

Test Report

- DFS tests only -

Report Number: F161612E4 4th version

Equipment under Test (EUT):

**PCI express Half mini card WLAN module
SX-PCEAN2**

Applicant:

PHOENIX CONTACT Electronics GmbH

Manufacturer:

PHOENIX CONTACT Electronics GmbH



Deutsche
Akkreditierungsstelle
D-PL-17186-01-01
D-PL-17186-01-02
D-PL-17186-01-03



REFERENCES

- [1] **FCC CFR 47 Part 15** Radio Frequency Devices
- [2] **KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02 (April 2016)**
Compliance measurement procedures for Unlicensed - National Information Infrastructure (U-NII) Devices operating in the 5250-5350 MHz and 5470-5725 MHz bands incorporating Dynamic Frequency Selection.

TEST RESULT

The requirements of the tests performed as shown in the overview (clause 4) were fulfilled by the equipment under test.

The complete test results are presented in the following.

Test engineer:	Manuel BASTERT		31.08.2020
	Name	Signature	Date
Authorized reviewer:	Paul NEUFELD		31.08.2020
	Name	Signature	Date

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1 Identification

1.1 Applicant

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Country:	Germany
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Applicant represented during the test by the following person:	none

1.2 Manufacturer

Name:	PHOENIX CONTACT Electronics GmbH
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Country:	Germany
Name for contact purposes:	Andreas Pape
Phone:	+49 5281 9 46-1545
Fax:	+49 5281 9 46-2398
eMail Address:	apape@phoenixcontact.com
Applicant represented during the test by the following person:	none

1.3 Test laboratory

The tests were carried out by: **PHOENIX TESTLAB GmbH**
Königswinkel 10
32825 Blomberg
Germany

Accredited by Deutsche Akkreditierungsstelle GmbH (DAkkS) in compliance with DIN EN ISO/IEC 17025 under Reg. No. D-PL-17186-01-02 and D-PL-17186-01-05, FCC Test Firm Designation Number DE0004, FCC Test Firm Registration Number 469623, CAB Identifier DE0003 and ISSED# 3469A.

1.4 EUT (Equipment Under Test)

Test object:	PCI express Half mini card WLAN module
FCC ID: *	YG3-SXPCEAN2
IC: *	4720B-SXPCEAN2
HVIN:*	SX-PCEAN2

* declared by the applicant

1.5 Dedicated Host device Description

Test object:	WLAN Access Point and Client
Model / PMN: *	FL WLAN 2101
Order number: *	2702540
Serial number: *	N/A (Engineering sample)
PCB identifier: *	PW101650BX
Hardware version: *	03
Software version: *	fl_wlan_1100PQC_tx99.bin
Software version (Final Version): *	1.00

* declared by the applicant

1.7 Technical data of equipment

Fulfills WLAN specification: *	IEEE, 802.11b, 802.11g, 802.11a, 802.11n HT20 + HT40,					
Antenna type: *	2JZ0102 (EUT ant port 0) 2JZ0102 (EUT ant port 1)					
Antenna name: *	Directional antenna (EUT ant port 0) Omnidirectional antenna (EUT ant port 1)					
Antenna gain: *	5 dBi peak (EUT ant port 0) 2 dBi peak (EUT ant port 1) 3.8 dBi (Directional gain with ant. Port 0&1 combined – calculated according to ANSI C63.10 clause 14.4.3.2.4 b)					
Highest / lowest E.I.R.P.: **	19.7 dB @ 5300 MHz / 14.0 dBm @ 5700 MHz					
Antenna connector: *	U-FL (50 Ohms)					
Power supply:	DC					
Supply voltage Evaluation Board:	U _{nom} =	24.0 V DC	U _{min} =	18.0 V DC	U _{max} =	32.0 V DC
Power supply:	DC					
Supply voltage WLAN module:	U _{nom} =	3.3 V DC	U _{min} =	2.805 V DC	U _{max} =	3.795 V DC
Type of modulation: *	802.11b: DSSS 802.11g: OFDM 802.11a: OFDM 802.11n: OFDM					
Operating frequency range:*	2412 MHz to 2462 MHz, 5180 MHz to 5240 MHz, 5260 MHz to 5320 MHz, 5500 MHz to 5700 MHz, 5745 to 5825 MHz					
Number of channels: *	32 (802.11 b/g/n20), 16 (802.11 n40)					
Temperature range: *	-40 °C to 60 °C					
Lowest / highest internal clock frequency: *	32 kHz / 5825 MHz					
TPC: *	Not implemented (EIRP < 200 mW)					
Time required to complete power on cycle:	40 s					
DFS operation mode: *	DFS master					

* declared by the applicant

** refer to test report F161629E2 for further details

The manufacturer declares that information regarding the parameters of the detected Radar Waveforms is not available to the end user.

5.15 - 5.25 GHz band (Non-DFS-band)

Channel 36	RX:	5180 MHz	TX:	5180 MHz
Channel 40	RX:	5200 MHz	TX:	5200 MHz
Channel 44	RX:	5220 MHz	TX:	5220 MHz
Channel 48	RX:	5240 MHz	TX:	5240 MHz

5.25 - 5.35 GHz band

Channel 52	RX:	5260 MHz	TX:	5260 MHz
Channel 56	RX:	5280 MHz	TX:	5280 MHz
Channel 60	RX:	5300 MHz	TX:	5300 MHz
Channel 64	RX:	5320 MHz	TX:	5320 MHz

5.47 - 5.725 GHz band

Channel 100	RX:	5500 MHz	TX:	5500 MHz
Channel 104	RX:	5520 MHz	TX:	5520 MHz
Channel 108	RX:	5540 MHz	TX:	5540 MHz
Channel 112	RX:	5560 MHz	TX:	5560 MHz
Channel 116	RX:	5580 MHz	TX:	5580 MHz
Channel 120	RX:	5600 MHz	TX:	5600 MHz
Channel 124	RX:	5620 MHz	TX:	5620 MHz
Channel 128	RX:	5640 MHz	TX:	5640 MHz
Channel 132	RX:	5660 MHz	TX:	5660 MHz
Channel 136	RX:	5680 MHz	TX:	5680 MHz
Channel 140	RX:	5700 MHz	TX:	5700 MHz

The grey-marked channels are not supported by the EUT.

5.745 - 5.825 GHz band (Non-DFS-band)

Channel 149	RX:	5745 MHz	TX:	5745 MHz
Channel 153	RX:	5765 MHz	TX:	5765 MHz
Channel 157	RX:	5785 MHz	TX:	5785 MHz
Channel 161	RX:	5805 MHz	TX:	5805 MHz
Channel 165	RX:	5825 MHz	TX:	5825 MHz

1.8 Ancillary equipment

Provided by the applicant:

- Serial interface to USB connector

Provided by Phoenix Testlab

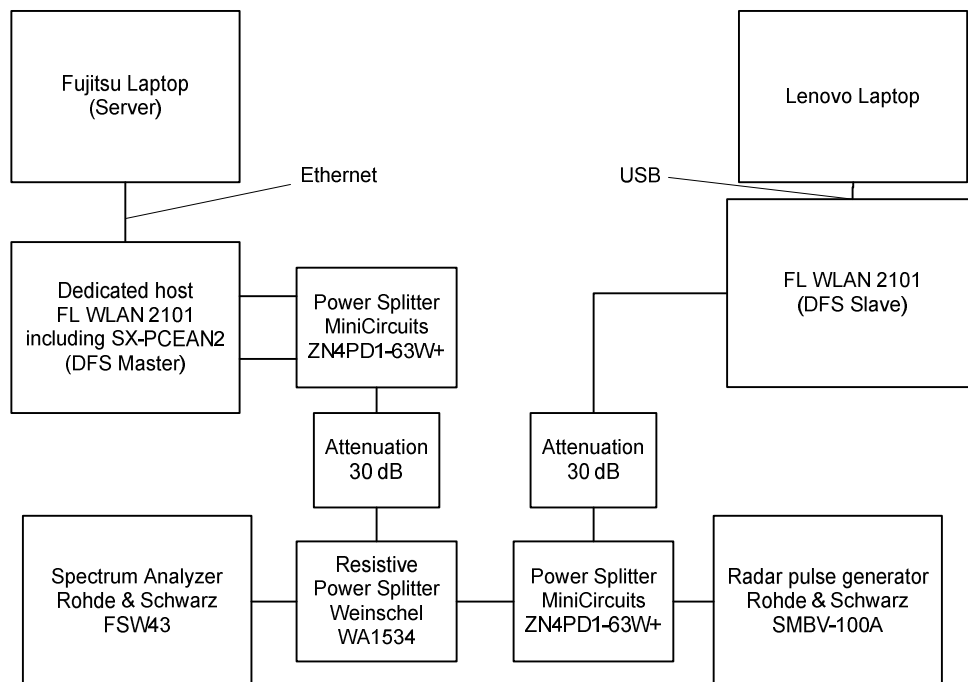
- MINI-PS-100-240AC/24DC/1.3
- Laptop Fujitsu E7800
- Laptop Lenovo X201T

1.9 Dates

Date of receipt of test sample:	25.08.2016
Start of test:	07.11.2016
Finish of test:	22.11.2016

2 Operational states

The EUT is an industrial Wireless LAN access point working in the 5 GHz U-NII band. The measurements were carried out according to the setup shown in the drawing below. The traffic was generated streaming a test video from the master to an associated client device. The EUT was set to operate in MIMO-mode. The attenuation of the test setup was adjusted to reach the DFS detection threshold of -64 dBm at the antenna ports of the EUT.



3 Additional information

None.

4 Test overview and DFS parameters

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section [1]	Status	Refer page
Dynamic Frequency Selection (DFS)	5250 – 5350 5470 – 5725	15.407 (h) (2)	Passed	20 et seq

4.1 Test frequencies

One frequency will be chosen from the operating channels of the EUT within the 5250 - 5350 MHz or 5470 - 5725 MHz bands.

4.2 Applicability of DFS requirements Prior to Use of a Channel

Requirement	Operational mode		
	Master	Client Without Radar Detection	Client With Radar Detection
Non-Occupancy Period	Yes	Not required*	Yes
DFS Detection Threshold	Yes	Not required	Yes
Channel Availability Check Time	Yes	Not required	Not required
U-NII Detection Bandwidth	Yes	Not required	Yes

4.3 Applicability of DFS requirements during normal operation

Requirement	Operational mode	
	Master Device or Client with Radar Detection	Client Without Radar Detection
DFS Detection Threshold	Yes	Not required
Channel Closing Transmission Time	Yes	Yes
Channel Move Time	Yes	Yes
U-NII Detection Bandwidth	Yes	Not required

Additional requirements for devices multiple bandwidth modes	Master Device or Client with Radar Detection	Client Without Radar Detection
U-NII Detection Bandwidth and Statistical Performance Check	All BW modes must be tested	Not required
Channel Move Time and Channel Closing Transmission Time	Test using widest BW mode available	Test using the widest BW mode available for the link
All other tests	Any single BW mode	Not required

Note: Frequencies selected for statistical performance check (Section 7.8.4) [2] should include several frequencies within the radar detection bandwidth and frequencies near the edge of the radar detection bandwidth. For 802.11 devices it is suggested to select frequencies in each of the bonded 20 MHz channels and the channel center frequency.

