



RF - TEST REPORT

- FCC Part 15.407, RSS-247 -

Type / Model Name : M2

Product Description : Radio Module 802.11a/b/n/ac & BLE

Applicant : BSH Hausgeräte GmbH

Address : Carl-Wery-Straße 34

81739 München

Manufacturer : BSH Hausgeräte GmbH

Address : Carl-Wery-Straße 34

81739 München

Test Result according to the standards
listed in clause 1 test standards:

POSITIVE

Test Report No. : 80091012-07 Rev_1

28. March 2022

Date of issue



Deutsche
Akkreditierungsstelle
D-PL-12030-01-01
D-PL-12030-01-02

FCC ID: 2AHES-M2

IC ID: 21152-M2

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Attachment A as separate supplement

The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

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1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15, Subpart E – UNII Devices (September 2020)

Part 15, Subpart E, Section 15.407 Operation within the bands 5.15 - 5.25 GHz, 5.25 - 5.35 GHz,
5.47 - 5.725 GHz and 5.725 - 5.825 GHz

905462 D02 UNII DFS Compliance Procedures New Rules v02, April 8, 2016

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2 EQUIPMENT UNDER TEST

2.1 Information provided by the Client

Please note, we do not take any responsibility for information provided by the client or his representative which may have an influence on the validity of the test results.

2.2 Sampling

The customer is responsible for the choice of sample. Sample configuration, start-up and operation is carried out by the customer or according to his/her instructions.

2.3 Photo documentation of the EUT – Detailed photos see attachment A

2.4 General remarks

As requested by the manufacturer all tests were performed with the highest possible power setting to still comply with the applying regulations and limits. Used power settings are listed under 2.13. of this test report.

2.5 Equipment category

WLAN - Client

2.6 Short description of the equipment under test (EUT)

The EUT is a communication module for assembling into household devices. The firmware does not support ad-hoc modes and gives the user no possibility to choose the data transmission or power setting. The EUT is compatible with IEEE 802.11b, g, n, a, ac Standard and 802.15. It supports the 2.4 GHz and 5 GHz frequency band and supports no beam forming.

Tested samples	: 1 (radiated)
Serial number	: 80012117280000440335000001789
SW	: BSH Embedded Linux Platform (SMM M2 default) - debug [HWTEST] 40.0.0-204-g45fedbf \n \l
Firmware	: 1.28 RC0.0 wI0: Apr 15 2021 03:04:08 version 7.45.234 (4ca95bb CY WLTEST) FWID 01-67595eaa
Tested samples	: 1 (conducted)
Serial number	: 80012117280000440335000001793
SW	: BSH Embedded Linux Platform (SMM M2 default) - debug [HWTEST] 40.0.0-204-g45fedbf \n \l
Firmware	: 1.28 RC0.0 wI0: Apr 15 2021 03:04:08 version 7.45.234 (4ca95bb CY WLTEST) FWID 01-67595eaa

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2.7 Variants of the EUT

There are no variants.

2.8 Channel plan:

The operating frequency is 5150 MHz to 5850MHz.

Channel plan:

WLAN Standard
802.11a, n HT20, ac VHT20

Channel	Frequency (MHz)
36	5180
40	5200
44	5220
48	5240
52	5260
56	5280
60	5300
64	5320
100	5500
104	5520
108	5540
112	5560
116	5580
120	5600
124	5620
128	5640
132	5660
136	5680
140	5700
144	5720
149	5745
153	5765
157	5785
161	5805
165	5825

WLAN Standard
802.11n HT40, ac VHT40

Channel	Frequency (MHz)
38	5190
46	5230
54	5270
62	5310
102	5510
110	5550
118	5590
126	5630
134	5670
142	5710
151	5755
159	5795

WLAN Standard
802.11ac VHT80

Channel	Frequency (MHz)
42	5210
58	5290
106	5530
122	5610
138	5690
155	5775

Note: Blue marked channel need to comply with DFS requirements.

