use at least 75 hopping frequencies.
The average dwell time on any channel shall not exceed 0.4 seconds within a 30 second period.

Ente Nacional de Comunicaciones

Band	Bandwidth [kHz]	Number of hopping frequencies	Average dwell time [sec]	Measurement period [sec]
902 – 928 MHz	< 250	≥ 50	≤ 0,4	20
	≥ 250 y ≤ 500	≥ 25	≤ 0,4	10
2.400 – 2.483,5 MHz	- - -	≥ 15	≤ 0,4	0.4 sec x number of hopping frequencies
5.725 – 5.850 MHz	- - -	≥ 75	≤ 0,4	30

Tabla 5 – Specifications for number of hopping frequencies and average dwell time

6.6. Non-desired emissions

The power of non-desired emissions in any band outside the transmitter's operating band must be attenuated by at least 20 dB with respect to the highest-level emission within the operating band, both measured with a resolution bandwidth of 100 kHz. Non-desired emissions will be evaluated up to at least the 2nd harmonic of the transmission channel used during the test.

7. Requirements for Hybrid Systems

The transmitter / transceiver equipment that is part of a hybrid system must meet the following technical requirements:

7.1. Transmitter Conducted Peak Power

Conducted peak power should be less than 1 W.

7.2. Hopping frequency separation

The separation between hopping frequencies must comply with the following limits:

Band	Limit	Observations
902 – 928 MHz	≥ 25 kHz y ≥ BW	
2.400 – 2.483,5 MHz	≥ 25 kHz y ≥ 2/3 BW	
5.725 – 5.850 MHz	≥ 25 kHz y ≥ BW	

Tabla 7 – Hopping frequency separation specifications

Ente Nacional de Comunicaciones

7.3. Number of Hopping Frequencies and Average Dwell Time

The number of hopping frequencies does not have a specified limit but must be verified in the test report.

The average dwell time on any channel shall not exceed 0.4 seconds within a 0.4 second period multiplied by the number of hopping frequencies.

7.4. Non-desired emissions

The power of non-desired emissions in any band outside the transmitter's operating band must be attenuated by at least 20 dB with respect to the highest-level emission within the operating band, both measured with a resolution bandwidth of 100 kHz.

Non-desired emissions will be evaluated up to at least the 2nd harmonic of the transmission channel used during the test.

7.5. Power density

The spectral power density shall be less than 8 dBm measured with a 3 kHz resolution bandwidth, with the frequency hopping function disabled.