FCC Measurement/Technical Report on

50165
Bluetooth® / Bluetooth® Low Energy / WLAN Wireless Module

FCC ID: TXH-50165
IC: 6315A-50165

Test Report Reference: MDE_COGNEX_1803_FCC_07

Test Laboratory:
7layers GmbH
Borsigstrasse 11
40880 Ratingen
Germany

Deutsche Akkreditierungsstelle
D-PL-12140-01-01
D-PL-12140-01-02
D-PL-12140-01-03

Note:
The following test results relate only to the devices specified in this document. This report shall not be reproduced in parts without the written approval of the test laboratory.

Table of Contents

1 APPLIED STANDARDS AND TEST SUMMARY

1.1 APPLIED STANDARDS

Type of Authorization
Certification for an Intentional Radiator (Digital Device / Spread Spectrum).

Applicable FCC Rules

Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 Parts 2 and 15 (10-1-19 Edition). The following subparts are applicable to the results in this test report.

Part 2, Subpart J - Equipment Authorization Procedures, Certification

Part 15, Subpart C – Intentional Radiators

§ 15.201 Equipment authorization requirement

§ 15.207 Conducted limits

§ 15.209 Radiated emission limits; general requirements

Part 15, Subpart E – Unlicensed National Information Infrastructure Devices

§ 15.403 Definitions

§ 15.407 General technical requirements

Note:
The tests were selected and performed with reference to KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02, 2016-04-08 “COMPLIANCE MEASUREMENT PROCEDURES FOR UNLICENSED-NATIONAL INFORMATION INFRASTRUCTURE DEVICES OPERATING IN THE 5250-5350 MHz AND 5470-5725 MHz BANDS INCORPORATING DYNAMIC FREQUENCY SELECTION”.

1.2 FCC-IC CORRELATION TABLE

Correlation of measurement requirements for UNII / LE-LAN (e.g. WLAN 5 GHz) equipment from FCC and IC

UNII equipment

Measurement	FCC reference	IC reference
Conducted emissions on AC Mains	§ 15.207	RSS-Gen Issue 5+A1+A2: 8.8
Occupied bandwidth	§ 15.403 (i) (26 dB) / § 15.407 (e) (6 dB)	RSS-247 Issue 2: 6.2.1.1, 6.2.2.1, 6.2.3.1 (99%) RSS-247 Issue 2: 6.2.4.1 (6 dB)
Maximum conducted output power	§ 15.407 (a) (1),(2),(3),(4)	RSS-247 Issue 2: 6.2.1.1, 6.2.2.1, 6.2.3.1, 6.2.4.1
Maximum power spectral density	§ 15.407 (a) (1),(2),(3),(5)	RSS-247 Issue 2: 6.2.1.1, 6.2.2.1, 6.2.3.1, 6.2.4.1
Transmitter undesirable emissions; General Field Strength Limits, Restricted Bands	§ 15.407 (b) § 15.209 (a)	RSS-Gen Issue 5+A1+A2: 6.13/8.9/8.10; RSS-247 Issue 2: 3.3/6.2 6.2.1.2, 6.2.2.2, 6.2.3.2, 6.2.4.2
Frequency stability	§ 15.407 (g)	RSS-Gen Issue 5+A1+A2: 6.11/8.11
Transmit Power Control (TPC) and Dynamic Frequency Selection (DFS)	§ 15.407 (h)	RSS-247 Issue 2: 6.2.2.1, 6.2.3.1, 6.3
Antenna requirement	§ 15.203 / 15.204	RSS-Gen Issue 5+A1+A2: 6.8
Receiver spurious emissions	–	–

1.3 MEASUREMENT SUMMARY

47 CFR CHAPTER I FCC PART 15 Subpart E §15.407			**FCC §15.31, §15.407 (h)**	
Dynamic Frequency Selection, U-NII Detection Bandwidth The measurement was performed according to KDB 905462 D02			**Final Result**	
OP-Mode Radio Technology, Operating Frequency	**Setup**	**Date**	**FCC**	**IC**
WLAN a, 5500 MHz	DFS_AI01	2021-04-06	Passed	Passed

47 CFR CHAPTER I FCC PART 15 Subpart E §15.407			**FCC §15.31, §15.407 (h)**	
Dynamic Frequency Selection, Channel Availability Check Time The measurement was performed according to KDB 905462 D02			**Final Result**	
OP-Mode Bandwidth, Operating Frequency	**Setup**	**Date**	**FCC**	**IC**
WLAN a, 5500 MHz	DFS_AI01	2021-04-06	Passed	Passed

47 CFR CHAPTER I FCC PART 15 Subpart E §15.407			**FCC §15.31, §15.407 (h)**	
Dynamic Frequency Selection, In-Service Monitoring for Channel Move Time, Channel Closing Transmission Time and Non-Occupancy Period The measurement was performed according to KDB 905462 D02			**Final Result**	
OP-Mode Bandwidth, Operating Frequency	**Setup**	**Date**	**FCC**	**IC**
WLAN a, 5500 MHz	DFS_AQ03_AR03	2021-05-14	Passed	Passed

47 CFR CHAPTER I FCC PART 15 Subpart E §15.407			**FCC §15.31, §15.407 (h)**	
Dynamic Frequency Selection, Statistical Performance Check The measurement was performed according to KDB 905462 D02			**Final Result**	
OP-Mode Bandwidth, Operating Frequency	**Setup**	**Date**	**FCC**	**IC**
WLAN a, 5500 MHz	DFS_AQ03_AR03	2021-05-18	Passed	Passed

N/A: Not applicable
N/P: Not performed

2 REVISION HISTORY / SIGNATURES

Report version control			
Version	**Release date**	**Change Description**	**Version validity**
initial	2021-08-10	--	valid
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COMMENT:
This report is a DFS report only. The other applicable tests are not part of this report.