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2.1 Transmit operating modes

The module uses OFDM modulation and is capable to provide following data rates:

- 802.11a	54, 48, 36, 24, 18, 12, 9, 6 Mbps	(Mbps = megabits per second)
- 802.11n	HT20, MCS 0 – 7	
- 802.11n	HT40, MCS 0 – 7	
- 802.11ac	VHT20, MCS 0 – 9	
- 802.11ac	VHT40, MCS 0 – 9	
- 802.11ac	VHT80, MCS 0 – 9	

2.2 Antenna

The following antennas shall be used with the EUT:

Number	Characteristic	Model number	Plug	Frequency range (GHz)	Gain (dBi)
1	Omni	PCB antenna	-	5	4.3

The EUT has only an integrated PCB antenna, no temporary connector and no external antenna to be connected.

2.3 Power supply system utilised

Power supply voltage, V_{nom} : 5 V_{DC}

2.4 Peripheral devices and interface cables

The following peripheral devices and interface cables were connected during the measurements:

- Debug Adapter	Model: _____
- Micro USB cable	Model: _____
- Laptop	Model: _____

2.4.1 Test jig

No test jig is used.

2.4.2 Test software

The test software is controlled by a terminal program (PuTTY). The test software allows to set the EUT into RX and TX continuous modulated mode and set different channel by command.

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3 TEST RESULT SUMMARY

Operating in the 5250 MHz - 5350 MHz and 5475 MHz – 5725 MHz band:

FCC Rule Part	RSS Rule Part	Description	Result
15.407(g)(2)	RSS247, 6.3	Dynamic frequency selection	passed
15.407(i)(B)iii	RSS247, 6.3.2(c)	Channel move time	passed
15.407(i)(B)iii	RSS247, 6.3.2(d)	Channel closing transmission time	passed
15.407(i)(B)iv	RSS247, 6.3.2(e)	Non-Occupancy period	passed

The mentioned RSS Rule Parts in the above table are related to:
RSS 247, Issue 2, February 2017

3.1 Revision history of test report

Test report No	Rev.	Issue Date	Changes
80091012-07	0	18 January 2022	Initial test report
80091012-07	1	28 March 2022	Added IC ID of Access Point

The test report with the highest revision number replaces the previous test reports.

3.2 Final assessment

The equipment under test fulfills the requirements cited in clause 1 test standards.

Date of receipt of test sample : acc. to storage records

Testing commenced on : 30 November 2021

Testing concluded on : 30 November 2021

Checked by:

Tested by:



Klaus Gegenfurtner
2022.03.29 07:50:18
+02'00'



Lukas Scheuermann
2022.03.28 14:45:54
+02'00'

Klaus Gegenfurtner
Teamleader Radio

Lukas Scheuermann
Radio Team

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4 TEST ENVIRONMENT

4.1 Address of the test laboratory

**CSA Group Bayern GmbH
Ohmstrasse 1-4
94342 STRASSKIRCHEN
GERMANY**

4.2 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature: 15 - 35 °C

Humidity: 30 - 60 %

Atmospheric pressure: 86 - 106 kPa

4.3 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. It is noted that the expanded measurement uncertainty corresponds to the measurement results from the standard measurement uncertainty multiplied by the coverage factor $k = 2$. The true value is located in the corresponding interval with a probability of 95 %. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16-4-2 / 2011 + A1 / 2014 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements“ and is documented in the quality system acc. to DIN EN ISO/IEC 17025. For all measurements shown in this report, the measurement uncertainty of the test laboratory, CSA Group Bayern GmbH, is below the measurement uncertainty as defined by CISPR. Therefore, no special measures must be taken into consideration with regard to the limits according to CISPR. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

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4.4 Measurement protocol for FCC and ISED

4.4.1 General information

CSA Group Bayern GmbH is recognized as wireless testing laboratory under the CAB identifier:

FCC: DE 0011
ISED: DE0009

4.4.2 General Standard information

The test methods used comply with ANSI C63.10 - "Testing Unlicensed Wireless Devices".

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5 TEST CONDITIONS AND RESULTS

5.1 DFS (client device without radar detection)

For test instruments and accessories used see section 6 Part DFS.