4.4 DFS detection thresholds for master devices and client devices with radar detection

Maximum transmit power	Value (see Notes 1 and 2)
EIRP \geq 200 milliwatt	-64 dBm
EIRP < 200 milliwatt and power spectral density < 10 dBm/MHz	-62 dBm
EIRP < 200 milliwatt that do not meet the power spectral density requirement	-64 dBm
<p>Note 1: This is the level at the input of the receiver assuming a 0 dBi receive antenna.</p> <p>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.</p> <p>Note 3: EIRP is based on the highest antenna gain. For MIMO devices refer to KDB Publication 662911 D01.</p>	

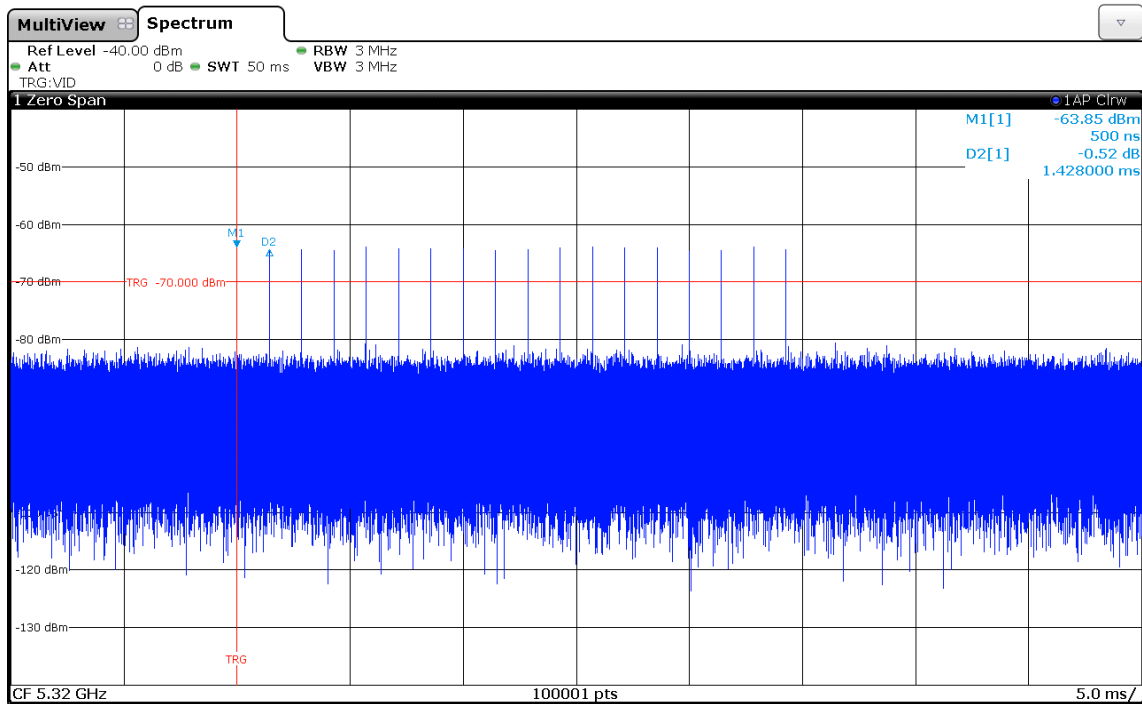
4.5 DFS response requirement values

Parameter	Value
Non-Occupancy Period	Minimum 30 minutes
Channel Availability Check Time	60 s
Channel Move Time	10 s See Note 1
Channel Closing Transmission Time	200 ms + an aggregate of 60 ms over remaining 10 s period See Notes 1 and 2
U-NII Detection Bandwidth	Minimum 100% of the U-NII 99% transmission power bandwidth. See Note 3.
<p>Note 1: Channel Move Time and the Channel Closing Transmission Time should be performed with Radar Type 0. The measurement timing begins at the end of the Radar Type 0 burst.</p> <p>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 to facilitate 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.</p> <p>Note 3: During the U-NII Detection Bandwidth detection test, radar type 0 should be used. For each frequency step the minimum percentage of detection is 90 percent. Measurements are performed with no data traffic.</p>	

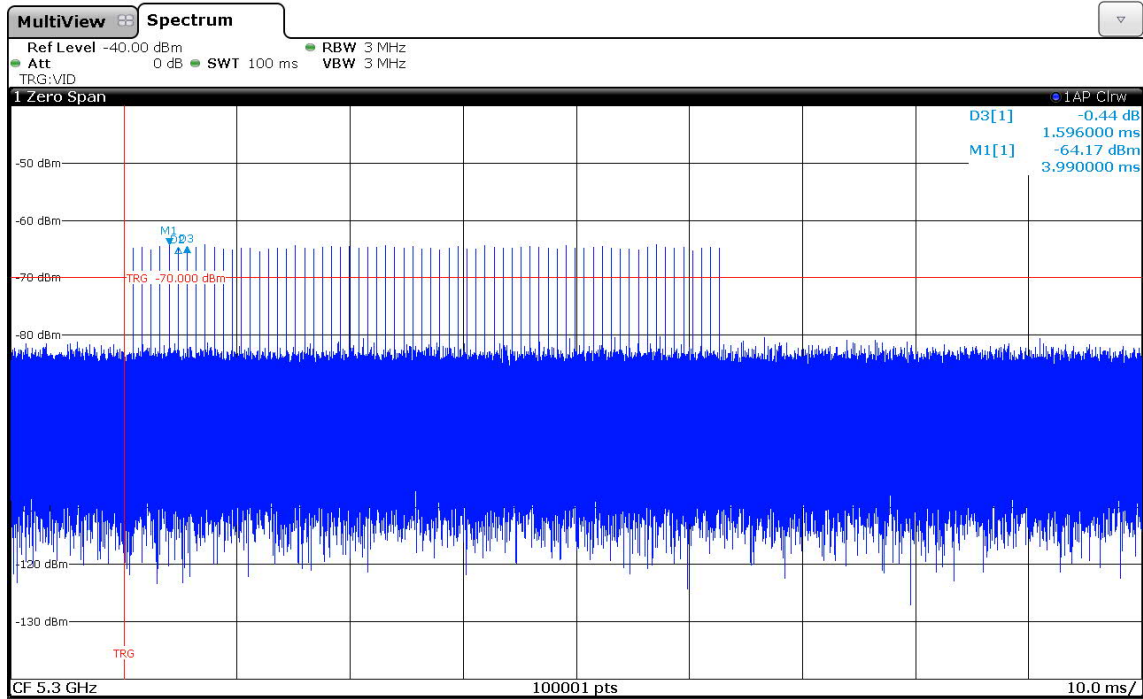
4.6 Radar test waveforms

The parameters of short pulse radar waveforms, long pulse radar waveforms as well as frequency hopping radar waveforms are described in chapter 6 of [2]. Examples of each generated radar type 0 to 6 are shown in the following.

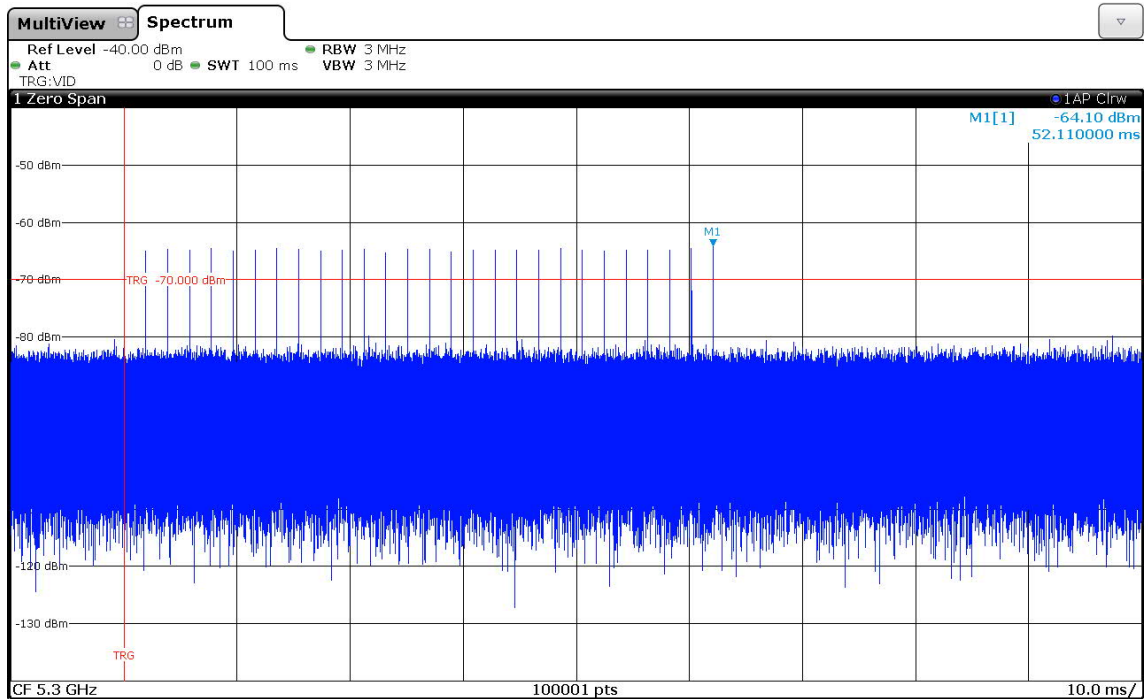
Radar type 0 at 5.3 GHz (detection threshold calibration plot)