(responsible for accreditation scope)
Dipl.-Ing. Daniel Gall

(responsible for testing and report)
Dipl.-Ing. Andreas Petz

7 layers GmbH, Borsigstr. 11
40880 Ratingen, Germany
Phone +49 (0)2102 749 0

3 ADMINISTRATIVE DATA

3.1 TESTING LABORATORY

Company Name:	7layers GmbH
Address:	Borsigstr. 11 40880 Ratingen Germany

The test facility is accredited by the following accreditation organisation:

Laboratory accreditation no:	DAkkS D-PL-12140-01-01| -02 | -03
FCC Designation Number:	DE0015
FCC Test Firm Registration:	929146
ISED CAB Identifier	DE0007; ISED#: 3699A
Responsible for accreditation scope:	Dipl.-Ing. Daniel Gall
Report Template Version:	2021-01-13

3.2 PROJECT DATA

Responsible for testing and report:	Dipl.-Ing. Andreas Petz
Employees who performed the tests:	documented internally at 7Layers
Date of Report:	2021-08-10
Testing Period:	2021-04-06 to 2021-05-18

3.3 APPLICANT DATA

Company Name:	Cognex Germany Aachen GmbH
Address:	Krefelder Straße 218 52070 Aachen Germany
Contact Person:	Mr. Simon Juenger

3.4 MANUFACTURER DATA

Company Name:	please see Applicant Data

4 TEST OBJECT DATA

4.1 GENERAL EUT DESCRIPTION

Kind of Device product description	Cognex wireless module 50165 for integration in Cognex 8700 series Handheld Readers and Base Stations
Product name	Bluetooth® / Bluetooth® Low Energy / WLAN Wireless Module
Type	50165
Declared EUT data by the supplier	
Voltage Type	DC
Voltage Level	5 V
Tested Modulation Type	OFDM
Specific product description	The EUT is a Bluetooth and WLAN module. It supports SISO Mode only. Supported WLAN modes are a, n and ac with 20 MHz nominal BW. The U-NII bands 1, 2A, 2C and 3 are supported. Channels falling into the frequency range 5600 to 5650 MHz are supported for the USA but not supported for Canada. The module supports both roles as access point and client.
Ports of the device	UART, SDIO, I2C, +5V, GND
Data Rates	WLAN a: up to 54 Mbps WLAN n: up to 72 Mbps WLAN ac: up to 87 Mbps
Antennas	Integral 3.5 dBi
Antenna Connector Impedance	50 Ohms (Temporary antenna connector, no permanent connector available on EUT)
Special software used for testing	the firmware accepts control commands which can be entered at a terminal emulation, test scripts are provided by the applicant
Transmit Power Control	Supported
Power level of the EUT (E.I.R.P.)	19.6 dBm, 4.9 dBm/MHz (CH140 / 5700 MHz, mode ac)
User Access Restriction	The manufacturer confirms that information regarding the parameters of the detected waveforms is not accessible to the end user.
Channel Loading System Type	IP based system

Declared data by the laboratory	
Used antenna ports during testing	SISO mode only, the relevant antenna port was connected to the test setup by temporary antenna connector.
Antenna Assembly gain used for DFS Threshold Level	3.5 dBi
Used threshold level	-62 dBm (EIRP < 200 mW and power spectral density < 10 dBm/MHz)
Channel loading	> 17 % by random data transfer with two instances (iperf3)
Pulse Type Generation	Pulses were randomly generated using Rohde & Schwarz K6 Pulse sequencer.

4.2 EUT MAIN COMPONENTS

Sample Name	Sample Code	Description
EUT ai02	DE1408000ai02	DFS Master
Sample Parameter	**Value**	
Serial No.	–	
HW Version	IDI88 RC	
SW Version	VERSION_ID: 9.9.9 SW 1.21 RC0.0 | w10: May 2 2019 02:41:00 | version 7.45.189 (r714228 CY WLTEST) | FWID 01-fc9ee776	
Comment	The EUT is used as Master operating in Master Mode.	

Sample Name	Sample Code	Description
EUT aq03	DE1408000aq03	DFS Master
Sample Parameter	**Value**	
Serial No.	–	
HW Version	IDI88 RC	
SW Version	VERSION_ID: 6.1.10-m37-16-g06c0f11562 SW 1.21 RC0.0 | w10: May 2 2019 02:41:00 | version 7.45.189 (r714228 CY WLTEST) | FWID 01-fc9ee776	
Comment	The EUT is used as Master operating in Master Mode.	

Sample Name	Sample Code	Description
EUT ar03	DE1408000ar03	DFS Client
Sample Parameter	**Value**	
Serial No.	–	
HW Version	IDI88 RC	
SW Version	VERSION_ID: 6.1.10-m37-16-g06c0f11562 SW 1.21 RC0.0 | w10: May 2 2019 02:41:00 | version 7.45.189 (r714228 CY WLTEST) | FWID 01-fc9ee776	
Comment	The EUT is used as Client operating in Client Mode	

NOTE: The short description is used to simplify the identification of the EUT in this test report.

4.3 ANCILLARY EQUIPMENT

For the purposes of this test report, ancillary equipment is defined as equipment which is used in conjunction with the EUT to provide operational and control features to the EUT. It is necessary to configure the system in a typical fashion, as a customer would normally use it. But nevertheless Ancillary Equipment can influence the test results.