5.1.1 Description of the test location

Test location: Shielded Room S6

5.1.2 General

The requirements and measurements applies are based on a **client device without radar detection**. The associated master device was an FCC approved Cisco AIR-AP1250 access point, certified under FCC ID: LDK102061; IC ID: 2461B-102061. Due to the fully compliance of the master it is interfered only with the radar pulse 1 for testing the client channel moving behaviour.

5.1.3 Applicable standard

According to FCC Part 15 Subpart D, Section 15.407, (h)(2):

Devices operating in the bands 5250 – 5350 MHz and 5470 – 5725 MHz shall comply with the following.

5.2 DFS requirements

Table 1: Applicability of DFS requirements prior to use of a channel (FCC 06-96)

Requirement	Operational mode		
	Master	Client without radar detection	Client with radar detection
<i>Non-Occupancy Period</i>	Yes	Not required	Yes
<i>DFS Detection Threshold</i>	Yes	Not required	Yes
<i>Channel Availability Check Time</i>	Yes	Not required	Not required
<i>Uniform Spreading</i>	Yes	Not required	Not required
<i>U-NII Detection Bandwidth</i>	Yes	Not required	Yes

Table 2: Applicability of DFS requirements during normal operation (FCC 06-96)

Requirement	Operational mode		
	Master	Client without radar detection	Client with radar detection
<i>DFS Detection Threshold</i>	Yes	Not required	Yes
<i>Channel Closing Transmission Time</i>	Yes	Yes	Yes
<i>Channel Move Time</i>	Yes	Yes	Yes
<i>U-NII Detection Bandwidth</i>	Yes	Not required	Yes

5.2.1 Description of measurement

EUT is connected to an Access Point at channel chosen by the tester in the DFS spektrum (CH52 – CH144).

A data transmission is established from the EUT to another Client (Laptop) on same AP with iPerf3.

Set command on Server (EUT M2):

iperf3 -s

Set command on Client (Laptop on Router):

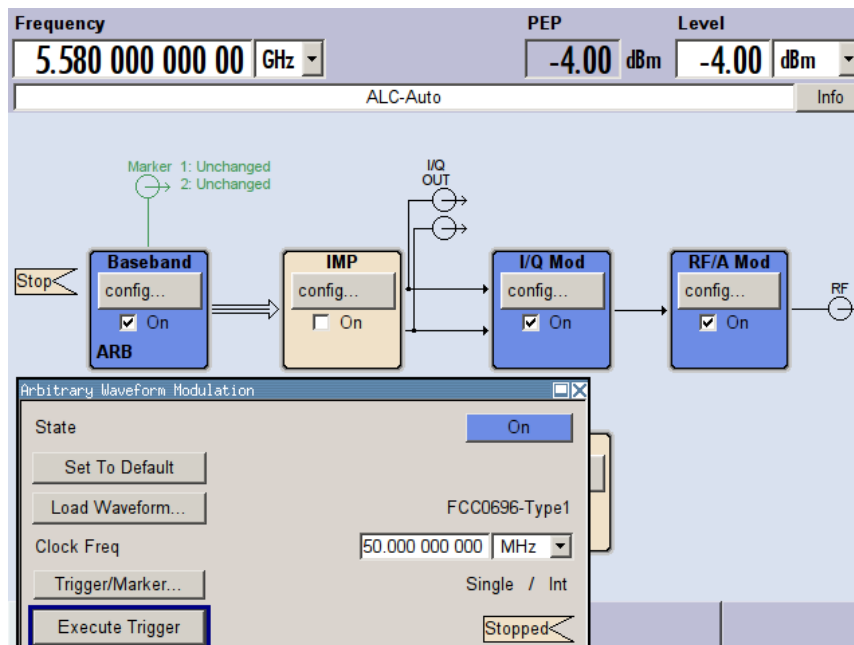
iperf3 -c 192.168.178.35 -i -u -b 1M -t 10000 -R

5.3 Radar test waveforms

Table 5 – Short pulse radar test waveforms (FCC 06-96)

Radar type	Pulse width (μsec)	PRI (μsec)	Number of pulses
0	1	1428	18

FCC Radar Types 0 system diagram



The appropriate radar test pattern is generated by an R&S SMBV100A (Vector SG with one ARB). The K6 sequencer software has been used for creating complex waveforms to generate the puls and burst sequence.