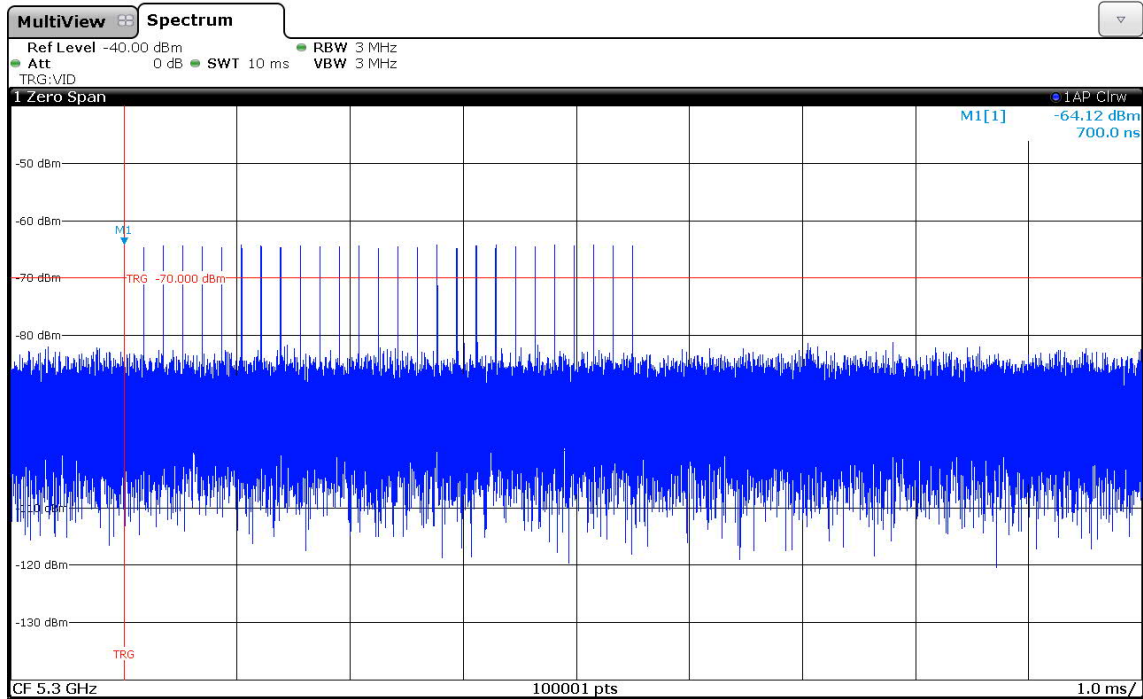
Radar type 1A at 5.3 GHz (detection threshold calibration plot)



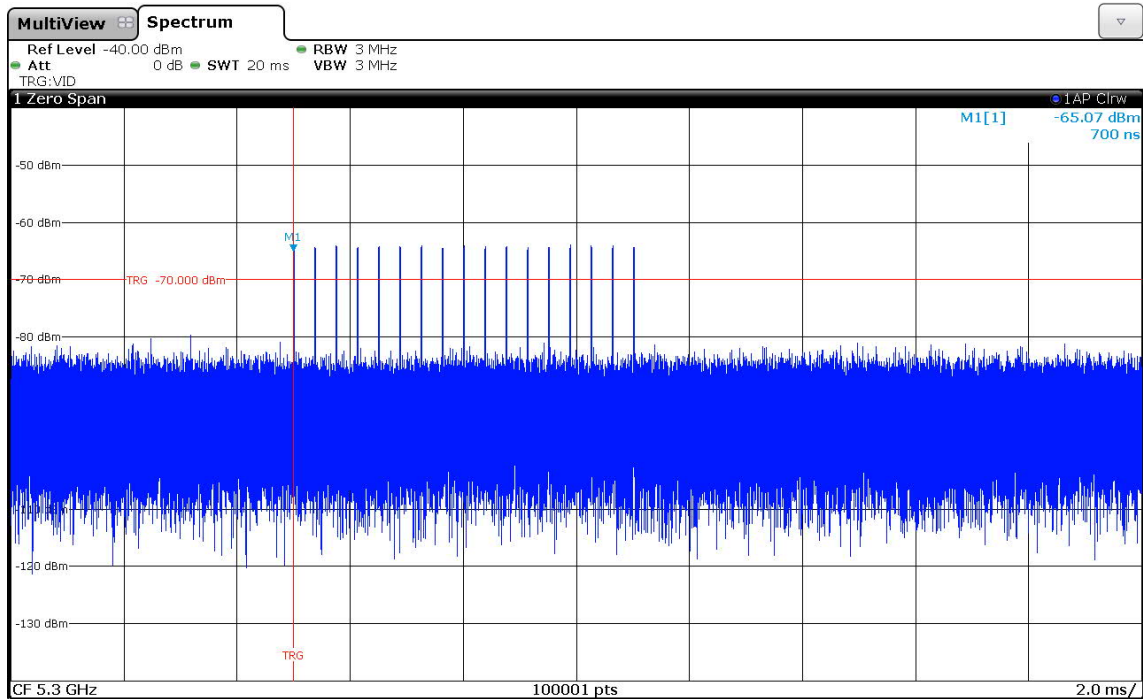
Radar type 1B at 5.3 GHz (detection threshold calibration plot)



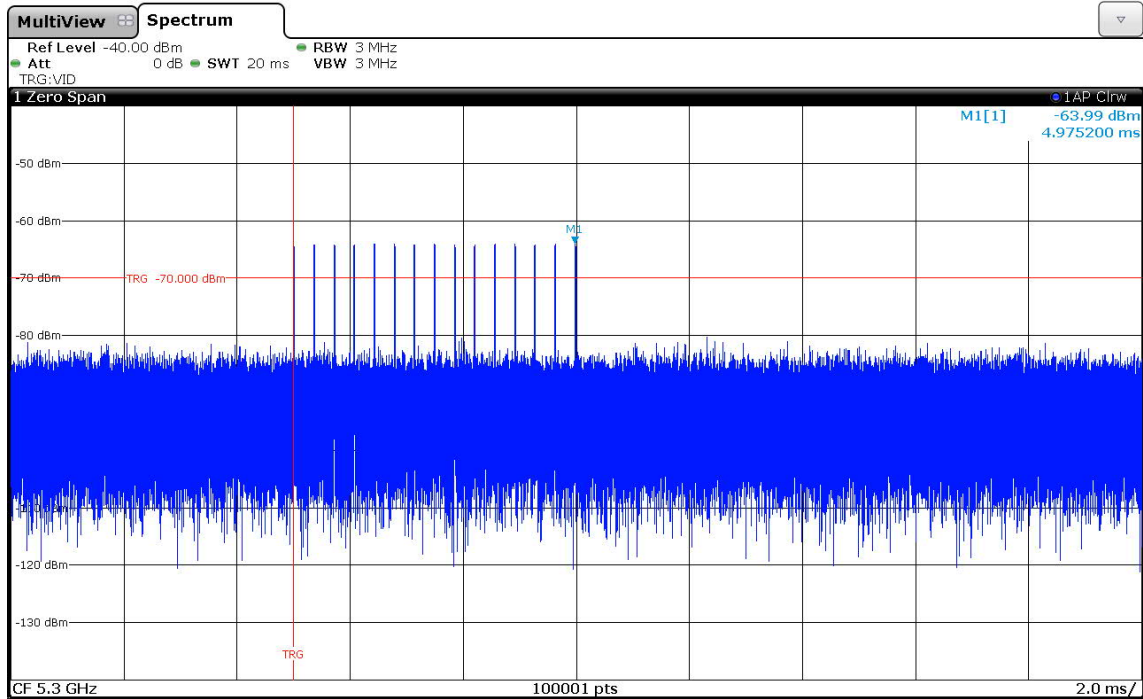
Radar type 2 at 5.3 GHz (detection threshold calibration plot)



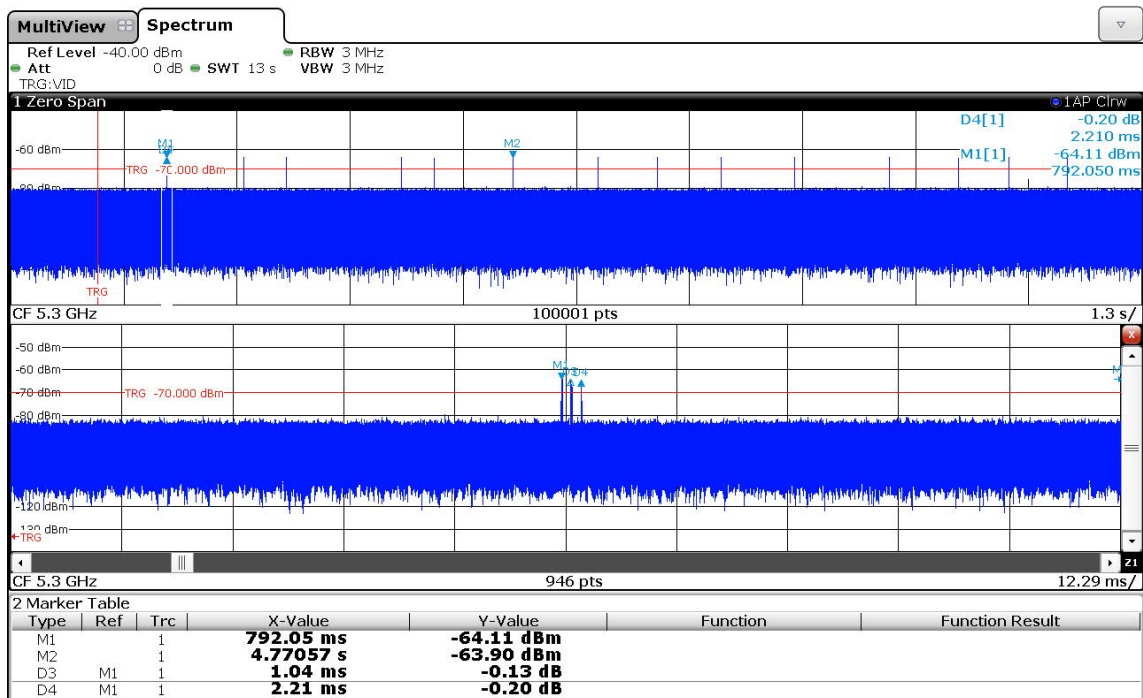
Radar type 3 at 5.3 GHz (detection threshold calibration plot)



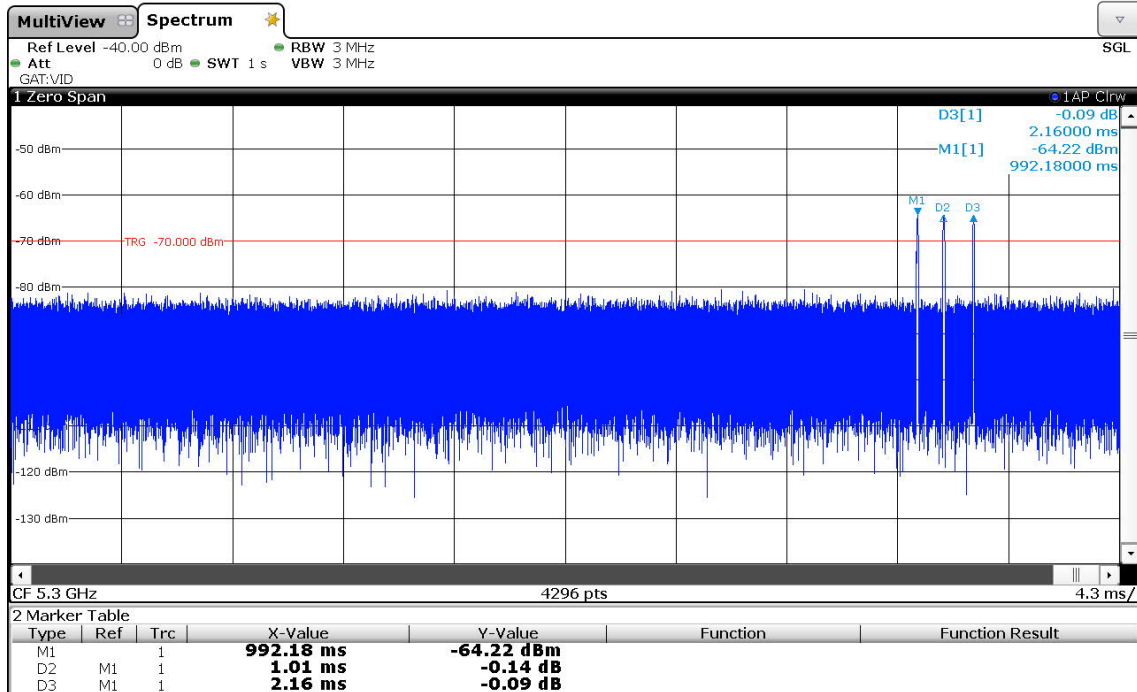
Radar type 4 at 5.3 GHz (detection threshold calibration plot)