Device	**Details (Manufacturer, Type Model, HW, SW, S/N)**	**Description**
-	-	-

4.4 AUXILIARY EQUIPMENT

For the purposes of this test report, auxiliary equipment is defined as equipment which is used temporarily to enable operational and control features especially used for the tests of the EUT which is not used during normal operation or equipment that is used during the tests in combination with the EUT but is not subject of this test report. It is necessary to configure the system in a typical fashion, as a customer would normally use it.
But nevertheless Auxiliary Equipment can influence the test results.

Device	**Details (Manufacturer, Type Model, HW, SW, S/N)**	**Description**
AC adapter (DE1408000ACDC1)	GlobTek, GTM96060-0606-0.5, WR9QA1090EIAJ2CK5R6B, - , 786273123/19	Providing additional current to USB input of Cradle
AC adapter (DE1408000ANC1)	GlobTek, GTM96060-0606-0.5, WR9QA1090EIAJ2CK5R6B, - , 786356123/19	Providing additional current to USB input of Cradle
Cradle CRA7 (DE1408000CRA7)	Cognex, DM8700 series Base Station R00087, IDB83-RE, -, QR label no. 557478 (used in conjunction with sample ai02)	Part of Base Station modified to test modules in DFS Master Mode
Cradle CRA8 (DE1408000CRA8)	Cognex, DM8700 series Base Station R00087, IDB83-RE, -, 1A2046PP520926 (used in conjunction with sample aq03)	Part of Base Station modified to test modules in DFS Master Mode
Cradle CRA9 (DE1408000CRA9)	Cognex, DM8700 series Base Station R00087, IDB83-RE, -, 1A2050PP582772 (used in conjunction with sample ar03)	Part of Base Station modified to test modules in DFS Client Mode
Laptop RE05	Fujitsu Ltd., Lifebook U758, -, -, DSAL009811	computer to control the EUT via terminal emulation
Laptop RE06	Fujitsu Ltd., Lifebook U758, -, -, DSAL009842	computer to control the EUT via terminal emulation
AC Adapter Laptop RE05	Fujitsu Ltd., A13-065N3A 65W, -, -, 184903C604	Power supply for laptop RE05
AC Adapter Laptop RE06	Fujitsu Ltd., A13-065N3A 65W, -, -, 186905OL04	Power supply for laptop RE06

4.5 EUT SETUPS

This chapter describes the combination of EUTs and equipment used for testing. The rationale for selecting the EUTs, ancillary and auxiliary equipment and interconnecting cables, is to test a representative configuration meeting the requirements of the referenced standards.

Setup	Combination of EUTs	Description and Rationale
DFS_AI01	EUT ai01, CRA7, DE1408000ACDC1, Laptop RE05, AC Adapter Laptop RE05	Conducted DFS Setup
DFS_AQ03_AR03	EUT aq03, EUT ar03, CRA8, CRA9, DE1408000ACDC1, DE1408000ANC1, Laptop RE05, Laptop RE06, AC Adapter Laptop RE05, AC Adapter Laptop RE06	Conducted DFS Setup