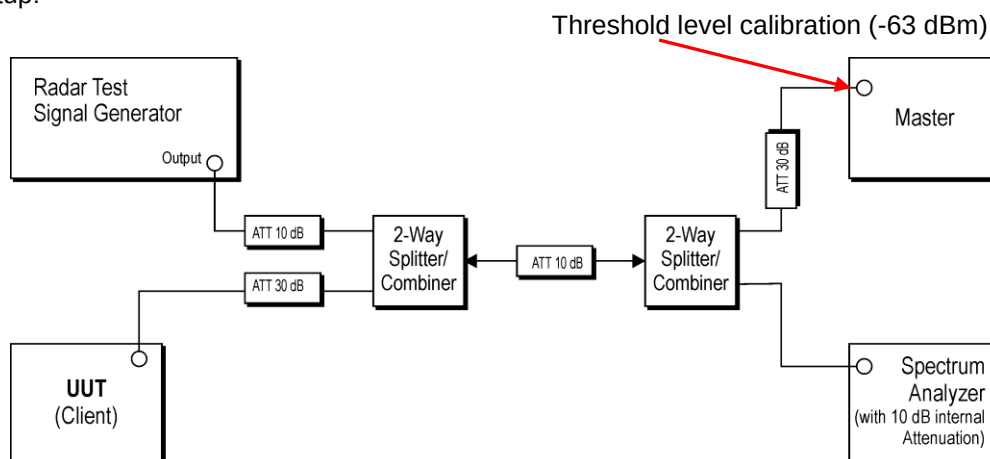
The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

5.4 Radar waveform calibration procedure

The interference radar detection threshold level is $-64 \text{ dBm} + 1 \text{ dB} = -63 \text{ dBm}$. A vector signal generator is used to establish the test signal level for each radar type. During the calibration process the slave device and the master device was set on no transmission. The spectrum analyser is set to zero span (time domain) at the frequency of the radar waveform generator. Peak detection is used for the measurement. The level of the signal generator is varied till the spectrum analyser reading shows the -63 dBm at the input of the master. The plot on the short radar puls was captured to demonstrate the right threshold level.

Test setup and conducted calibration diagram for client with injection at the master

Calibration setup:



The interference radar detection threshold is as follows:

Table 3: DFS detection thresholds for master devices and client devices with radar detection (FCC 06-96)

Maximum Transmit Power	Value (See Notes 1 and 2)
$\geq 200 \text{ milliwatt}$	-64 dBm
$< 200 \text{ milliwatt}$	-62 dBm

Note 1: This is the level at the input of the receiver assuming a 0 dBi receive antenna.
 Note 2: Throughout these test procedures an additional 1 dB has been added to the amplitude of the test transmission waveforms to account for variations in measurement equipment. This will ensure that the test signal is at or above the detection threshold level to trigger a DFS response.

The applied interference radar detection threshold conducted at the input of the AP is -64 dBm . Therefore the level at the AP connector + 1 dB variation in measurement equipment = -63 dBm .

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5.5 Channel move time

Requirement according to FCC Part 15 Subpart D, Section 15.407, (h)(2)(iii):

The requirement for channel move time applies in both the master and the slave operational modes.

Table 4: DFS response requirement values (FCC 06-96)

Parameter	Value
<i>Non-occupancy period</i>	Minimum 30 minutes
<i>Channel Availability Check Time</i>	60 seconds
Channel Move Time	10 seconds, See Note 1.
Channel Closing Transmission Time	200 ms + an aggregate of 60 ms over remaining 10 s period. See Notes 1 and 2.
<i>U-NII Detection Bandwidth</i>	Minimum 80 % of the U-NII 99 % transmission power bandwidth. See Note 3.