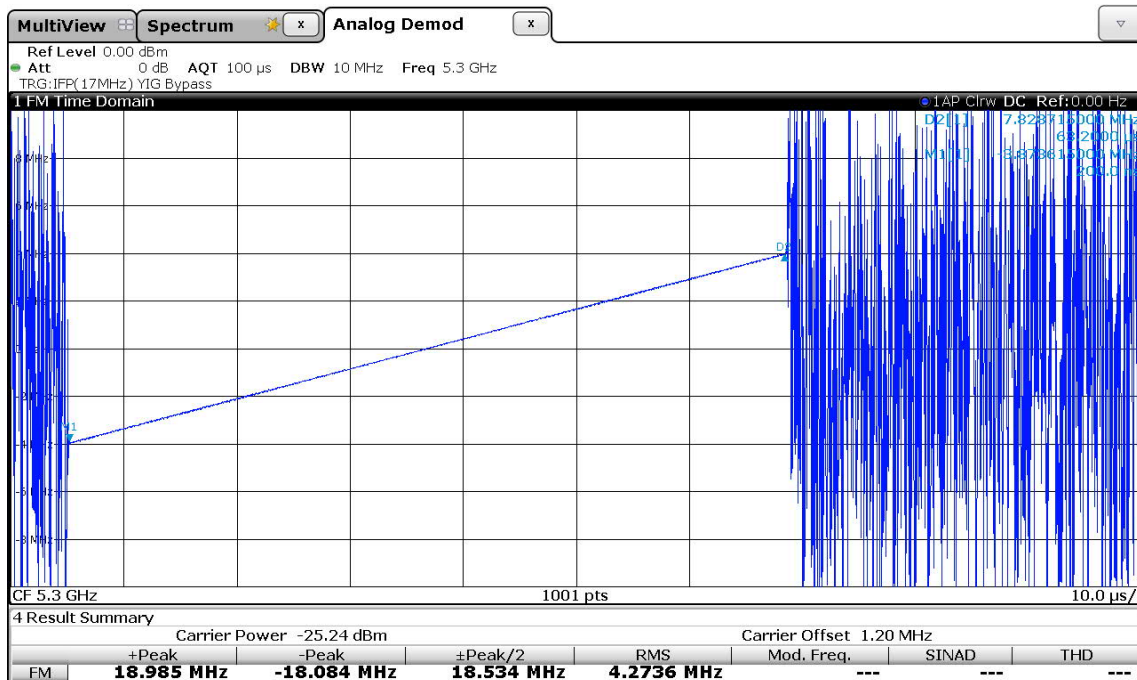
Radar type 5 at 5.3 GHz (overall view and zoom to one burst / detection threshold calibration plot)



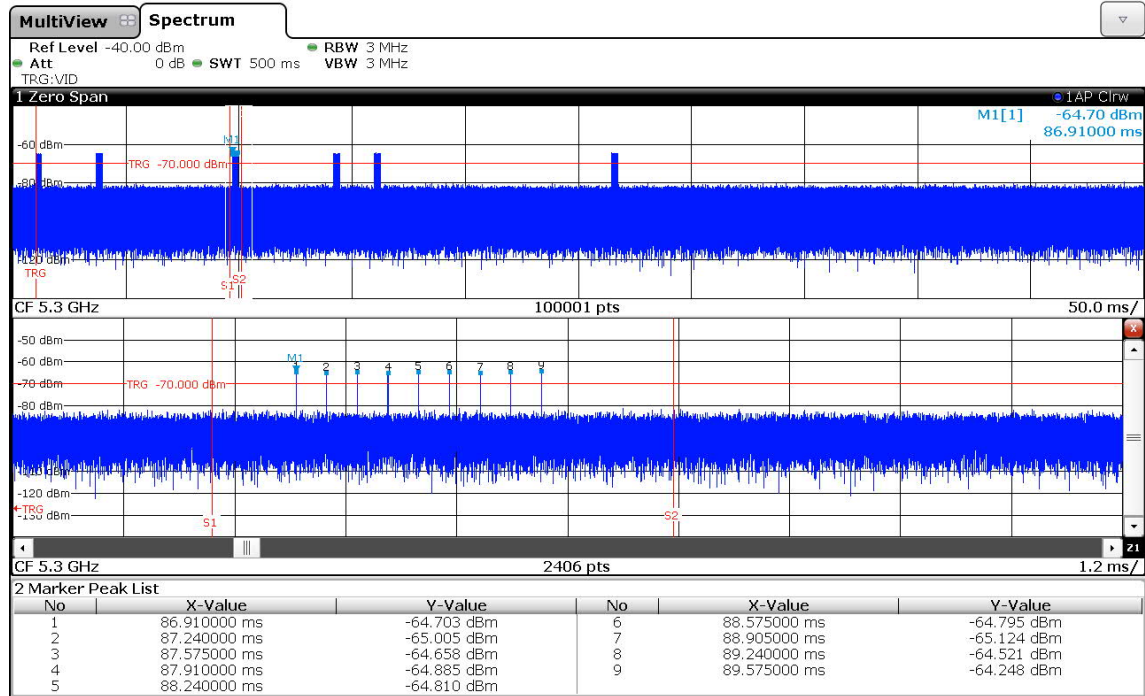
Radar type 5 at 5.3 GHz (Burst with 3 pulses)



Radar type 5 at 5.3 GHz (Demodulation of one chirp pulse)

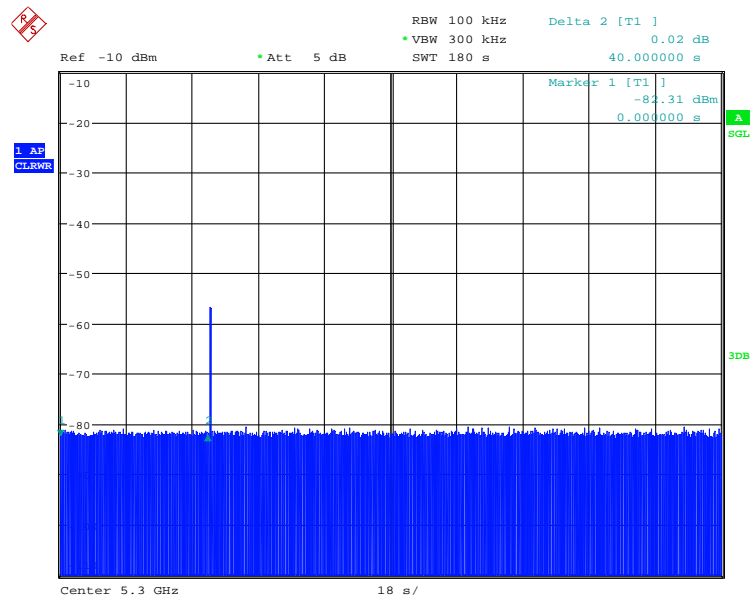


Radar type 6 at 5.3 GHz (detection threshold calibration plot)

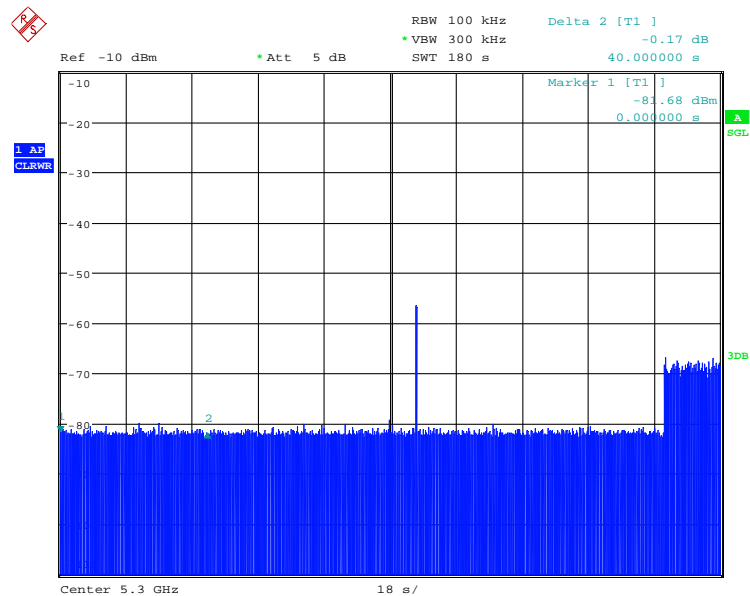


4.7 Timing plots

Timing plot with radar type 0 at 5.3 GHz according to [2] 8.3 f) 1)



Timing plot with radar type 0 at 5.3 GHz according to [2] 8.3 f) 2)

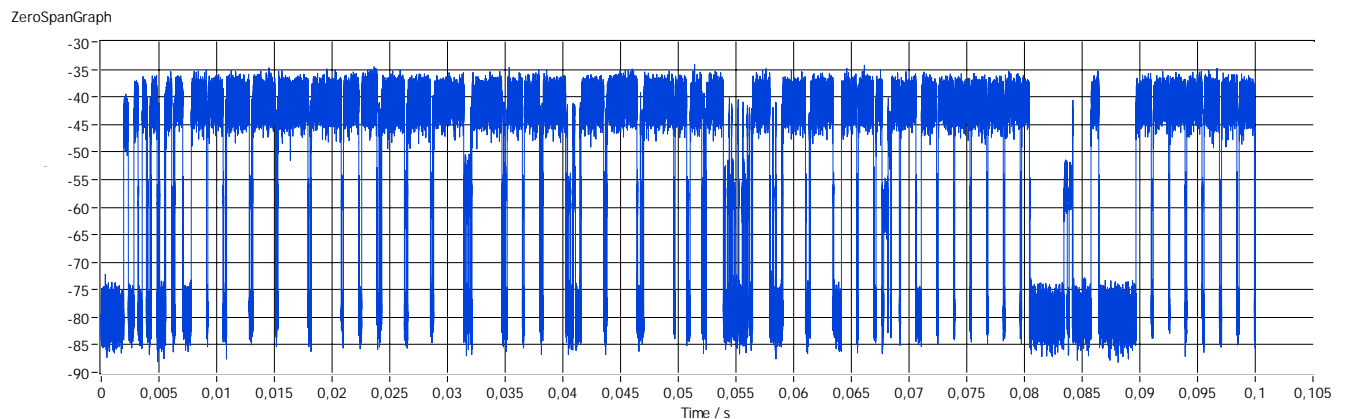


4.8 Channel loading

System testing will be performed with channel-loading using means appropriate to the data types that are used by the unlicensed device. The following requirements apply:

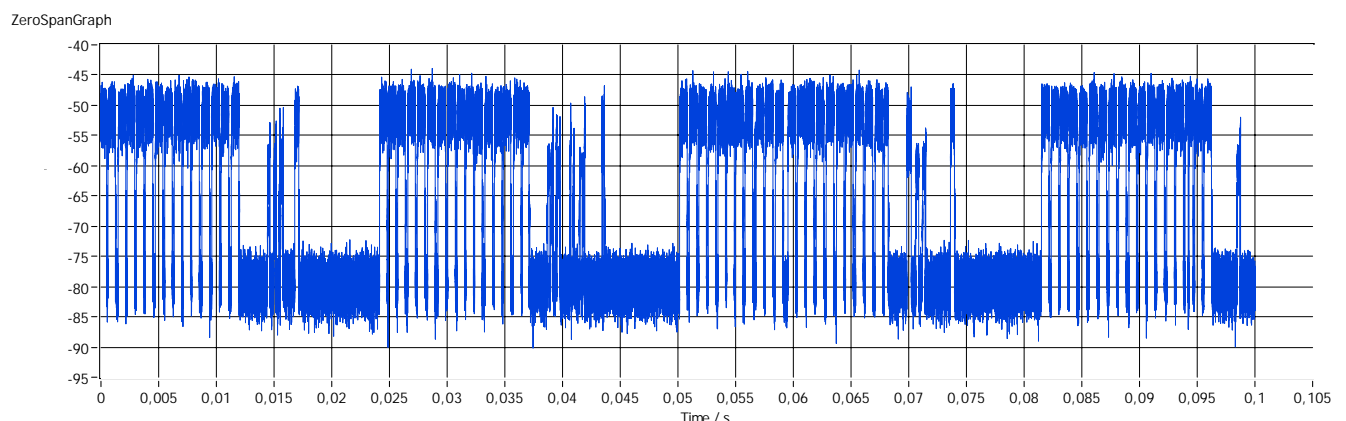
- The data file must be of a type that is typical for the device (i.e., MPEG-2, MPEG-4, WAV, MP3, MP4, AVI, etc.) and must generally be transmitting in a streaming mode.
- Software to ping the client is permitted to simulate data transfer but must have random ping intervals.
- Timing plots are required with calculations demonstrating a minimum channel loading of approximately 17% or greater. For example, channel loading can be estimated by setting the spectrum analyzer for zero span and approximate the Time On / (Time On + Off Time). This can be done with any appropriate channel BW and modulation type.
- Unicast or Multicast protocols are preferable but other protocols may be used. The appropriate protocol used must be described in the test procedures.

Channel loading in N20 mode:



$$\text{Channel load} = \frac{\text{Time on}}{(\text{Time on} + \text{Off Time})} = \frac{26.64 \text{ ms}}{100 \text{ ms}} = 0.2664 \xrightarrow{\text{yields}} 26.6 \%$$

Channel loading in N40 mode:



$$\text{Channel load} = \frac{\text{Time on}}{(\text{Time on} + \text{Off Time})} = \frac{31.98 \text{ ms}}{100 \text{ ms}} = 0.3198 \xrightarrow{\text{yields}} 32 \%$$

5 Test results

5.1 U-NII Detection Bandwidth

subclause 7.8.1 [2]

5.1.1 Measurement with nominal 20 MHz channel bandwidth

WLAN channel 60, Nominal Channel BW: 20 MHz, Radar type 0, Detection threshold: -64 dBm			
Radar frequency [MHz]	Successful Trials of 10	Detection rate [%]	Result [passed if Detection rate > 90 %]
5285	0	0	---
5286	0	0	---
5287	1	10	---
5288	7	70	---
5289	10	100	✓ (f _L = 5289 MHz)
5290	10	100	✓
5295	10	100	✓
5300	10	100	✓
5305	10	100	✓
5310	10	100	✓
5311	9	90	✓ (f _H = 5311 MHz)
5312	7	70	---
5313	4	40	---
5314	0	0	---
5315	0	0	---
Detection Bandwidth: f _H - f _L = 22 MHz			
Detection Bandwidth > 99 % Bandwidth (19.64 MHz): Passed			

WLAN channel 132, Nominal Channel BW: 20 MHz, Radar type 0, Detection threshold: -64 dBm			
Radar frequency [MHz]	Successful Trials of 10	Detection rate [%]	Result [passed if Detection rate > 90 %]
5575	0	0	---
5574	1	10	---
5573	3	30	---
5572	6	60	---
5571	10	100	✓ (f _L = 5571 MHz)
5570	10	100	✓
5565	10	100	✓
5560	10	100	✓
5555	10	100	✓
5550	10	100	✓ (f _H = 5500 MHz)
5549	8	80	---
5548	7	70	---
5547	1	10	---
5546	0	0	---
5545	0	0	---
Detection Bandwidth: f _H - f _L = 21 MHz			
Detection Bandwidth > 99 % Bandwidth (19.5 MHz): Passed			

5.1.2 Measurement with nominal 40 MHz channel bandwidth

WLAN channel 54, Nominal Channel BW: 20 MHz, Radar type 0, Detection threshold: -64 dBm			
Radar frequency [MHz]	Successful Trials of 10	Detection rate [%]	Result [passed if Detection rate > 90 %]
5245	0	0	---
5246	0	0	---
5247	0	0	---
5248	0	0	---
5249	0	0	---
5250	10	100	✓ (f _L = 5250 MHz)
5255	10	100	✓
5260	10	100	✓
5265	10	100	✓
5270	10	100	✓
5275	10	100	✓
5280	10	100	✓
5690	10	100	✓ (f _H = 5290 MHz)
5291	0	0	---
5292	0	0	---
5293	0	0	---
5294	0	0	---
5295	0	0	---
Detection Bandwidth: f _H - f _L = 40 MHz			
Detection Bandwidth > 99 % Bandwidth (37.72): Passed			

WLAN channel 134, Nominal Channel BW: 20 MHz, Radar type 0, Detection threshold: -64 dBm			
Radar frequency [MHz]	Successful Trials of 10	Detection rate [%]	Result [passed if Detection rate > 90 %]
5645	0	0	---
5646	0	0	---
5647	0	0	---
5648	0	0	---
5649	0	0	---
5650	10	100	✓ (f _L = 5650 MHz)
5655	10	100	✓
5660	10	100	✓
5665	10	100	✓
5670	10	100	✓
5675	10	100	✓
5680	10	100	✓
5690	10	100	✓ (f _H = 5690 MHz)
5691	0	0	---
5692	0	0	---
5693	0	0	---
5694	0	0	---
5695	0	0	---
Detection Bandwidth: f _H - f _L = 40 MHz			
Detection Bandwidth > 99 % Bandwidth (37.74 MHz): Passed			

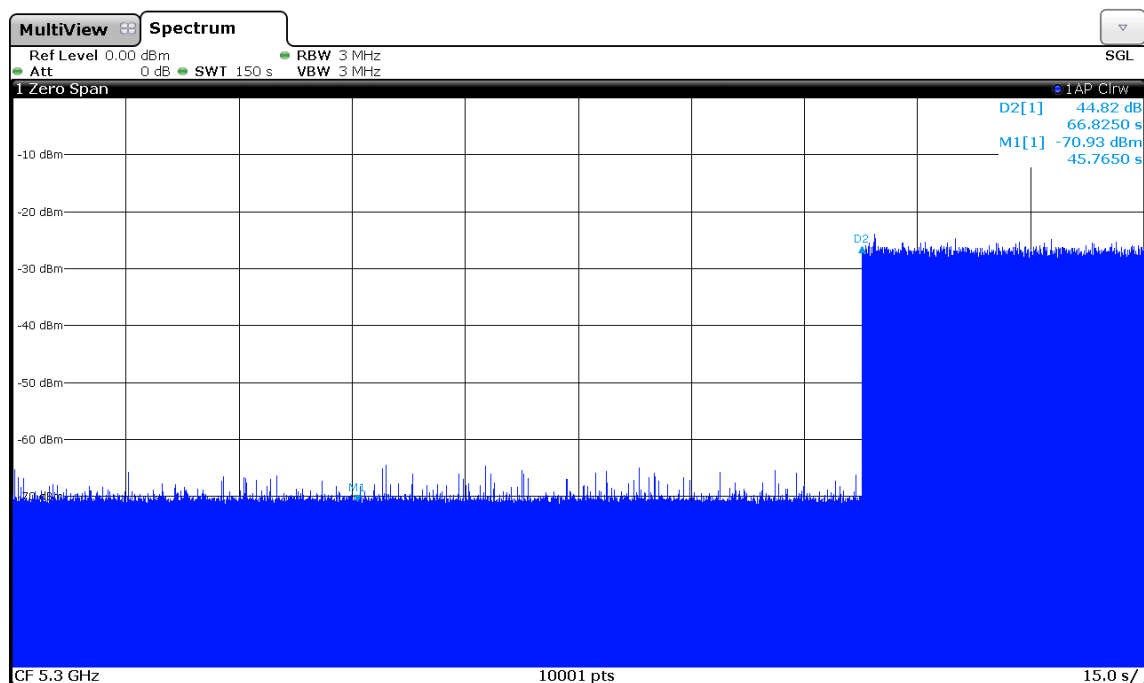
5.2 Performance Requirements Check

subclause 7.8.2 [2]

The following tests must be performed for U-NII device certification: Initial Channel Startup Check with a radar Burst at start of Channel Availability Check and with a radar Burst at end of Channel Availability Check; In-Service Monitoring; and the 30 minute Non-Occupancy Period.