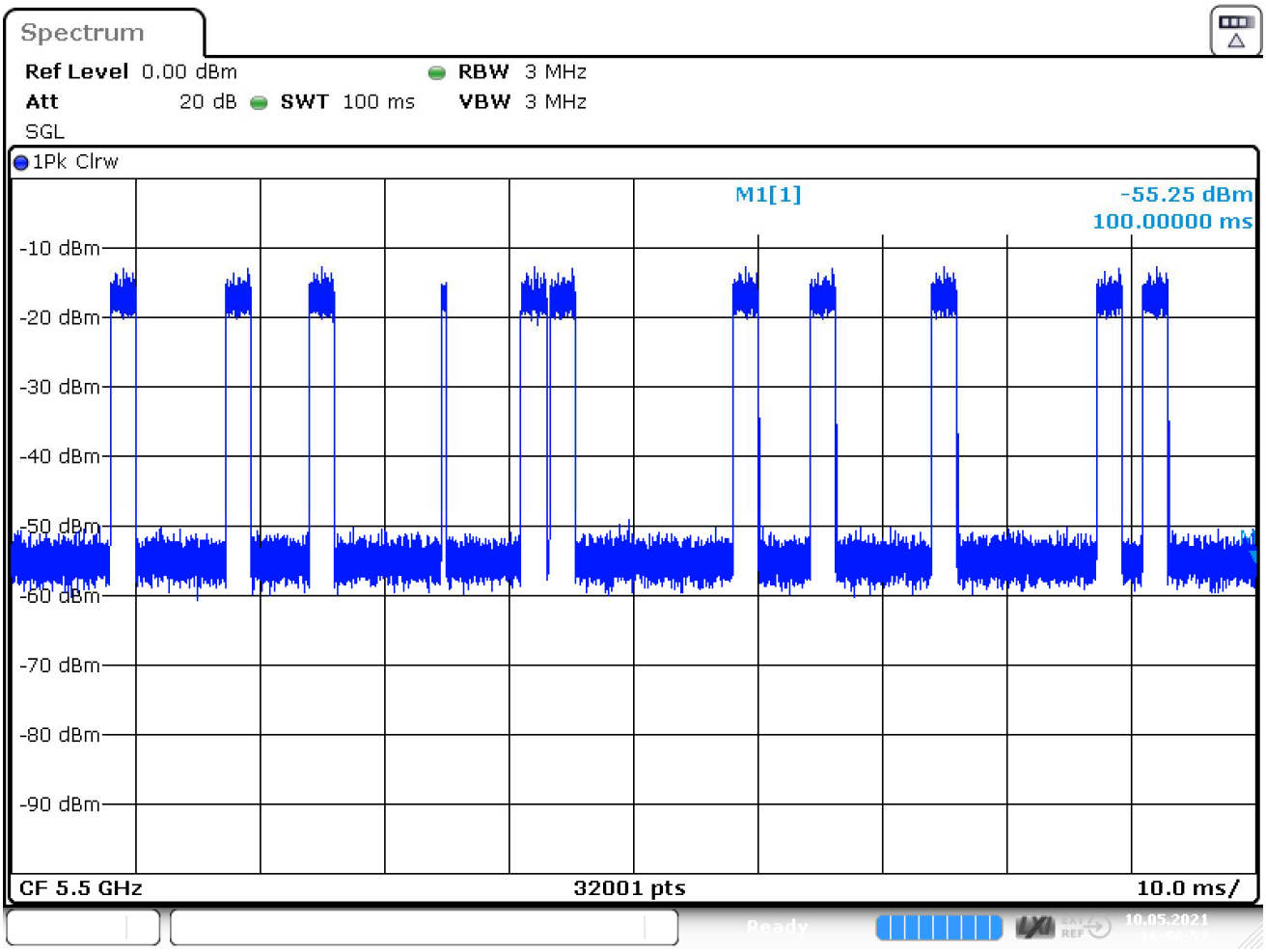
4.6 OPERATING MODES / TEST CHANNELS

This chapter describes the operating modes of the EUTs used for testing.

U-NII-Subband 2A 5250 - 5350 MHz			U-NII-Subband 2C 5470 - 5725 MHz			Nom. BW
low	mid	high	low	mid	high	20 MHz
-	-	-	100	-	-	Ch.-No.
-	-	-	5500	-	-	MHz

4.7 CHANNEL LOADING DUTY CYCLE

WLAN a



Date: 10.MAY.2021 16:56:53

Comment: 6682 points above -30 dBm corresponds to 20.8 % DC

4.8 PRODUCT LABELLING

Please refer to the documentation of the applicant.

5 TEST RESULTS

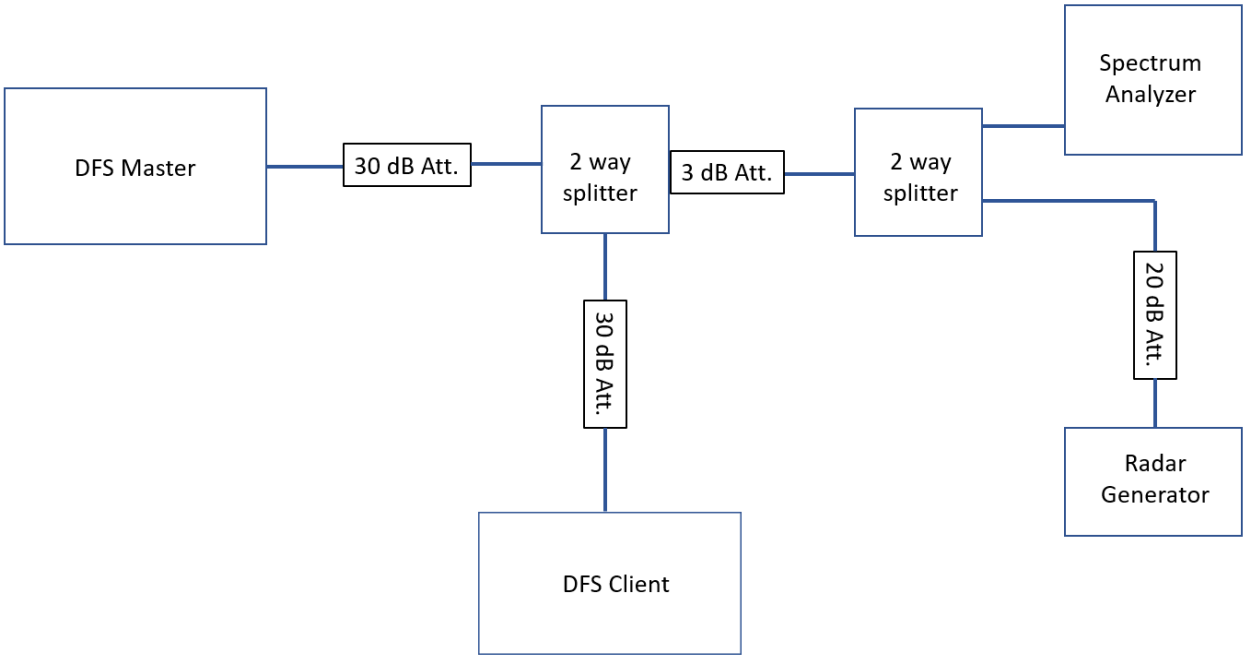
5.1 DYNAMIC FREQUENCY SELECTION, U-NII DETECTION BANDWIDTH

Standard **FCC Part 15 Subpart E**

The test was performed according to:
KDB 905462 D02

5.1.1 TEST DESCRIPTION

The Equipment Under Test (EUT) was set up in a shielded room for the DFS measurements.



Since the DFS Master shall be tested stand alone, the DFS Client was connected but not activated.

After activating the EUT, a radar pulse of type 0 was send on mid channel frequency from the radar signal generator and the response was noted. This was repeated 9 further times.

If at least 9 of the 10 pulses were recognized by the device, the radar pulse frequency was increased or decreased by 5 MHz and the test was repeated. If the detection rate falls below 9 pulses, the step size is reduced to 1 MHz from the previous 5 MHz step until detection rate falls below 9 again. The result is compared to the 99 % Bandwidth.