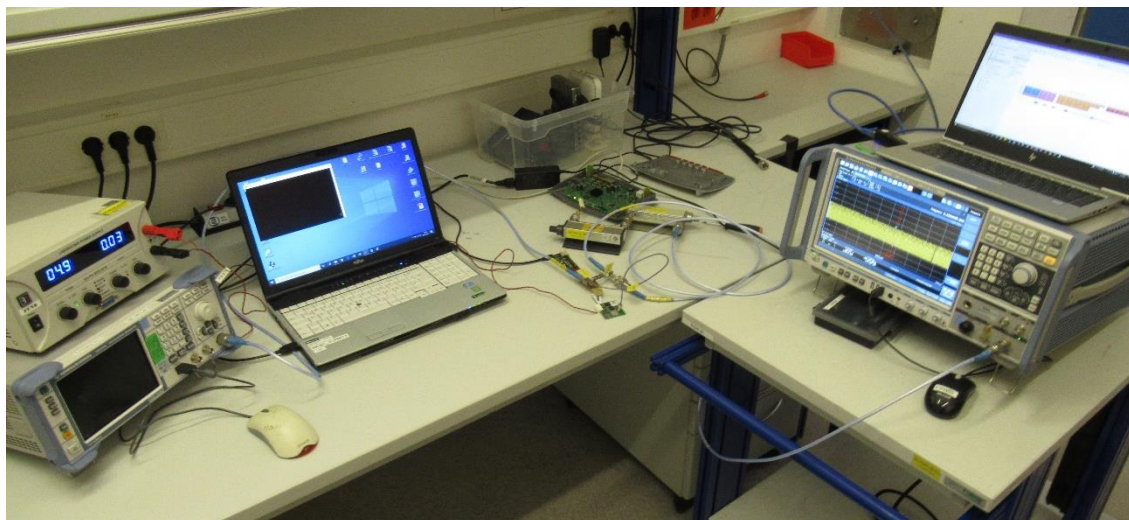
Note 1: The instant that the *Channel Move Time* and the *Channel Closing Transmission Time* begins is as follows:

- For the Short Pulse Radar Test Signals this instant is the end of the *Burst*.
- For the Frequency Hopping radar Test Signal, this instant is the end of the last radar *Burst* generated.
- For the Long Pulse Radar Test Signal this instant is the end of the 12 second period defining the *Radar Waveform*.

Note 2: The *Channel Closing Transmission Time* is comprised of 200 milliseconds starting at the beginning of the *Channel Move Time* plus any additional intermittent control signals required facilitating a *Channel* move (an aggregate of 60 milliseconds) during the remainder of the 10 second period. The aggregate duration of control signals will not count quiet periods in between transmissions.

Note 3: During the *U-NII Detection Bandwidth* detection test, radar type 1 is used and for each frequency step the minimum percentage of detection is 90 percent. Measurements are performed with no data traffic.