5.2.1 Initial Channel Availability Check Time

subclause 7.8.2.1 [2]



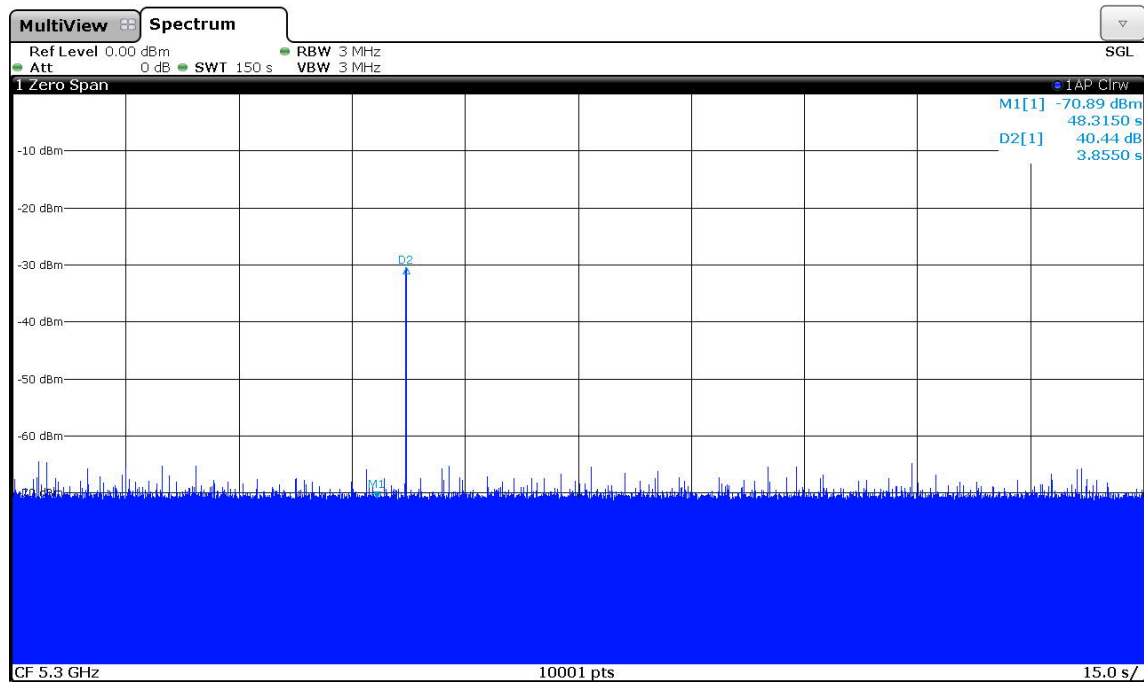
The UUT transmits no beacon or data transmissions until at least 1 minute after the completion of the power-on cycle.

Test result: Passed.

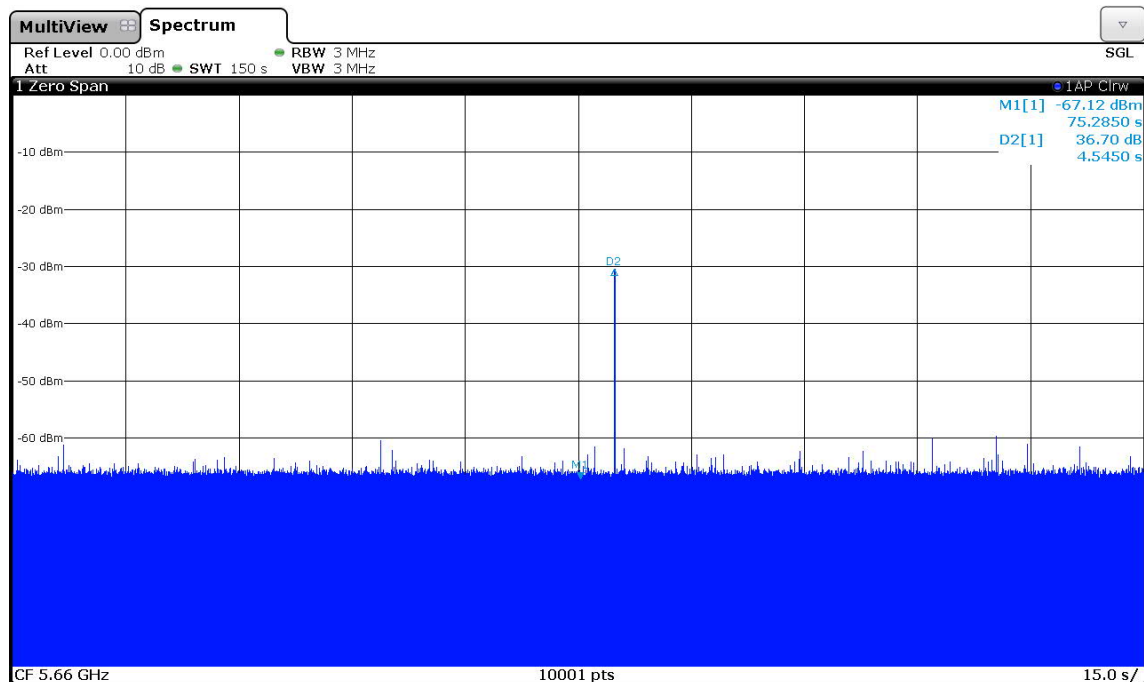
5.2.2 Radar Burst at the Beginning of the Channel Availability Check Time

subclause 7.8.2.2 [2]

Radar_Beginning_CAC_5300M_BW20_FCC.png



Radar_Beginning_CAC_5660M_BW40_FCC.png



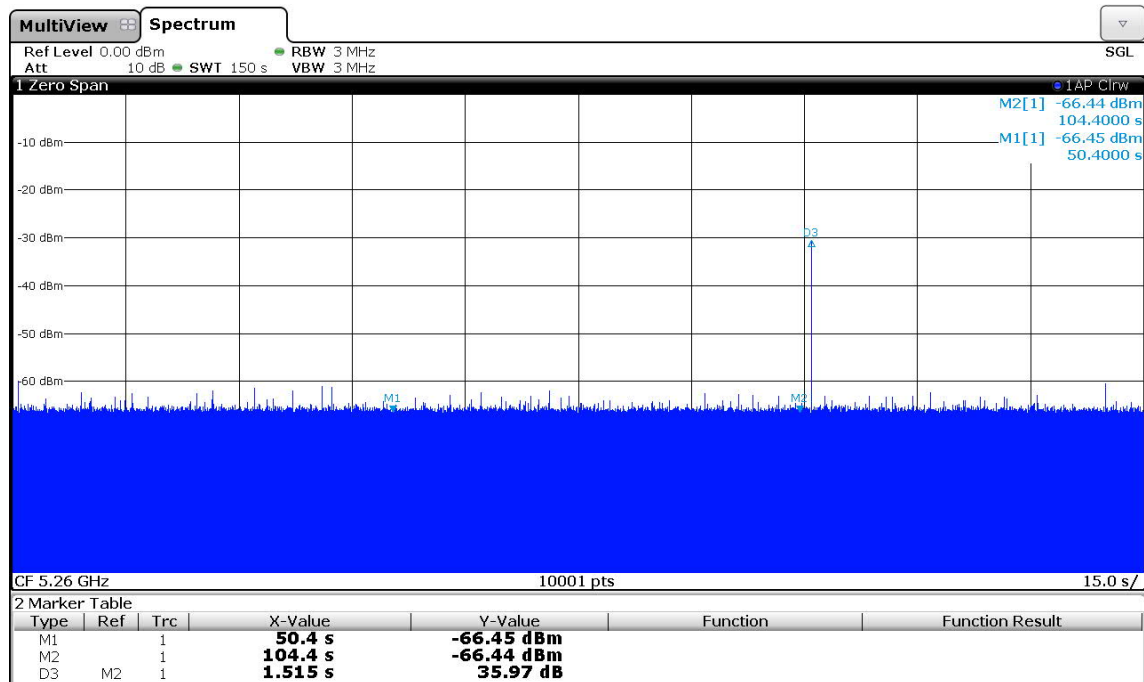
During the 2.5 minute measurement window no UUT transmissions occurred on Ch.

Test result: Passed.

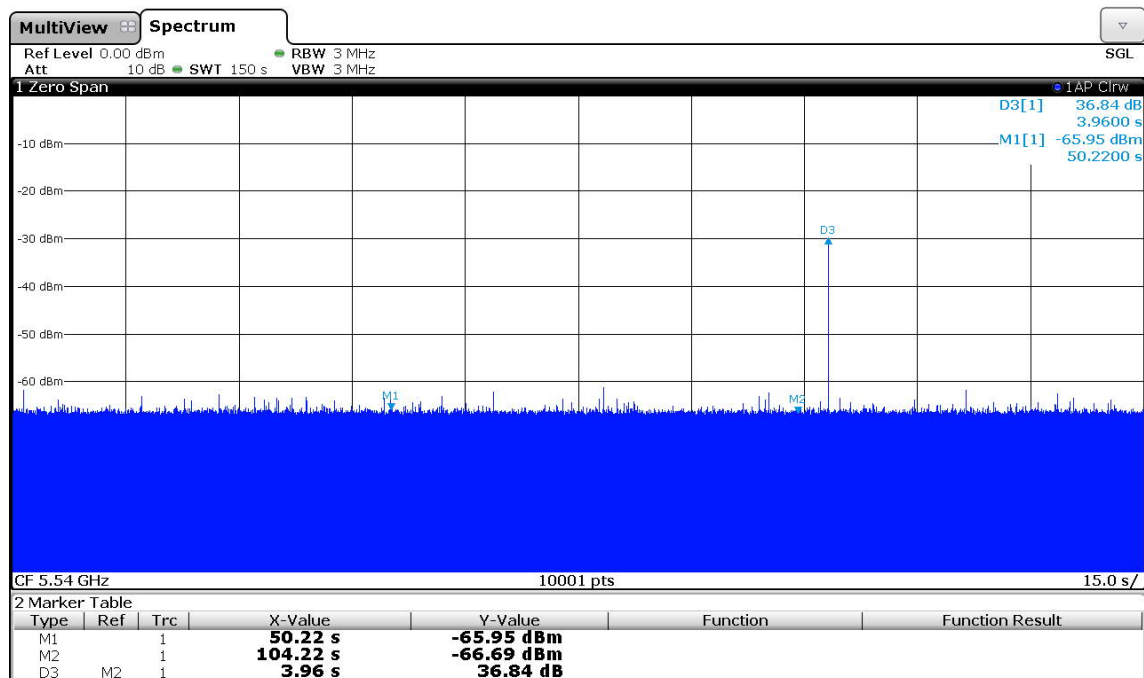
5.2.3 Radar Burst at the End of the Channel Availability Check Time

subclause 7.8.2.3 [2]

Radar_End_CAC_5260M_BW20_FCC.png



Radar_End_CAC_5500M_BW40_FCC.png



During the 2.5 minute measurement window no UUT transmissions occurred on Ch.

Test result: Passed.

5.3 In-Service Monitoring

subclause 7.8.3 [2]

5.3.1 Channel Shutdown, Channel Move Time and Non-Occupancy period

The measurement procedure and limits are described in clause 7.8.3 [2].