5.1.2 TEST REQUIREMENTS / LIMITS

FCC Part 15, Subpart E, §15.407 (h) (2)
The device must sense for radar signals at 100 percent of its emission bandwidth.
The minimum DFS detection threshold for devices with a maximum e.i.r.p. of 200 mW to 1 W is −64 dBm. For devices that operate with less than 200 mW e.i.r.p. and a power spectral density of less than 10 dBm in a 1 MHz band, the minimum detection threshold is −62 dBm. The detection threshold is the received power averaged over 1 microsecond referenced to a 0 dBi antenna.

5.1.3 TEST PROTOCOL

Ambient temperature: 25 °C
Air Pressure: 1006 hPa
Humidity: 30 %

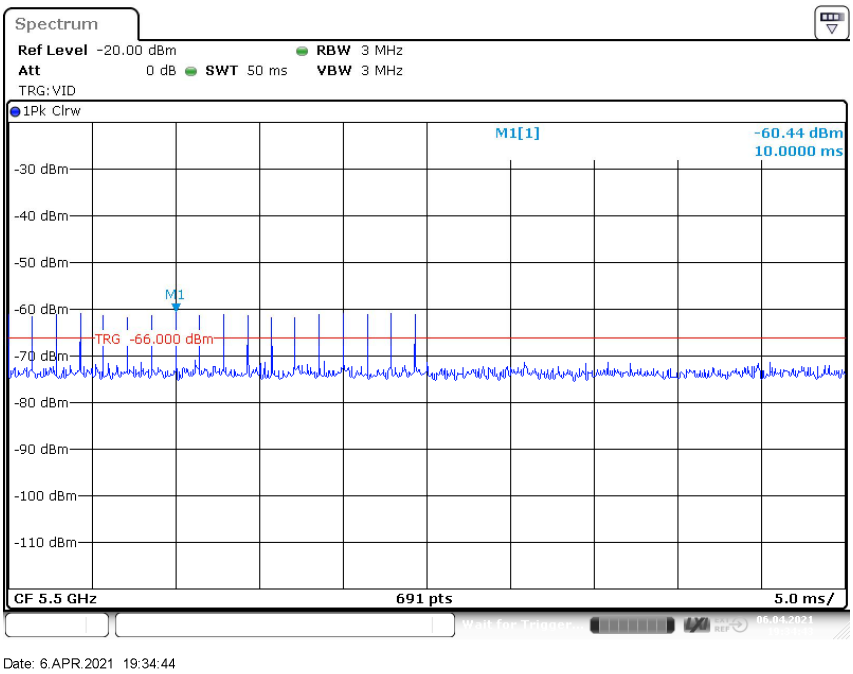
Mode	TX Frequency [MHz]	Channel BW [MHz]	Radar Test Signal #	F_L [MHz]	F_H [MHz]	Detection BW [MHz]	99 % BW [MHz]
WLAN a	5500	20	Radar Type 0	5490	5510	20	19

Remark: Detection of radar pulses is monitored by console interface.
No plots are recorded.

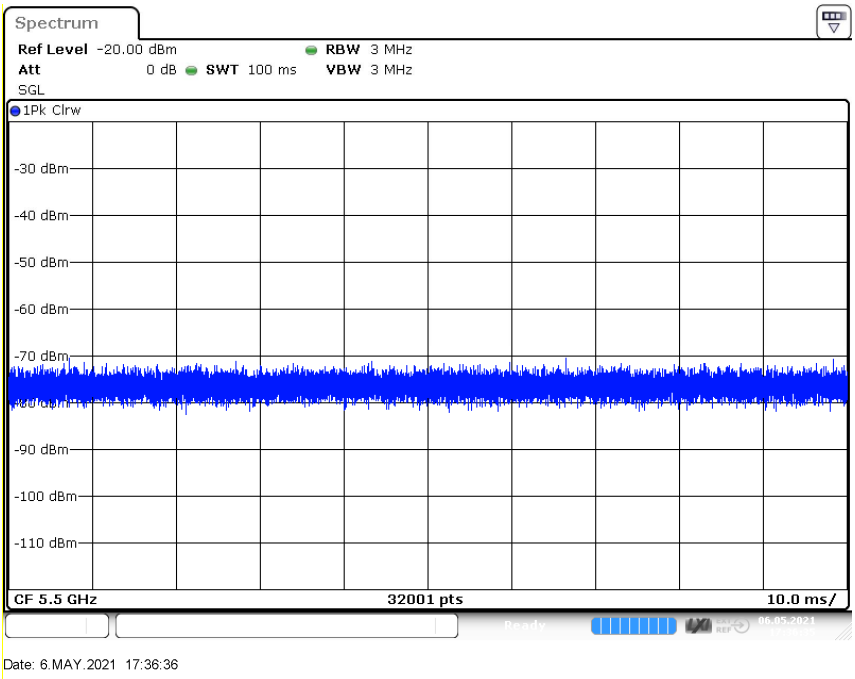
5.1.4 MEASUREMENT RESULT

MHz from Centre	TX Frequency [MHz]	Channel BW [MHz]	Detected
-10	5500	20	10
-9	5500	20	10
-8	5500	20	10
-7	5500	20	10
-6	5500	20	10
-5	5500	20	10
0	5500	20	10
5	5500	20	10
6	5500	20	10
7	5500	20	10
8	5500	20	10
9	5500	20	10
10	5500	20	10