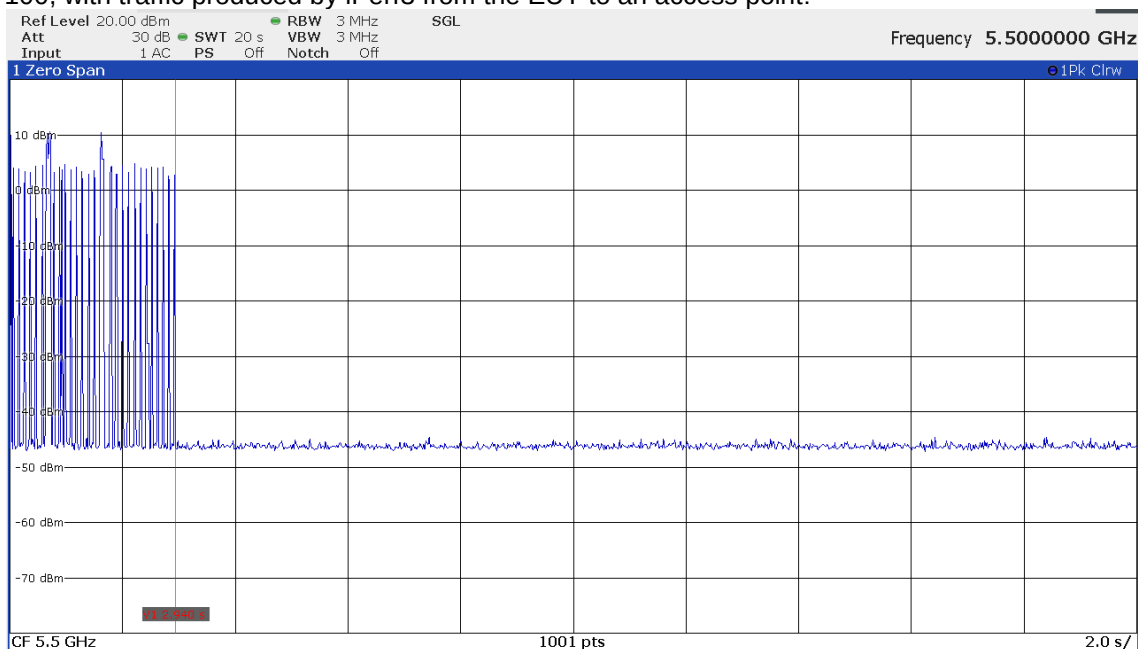
5.5.1.1 Photo documentation of the test set-up



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5.5.1.2 Test result

Channel 100, with traffic produced by iPerf3 from the EUT to an access point:



Radar Impulse was applied at vertical line V1(2.940 s).

Applied sample short puls radar type 1:

RADAR TYPE 1				
Rohde & Schwarz K6 Pulse Sequencer				
Trial #	Number of Pulses per Burst	Pulse Width (µsec)	PRI (µs)	Detection (yes/no)
1	18	1	1428	y

Limit according to FCC Part 15 Subpart D, Section 15.407, (h)(2)(iii):

After the radar signal is detected, the device shall cease all transmissions on the operating channel within 10 s. Transmission during this period shall consist of normal traffic for a minimum 200 ms after detection of the radar signal. In addition, the intermittent management and control signals can be sent during the remaining time to facilitate vacating the operating channel.

The requirements are **FULFILLED**.

Remarks:

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5.6 Channel closing transmission time

Requirement according to FCC Part 15 Subpart D, Section 15.407, (h)(2)(iv):
The requirement for channel closing time is 200 ms + 60 ms. (See table 4)

5.6.1.1 Test result

Calculation of the Channel closing transmission time:

Channel 100:

T_{cctt} = aggregate duration of all transmission

➔ 0 transmission pulses are left after the radar puls.

$T_{cctt} = 0.0 \text{ s}$

Limit according to FCC Part 15 Subpart D, Section 15.407, (h)(2)(iii):

After the radar signal is detected, the device shall cease all transmissions on the operating channel within 10 s. Transmission during this period shall consist of normal traffic for a minimum 200 ms after detection of the radar signal. In addition, the intermittent management and control signals can be sent during the remaining time to facilitate vacating the operating channel.

The requirements are **FULFILLED**.

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5.7 Non-Occupancy period

Requirement according to FCC Part 15 Subpart D, Section 15.407, (h)(2)(iv):