Operation mode: EUT is in continuous transmission mode with specified test transmission load generated by specific load data (minimum 17 % channel load) from the master to the slave. After the radar event the master initiates the *Channel Shutdown* process given in the table below:

Channel Shutdown	Channel Closing Transmission Time	200 ms + 60 ms*
	Channel Move Time	10 s
Non-Occupancy period		30 min

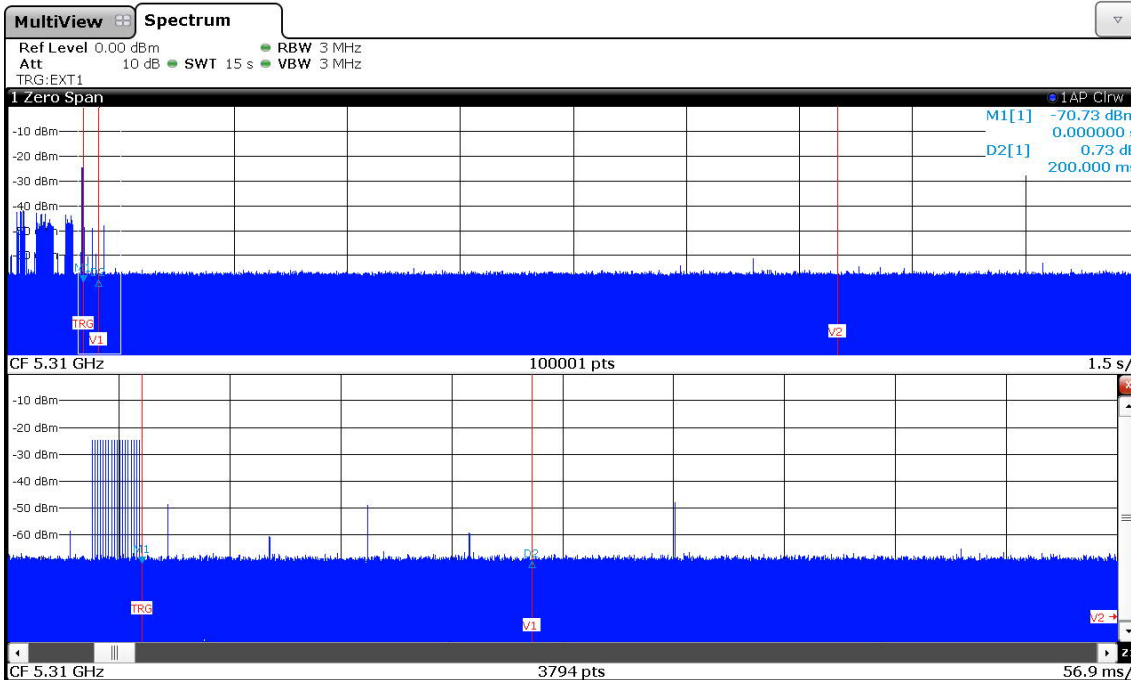
* see chapter 4.3, note 2

The following table and measurement plots show the results of the *Channel Shutdown*.

Measurement result Channel Shutdown	
Master and slave connected, data traffic active / Radar detection threshold level: -64 dBm	
Radar pulse	Radar type 0
Operating frequency	5 310 MHz
Channel bandwidth	20 MHz
Channel closing time	< 200 ms
Channel move time	< 10 s
Measurement uncertainty: < 10 %	

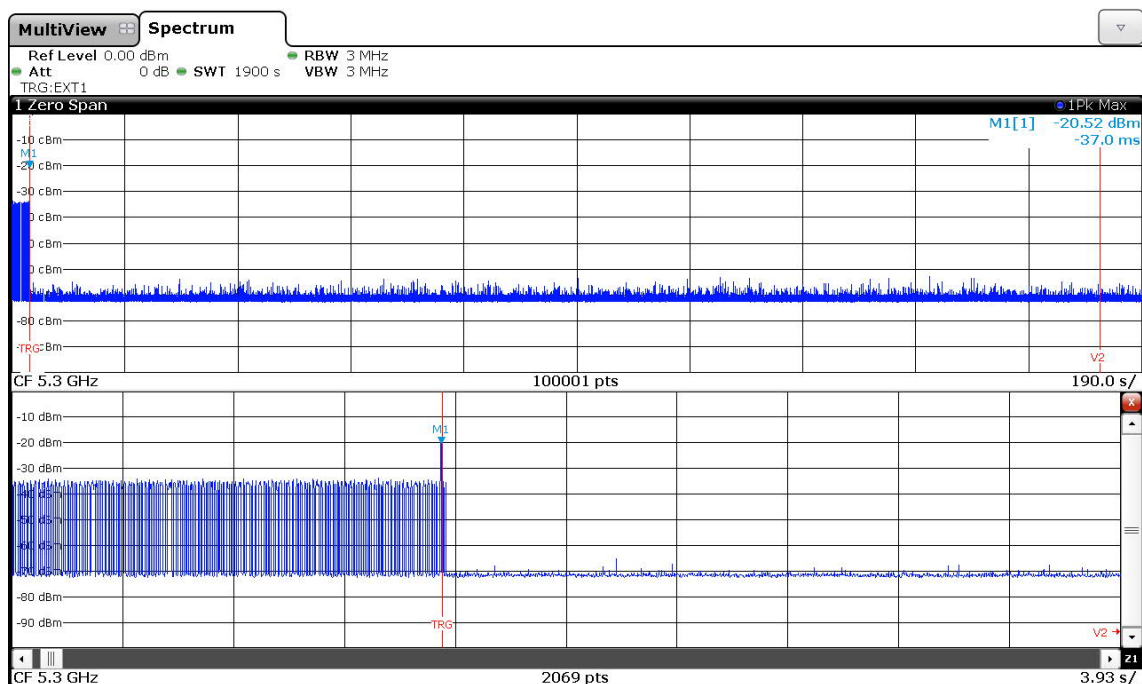
Measurement result Non-Occupancy period	
Master and slave connected, data traffic active / Radar detection threshold level: -64 dBm	
Radar pulse	Radar type 0
Operating frequency	5 300 MHz
Non occupancy period	> 30 min
Measurement uncertainty: < 10 %	

Channel closing transmission and move time at 5310 MHz after type 0 radar event



The beacons after the channel closing transmission time of 200 ms are additional intermittent control signals caused by the master (See Note 2 in 4.5).

Non occupancy period at 5300 MHz after type 0 radar event



5.4 Statistical Performance Check

subclause 7.8.4 [2]

5.4.1 Short Pulse Radar Test

subclause 7.8.4.1 [2]

5.3 GHz, 20 MHz channel bandwidth

RADAR TYPE 1				
Trial #	Number of Pulses per Burst	Pulse Width (µsec)	PRI (µs)	Detection (yes/no)
1	67	1	798	✓
2	74	1	718	✓
3	57	1	938	✓
4	59	1	898	✓
5	95	1	558	---
6	78	1	678	✓
7	86	1	618	✓
8	63	1	838	✓
9	65	1	818	✓
10	81	1	658	---
11	76	1	698	✓
12	98	1	538	✓
13	92	1	578	✓
14	102	1	518	✓
15	68	1	778	✓
16	28	1	1930	✓
17	48	1	1114	✓
18	20	1	2718	✓
19	35	1	1510	✓
20	26	1	2086	✓
21	33	1	1639	✓
22	57	1	929	---
23	20	1	2686	✓
24	27	1	2026	---
25	24	1	2209	✓
26	26	1	2074	✓
27	88	1	602	✓
28	35	1	1508	✓
29	42	1	1279	✓
30	91	1	584	✓
Successful detection: 86.67 %				

Requirement: Minimum percentage of successful detection: 60 %

5.67 GHz, 40 MHz channel bandwidth

RADAR TYPE 1				
Trial #	Number of Pulses per Burst	Pulse Width (µsec)	PRI (µs)	Detection (yes/no)
1	70	1	758	✓
2	76	1	698	✓
3	81	1	658	✓
4	65	1	818	✓
5	57	1	938	✓
6	95	1	558	✓
7	72	1	738	✓
8	98	1	538	✓
9	86	1	618	✓
10	74	1	718	✓
11	63	1	838	✓
12	89	1	598	✓
13	62	1	858	✓
14	78	1	678	✓
15	58	1	918	✓
16	29	1	1850	✓
17	32	1	1692	✓
18	24	1	2218	✓
19	22	1	2482	✓
20	22	1	2497	✓
21	54	1	994	✓
22	25	1	2124	✓
23	89	1	593	✓
24	50	1	1065	✓
25	35	1	1506	✓
26	22	1	2450	✓
27	19	1	2842	✓
28	26	1	2060	✓
29	21	1	2619	✓
30	49	1	1097	✓
Successful detection: 100 %				

Requirement: Minimum percentage of successful detection: 60 %

5.3 GHz, 20 MHz channel bandwidth

RADAR TYPE 2				
Trial #	Number of Pulses per Burst	Pulse Width (µsec)	PRI (µs)	Detection (yes/no)
1	25	2.1	156	✓
2	27	3.8	159	✓
3	26	1	159	---
4	25	3.3	179	✓
5	29	3.2	205	✓
6	29	1.9	162	✓
7	25	1.1	219	✓
8	26	3.4	159	✓
9	23	4.5	191	✓
10	24	4.5	215	✓
11	27	2.3	221	✓
12	26	2.9	204	✓
13	25	2.4	150	✓
14	24	4.6	216	✓
15	25	4.6	177	✓
16	23	4.3	159	---
17	27	3.7	153	✓
18	23	2.9	226	✓
19	28	4.7	168	✓
20	26	3.9	201	✓
21	29	2.1	178	✓
22	26	3	181	---
23	26	2.6	189	---
24	27	2.5	202	✓
25	27	1.8	207	✓
26	26	4.4	150	✓
27	25	1	176	✓
28	26	1.5	215	✓
29	23	4.8	164	✓
30	24	3.1	214	✓
Successful detection: 86.67 %				

Requirement: Minimum percentage of successful detection: 60 %

5.67 GHz, 40 MHz channel bandwidth

RADAR TYPE 2				
Trial #	Number of Pulses per Burst	Pulse Width (µsec)	PRI (µs)	Detection (yes/no)
1	28	1.8	166	✓
2	24	4.8	212	✓
3	29	3.8	176	✓
4	28	1	158	✓
5	24	4.9	212	✓
6	24	3.2	182	---
7	28	4.8	153	✓
8	26	2.9	160	✓
9	28	3.5	205	✓
10	25	5	202	✓
11	26	1.2	153	✓
12	25	2.2	185	---
13	27	4.7	158	✓
14	27	1.2	152	✓
15	28	4.1	187	✓
16	24	4	205	✓
17	24	1.5	190	✓
18	25	1	165	✓
19	24	2.5	170	✓
20	26	4	228	✓
21	27	4.1	226	✓
22	28	4.4	226	✓
23	26	2.7	230	✓
24	25	1.8	169	✓
25	23	1.9	180	✓
26	24	2.2	210	✓
27	27	4.2	215	---
28	27	3.6	209	✓
29	23	4.3	155	✓
30	25	4.7	187	✓
Successful detection: 90 %				