Radar Pulse Level Calibration



Radar Pulse level



Noise Level

5.1.5 TEST EQUIPMENT USED

- R&S TS8997

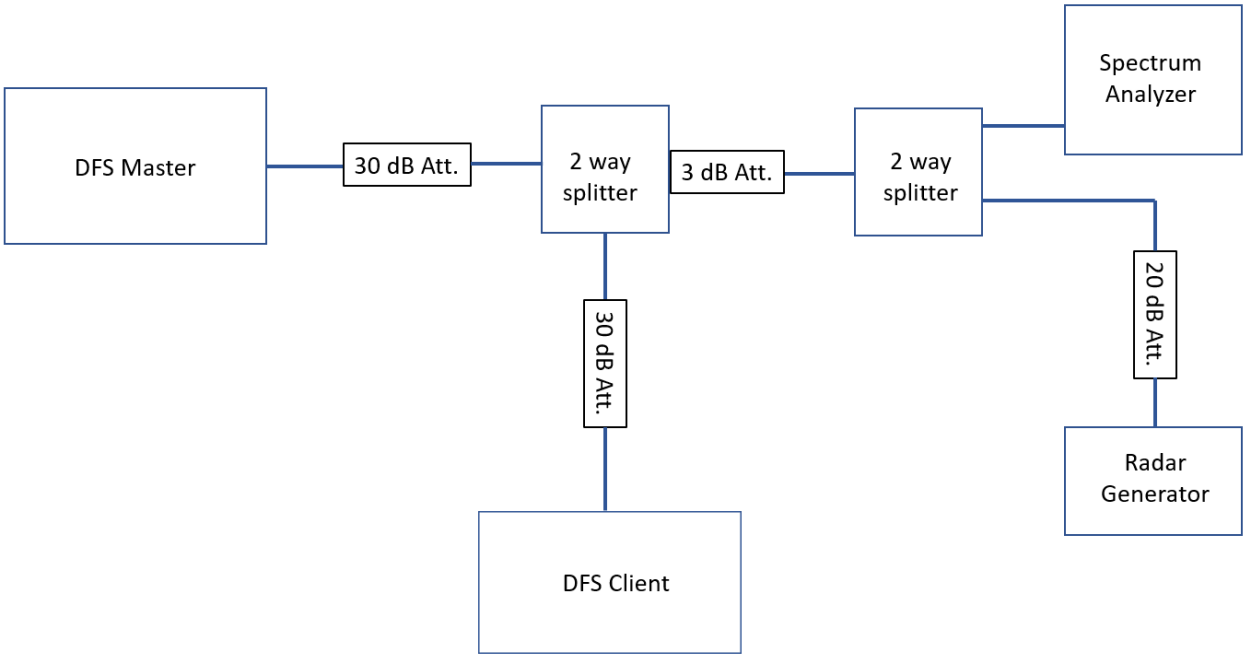
5.2 DYNAMIC FREQUENCY SELECTION, CHANNEL AVAILABILITY CHECK TIME

Standard **FCC Part 15 Subpart E**

The test was performed according to:
KDB 905462 D02

5.2.1 TEST DESCRIPTION

The Equipment Under Test (EUT) was set up in a shielded room for the DFS measurements.



The DFS Master is powered.

Afterwards, the measurement sweep on the spectrum analyser is started simultaneously with the script for activation of the Master's WLAN on the test channel.

Three plots are recoded, the first plot without radar pulse to determine the EUT start-up time, the second plot with radar pulse at the beginning of the CAC time and the third plot with the radar pulse at the end of the CAC time.
It is checked for unwanted emissions outside CAC time.

Analyzer settings:
•Resolution Bandwidth (RBW): 3 MHz
•Video Bandwidth (VBW): 3 MHz
•Trace: Clear/Write
•Sweeps: Single Sweep
•Sweeptime: 150 s
•Detector: Peak

5.2.2 TEST REQUIREMENTS / LIMITS

FCC Part 15, Subpart E, §15.407 (h) (2) (ii)
Channel Availability Check Time. A U-NII device shall check if there is a radar system already operating on the channel before it can initiate a transmission on a channel and when it has to move to a new channel. The U-NII device may start using the channel if no radar signal with a power level greater than the interference threshold values listed in paragraph (h)(2) of this section, is detected within 60 seconds.

FCC Part 15, Subpart E, §15.407 (h) (2)
The minimum DFS detection threshold for devices with a maximum e.i.r.p. of 200 mW to 1 W is −64 dBm. For devices that operate with less than 200 mW e.i.r.p. and a power spectral density of less than 10 dBm in a 1 MHz band, the minimum detection threshold is −62 dBm. The detection threshold is the received power averaged over 1 microsecond referenced to a 0 dBi antenna.