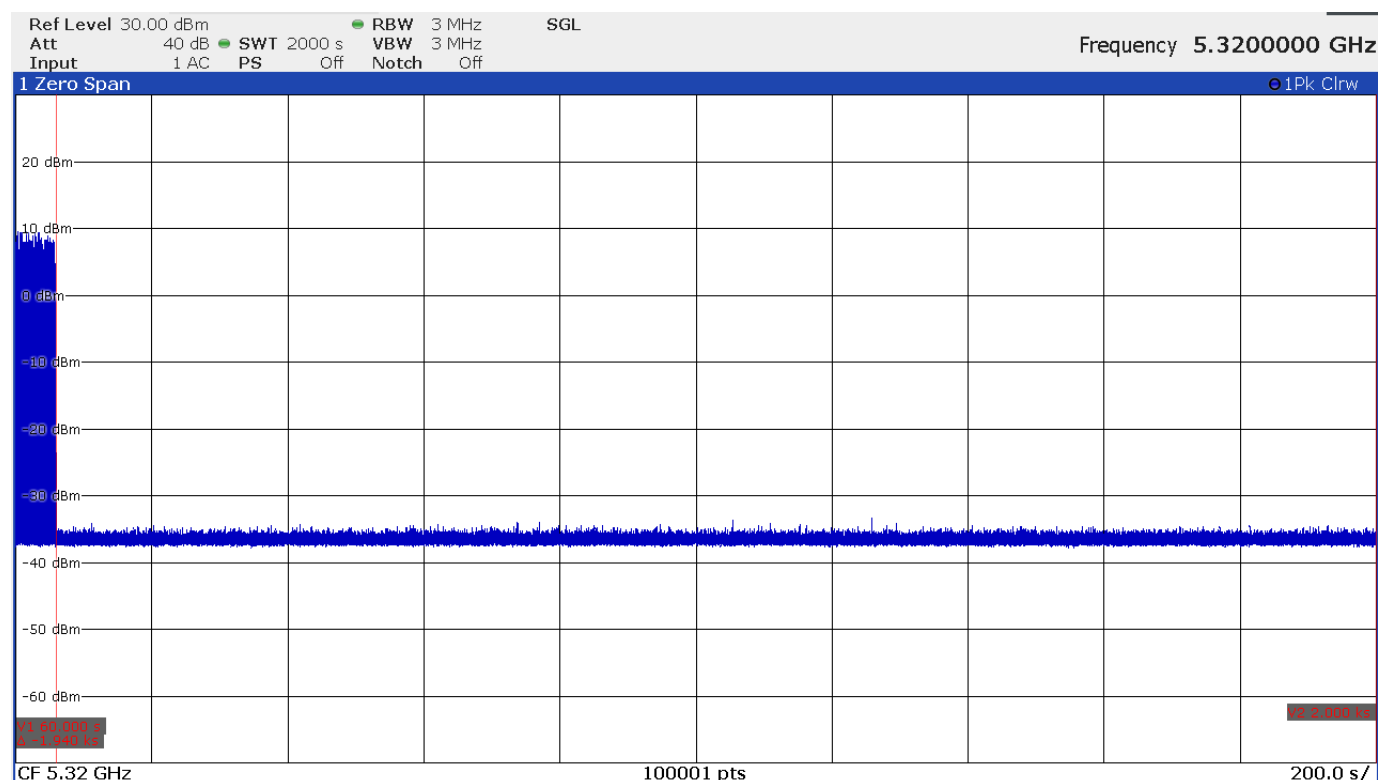
The requirement for testing the non-occupancy period does not exist (see Table 1) but the EUT has to ensure that no transmission of any type before having received appropriate control signals from a master device. See requirement 06-96, item 5.2.

5.7.1.1 Test result

During the power on observation the EUT did not try to search for an AP or send any beacons by itself.

Behaviour after channel changing from 64, AP has detected a radar signal:

During the 30 minutes observation after channel changing the EUT doesn't transmit any signals on the channel.



The requirements are **FULFILLED**.

Remarks:

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6 USED TEST EQUIPMENT AND ACCESSORIES

All test instruments used are calibrated and verified regularly. The calibration history is available on request.

Test ID	Model Type	Equipment No.	Next Calib.	Last Calib.	Next Verif.	Last Verif.
DFS	SMBV100A	02-02/05-09-001	24/03/2024	24/03/2021	24/03/2022	24/03/2021
	FSW43	02-02/11-21-001	08/04/2022	08/04/2021		
	6014-01 SMA 12.4 GHz	02-02/50-10-007				
	6014-01 SMA 12.4 GHz	02-02/50-10-008				
	KK-SF104-11SMA-11N-2M	02-02/50-14-002				
	minibend KR-16	02-02/50-16-018				
	EA-PS 3032-05 B	02-02/50-20-008				