Requirement: Minimum percentage of successful detection: 60 %

5.3 GHz, 20 MHz channel bandwidth

RADAR TYPE 3				
Trial #	Number of Pulses per Burst	Pulse Width (µsec)	PRI (µs)	Detection (yes/no)
1	16	9.8	353	✓
2	18	6.8	490	✓
3	16	7.2	320	---
4	16	6	280	✓
5	17	6.1	270	✓
6	16	9.5	283	✓
7	17	8	348	---
8	17	8.3	232	✓
9	17	6.1	221	---
10	16	7	480	✓
11	16	8.8	369	✓
12	18	7.4	401	✓
13	17	9.8	407	✓
14	18	7.8	405	✓
15	18	7.5	292	✓
16	16	7	259	---
17	16	7.5	419	✓
18	17	9.3	256	✓
19	17	6.9	215	---
20	17	7.5	233	✓
21	18	6.2	397	✓
22	16	7.7	280	✓
23	16	9.6	271	✓
24	16	6.4	200	---
25	18	6.3	411	✓
26	17	6.9	335	✓
27	17	10	280	✓
28	16	8.1	402	✓
29	17	7.3	373	✓
30	18	8.7	404	✓
Successful detection: 80 %				

Requirement: Minimum percentage of successful detection: 60 %

5.67 GHz, 40 MHz channel bandwidth

RADAR TYPE 3				
Trial #	Number of Pulses per Burst	Pulse Width (µsec)	PRI (µs)	Detection (yes/no)
1	17	10	376	✓
2	17	6.1	474	✓
3	18	8.7	453	✓
4	18	9.7	448	✓
5	17	6.1	386	---
6	18	8.3	369	✓
7	17	6.3	227	✓
8	16	8	449	✓
9	17	8.8	327	✓
10	18	6.6	246	✓
11	17	7.3	423	✓
12	17	8.3	410	✓
13	17	6.6	468	✓
14	18	7.7	452	✓
15	18	9.1	470	✓
16	17	7.3	269	✓
17	17	7.6	347	✓
18	18	8.3	229	✓
19	17	9.8	459	✓
20	17	6.1	251	✓
21	16	7.8	234	✓
22	16	6.2	498	---
23	17	6.4	390	✓
24	18	9.6	436	✓
25	17	6.6	277	✓
26	16	6.3	231	✓
27	17	6.7	290	✓
28	17	9.4	384	✓
29	17	8.2	286	✓
30	17	9.6	409	✓
Successful detection: 93.33 %				

Requirement: Minimum percentage of successful detection: 60 %

5.3 GHz, 20 MHz channel bandwidth

RADAR TYPE 4				
Trial #	Number of Pulses per Burst	Pulse Width (µsec)	PRI (µs)	Detection (yes/no)
1	16	16.1	224	---
2	13	14.3	340	✓
3	13	16.9	489	✓
4	16	17.8	398	✓
5	15	14.6	303	✓
6	13	14.2	270	✓
7	13	17	327	✓
8	16	13.1	228	✓
9	14	17.7	332	✓
10	12	14.9	285	✓
11	16	18.1	228	✓
12	14	11.3	469	---
13	12	18	255	✓
14	14	17.9	246	✓
15	15	15.4	400	✓
16	15	19.7	224	✓
17	14	13	293	✓
18	14	14.8	472	---
19	14	11.7	246	✓
20	13	11.6	315	✓
21	12	12.8	473	---
22	16	13	312	✓
23	12	18.4	491	✓
24	14	15.5	225	---
25	15	13.2	317	✓
26	15	14.5	432	✓
27	14	17.4	268	✓
28	13	18.4	200	---
29	12	17.7	284	✓
30	12	12.4	443	✓
Successful detection: 80 %				

Requirement: Minimum percentage of successful detection: 60 %

5.67 GHz, 40 MHz channel bandwidth

RADAR TYPE 4				
Trial #	Number of Pulses per Burst	Pulse Width (µsec)	PRI (µs)	Detection (yes/no)
1	13	12.3	396	✓
2	16	13.3	430	✓
3	16	11.7	448	✓
4	12	15.1	458	✓
5	16	13.1	455	✓
6	16	18.5	263	✓
7	13	17.4	322	✓
8	14	12.2	446	✓
9	16	13.8	381	✓
10	14	14.7	343	✓
11	15	15.9	228	✓
12	15	19.8	303	✓
13	13	11.8	291	✓
14	12	18.2	282	✓
15	13	14.4	218	✓
16	14	11.5	233	---
17	15	14.3	450	✓
18	14	17.1	320	✓
19	14	15.2	255	✓
20	14	16.2	487	✓
21	14	13.6	290	✓
22	14	13.9	423	✓
23	15	15.5	270	✓
24	15	12.9	299	✓
25	16	15.3	496	✓
26	12	19.4	477	✓
27	14	15.6	493	✓
28	14	13.9	267	✓
29	13	16.8	494	✓
30	13	18.8	470	✓
Successful detection: 96.67 %				

Requirement A: Minimum percentage of successful detection of every Short Pulse Radar Type: 60 %.

Requirement B: Minimum aggregate (Average of the percentage of successful detections of Short Pulse Radar Types 1 – 4): 80 %.

20 MHz channel BW: $(86.67 \% + 86.67 \% + 80 \% + 80 \%) / 4 = 83.3 \%$

40 MHz channel BW: $(100 \% + 90 \% + 93.33 \% + 96.67 \%) / 4 = 95 \%$

Test result: Passed.

5.4.2 Long Pulse Radar Test

subclause 7.8.4.2 [2]

5.3 GHz, 20 MHz channel bandwidth

RADAR TYPE 5				
Trial #	Detection (yes/no)	Chirp Width (MHz)	Subset	FC
1	✓	6	1	5300
2	✓	12	1	5300
3	✓	19	1	5300
4	✓	9	1	5300
5	✓	7	1	5300
6	✓	19	1	5300
7	✓	20	1	5300
8	✓	15	1	5300
9	✓	18	1	5300
10	✓	14	1	5300
11	---	9	2	5293.6
12	✓	16	2	5296.4
13	✓	18	2	5297.2
14	---	10	2	5294
15	✓	11	2	5294.4
16	✓	5	2	5292
17	✓	11	2	5294.4
18	---	11	2	5294.4
19	---	11	2	5294.4
20	✓	16	2	5296.4
21	✓	18	3	5302.8
22	✓	5	3	5308
23	✓	17	3	5303.2
24	✓	9	3	5306.4
25	✓	7	3	5307.2
26	✓	9	3	5306.4
27	✓	7	3	5307.2
28	✓	5	3	5308
29	✓	13	3	5304.8
30	✓	9	3	5306.4
Successful detection: 86.67 %				

5.67 GHz, 40 MHz channel bandwidth

RADAR TYPE 5				
Trial #	Detection (yes/no)	Chirp Width (MHz)	Subset	FC
1	✓	5	1	5670
2	✓	19	1	5670
3	✓	8	1	5670
4	✓	15	1	5670
5	✓	18	1	5670
6	✓	8	1	5670
7	✓	11	1	5670
8	✓	7	1	5670
9	✓	18	1	5670
10	✓	10	1	5670
11	✓	13	2	5656.2
12	✓	18	2	5658.2
13	✓	11	2	5655.4
14	✓	8	2	5654.2
15	✓	10	2	5655
16	✓	10	2	5655
17	✓	15	2	5657
18	✓	6	2	5653.4
19	✓	10	2	5655
20	✓	7	2	5653.8
21	✓	13	3	5683.8
22	✓	16	3	5682.6
23	✓	15	3	5683
24	✓	18	3	5681.8
25	✓	9	3	5685.4
26	✓	6	3	5686.6
27	✓	17	3	5682.2
28	✓	9	3	5685.4
29	✓	17	3	5682.2
30	✓	10	3	5685
Successful detection: 100 %				

Requirement: Minimum percentage of successful detection: 80 %.

Test result: Passed.

5.4.3 Frequency Hopping Radar Test

subclause 7.8.4.3 [2]

5.3 GHz, 20 MHz channel bandwidth

RADAR TYPE 6 S	
Trial #	Detection (yes/no)
1	✓
2	✓
3	✓
4	✓
5	✓
6	✓
7	✓
8	✓
9	✓
10	✓
11	✓
12	✓
13	✓
14	✓
15	✓
16	✓
17	✓
18	✓
19	✓
20	✓
21	✓
22	✓
23	✓
24	✓
25	✓
26	✓
27	✓
28	✓
29	✓
30	✓
Successful detection: 100 %	

5.67 GHz, 40 MHz channel bandwidth

RADAR TYPE 6 S	
Trial #	Detection (yes/no)
1	✓
2	✓
3	✓
4	✓
5	✓
6	✓
7	✓
8	✓
9	✓
10	✓
11	✓
12	✓
13	✓
14	✓
15	✓
16	✓
17	✓
18	✓
19	✓
20	✓
21	✓
22	✓
23	✓
24	✓
25	✓
26	✓
27	✓
28	✓
29	✓
30	✓
Successful detection: 100 %	

Requirement: Minimum percentage of successful detection: 70 %.

Test result: Passed.

6 Test equipment

No.	Test equipment	Type	Manufacturer	Serial No.	PM-No	Date of calibration	
01	Spectrum analyser	FSW43	Rohde & Schwarz	100586	481720	02/24/2016	02/2018
02	Vector signal generator	SMBV-100A	Rohde & Schwarz	255092	481326	02/17/2016	02/2017
03	Attenuator 11 dB	8494B	Hewlett-Packard	3308A38264	480264	Weekly verification	
04	Attenuator 110 dB	8496B	Agilent	00626	480265	Weekly verification	
05	4-way power divider	ZN4PD1-63W-S+	Mini Circuits	-	481787	Weekly verification	
06	4-way power divider	ZN4PD1-63W-S+	Mini Circuits	-	481788	Weekly verification	
07	2-way resistive divider	WA1534	Weinschel	A106	481453	Weekly verification	
08	Attenuator 10 dB	WA8/18-10-34	Weinschel	-	481448	Weekly verification	
09	Attenuator 20 dB	WA8/18-20-34	Weinschel	-	481451	Weekly verification	

7 Report history

Report Number	Date	Comment
F161612E4	28.06.2017	Document created
F161612E4 2 nd version	14.01.2020	Editorial changes: Adding of EIRP, TPC, Impedance, Time required to complete power on cycle in table 1.5. Adding of chapter 4.7 with timing plots.
F161612E4 3 rd version	27.04.2020	Correction of detection threshold level and clarification of communication mode (MIMO) in chapter 2.
F161612E4 4 th version	31.08.2020	Correction of Equipment under Test on title page and in chapter 1.4. Addition of dedicated host in chapter 1.5. Correction of model / PMN on page 41. Change of structure of annexes.

8 List of Annexes

Annex A	Test setup photos	6 pages
	161612_DFS1.jpg Test setup 161612_DFS_M1.jpg FL WLAN 2101, 3D view 1 161612_DFS_M2.jpg FL WLAN 2101, 3D view 2 161612_DFS5.jpg FL WLAN 2101, Main PCB, top view 161612_DFS6.jpg FL WLAN 2101, Main PCB, top view, WLAN module removed 161612_DFS7.jpg FL WLAN 2101, Main PCB, bottom view	
Annex B	External photos	2 pages
	161612_DFS3.jpg SX-PCEAN2, WLAN module, top view 161612_DFS4.jpg SX-PCEAN2, WLAN module, bottom view	