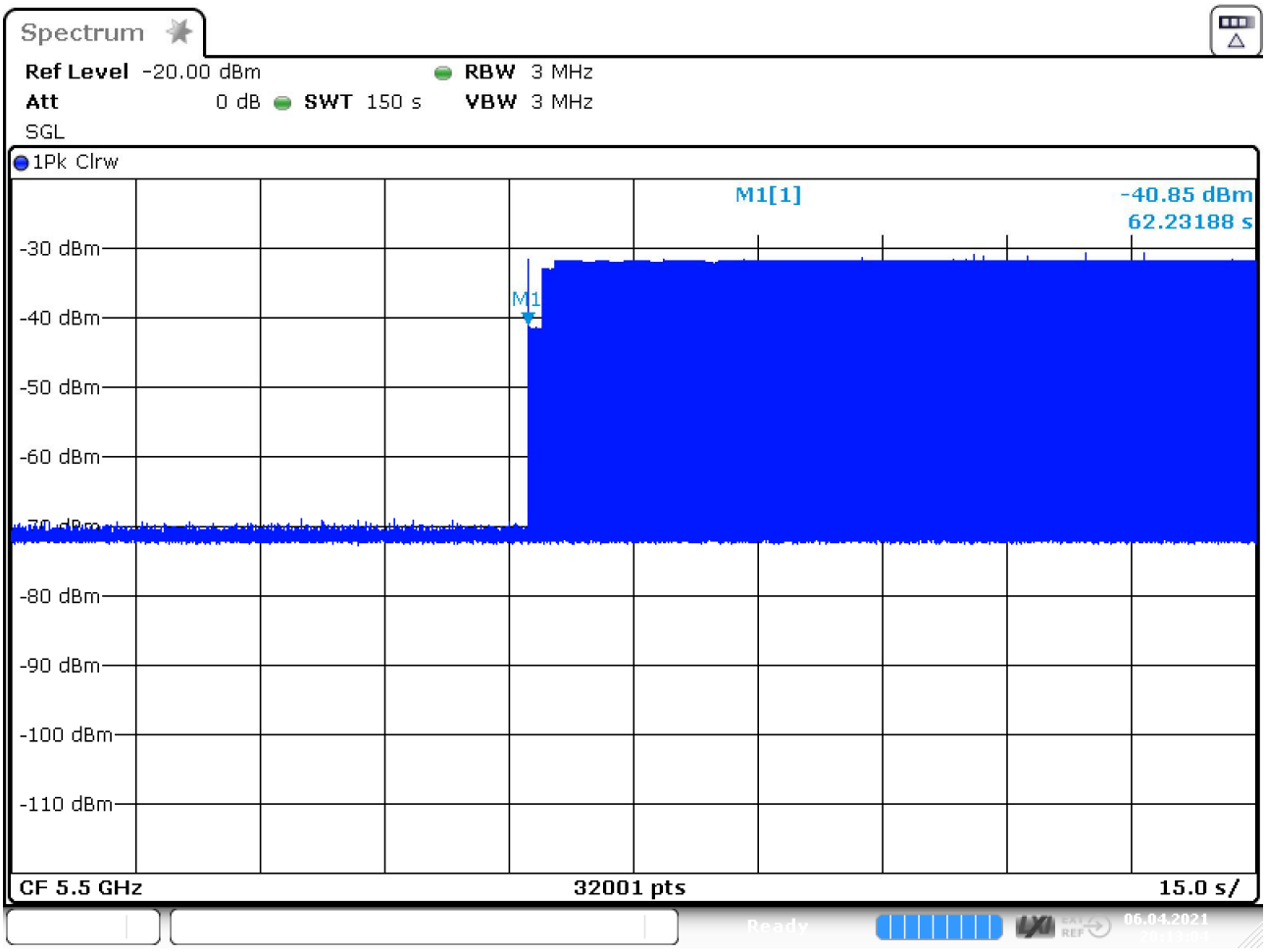
5.2.3 TEST PROTOCOL

Ambient temperature: 25 °C
Air Pressure: 1006 hPa
Humidity: 30 %

Mode	TX Frequency [MHz]	Radar Test Signal #	Detected?	Transmissions within 150 s?
WLAN a	5500	Type 0 @ 0 to 6 s	Yes	No
WLAN a	5500	Type 0 @ 54 to 60 s	Yes	No

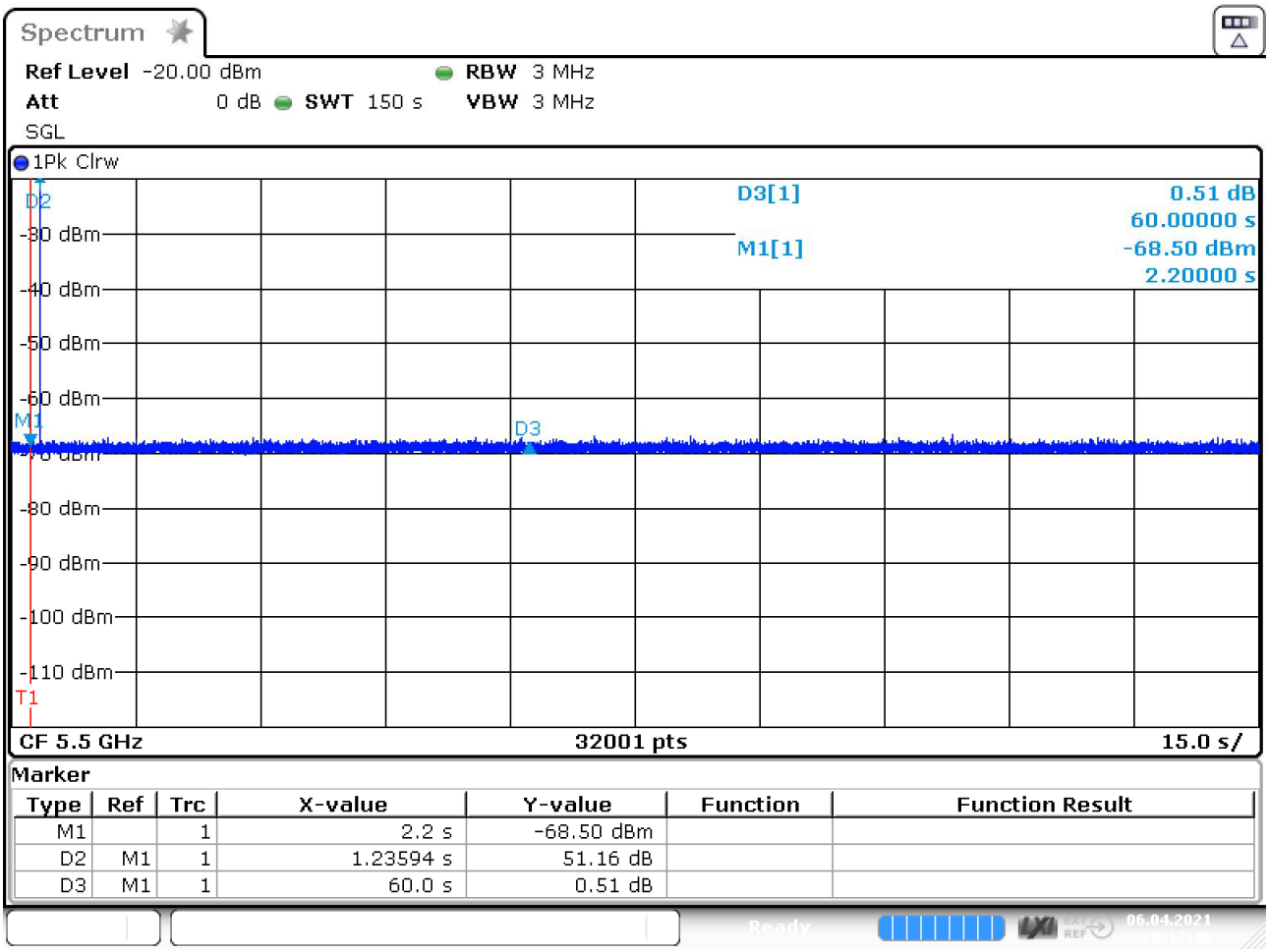
Remark: Please see next sub-clause for the measurement plot.
For radar pulse calibration see test case U-NII detection BW.

5.2.4 MEASUREMENT PLOT



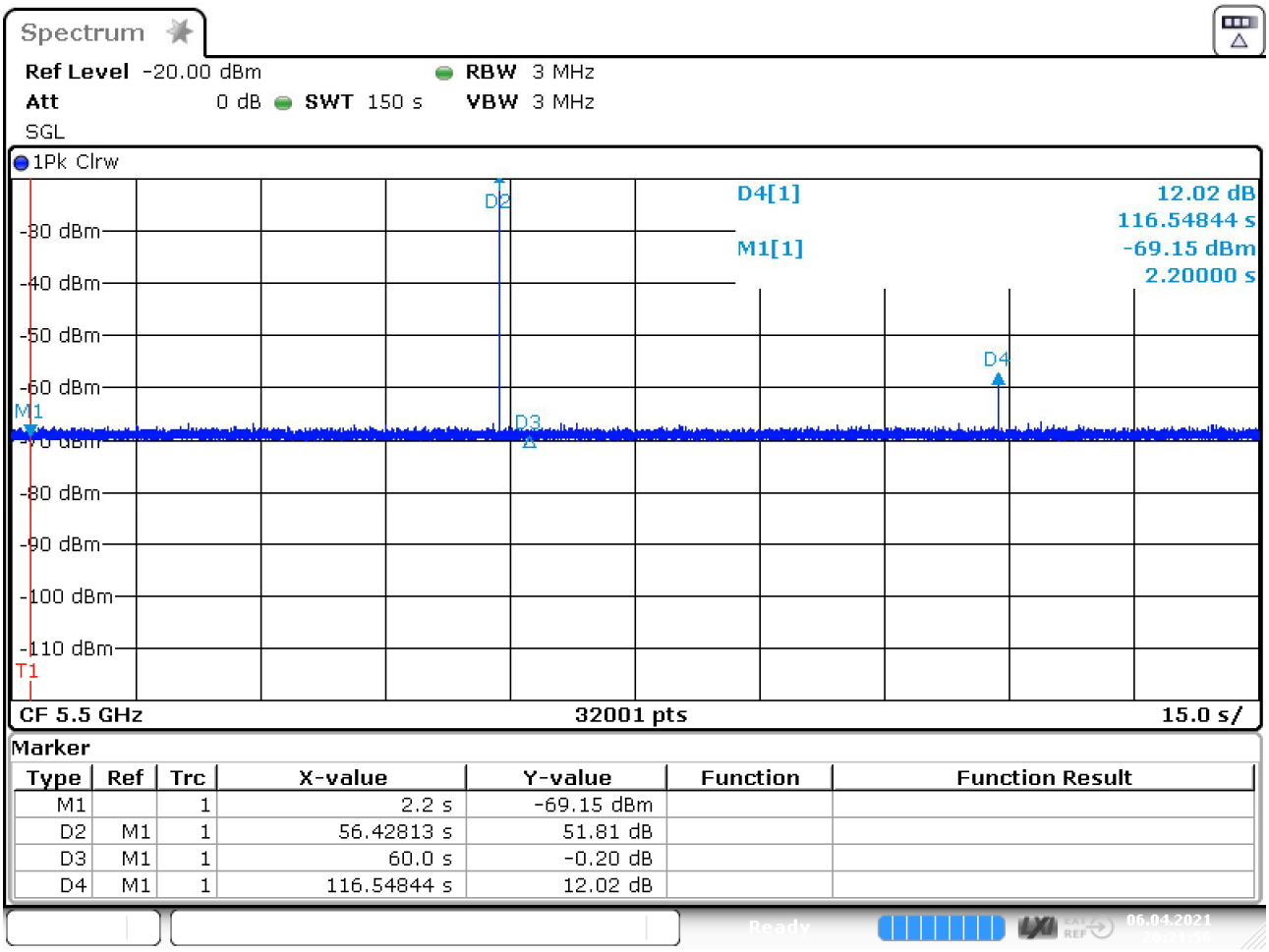
Date: 6.APR.2021 20:13:05

Determination of start-up time (no radar pulse send)
Resulting start up time: 2.2 s



Date: 6.APR.2021 20:17:46

Radar Pulse at beginning of CAC period.
Emission of radar pulse at 1.2s after calculated start-up (Marker D2)



Date: 6.APR.2021 20:21:57

Radar Pulse at end of CAC period.
Emission of radar pulse at 56.4s after calculated start-up (Marker D2)

5.2.5 TEST EQUIPMENT USED

- R&S TS8997

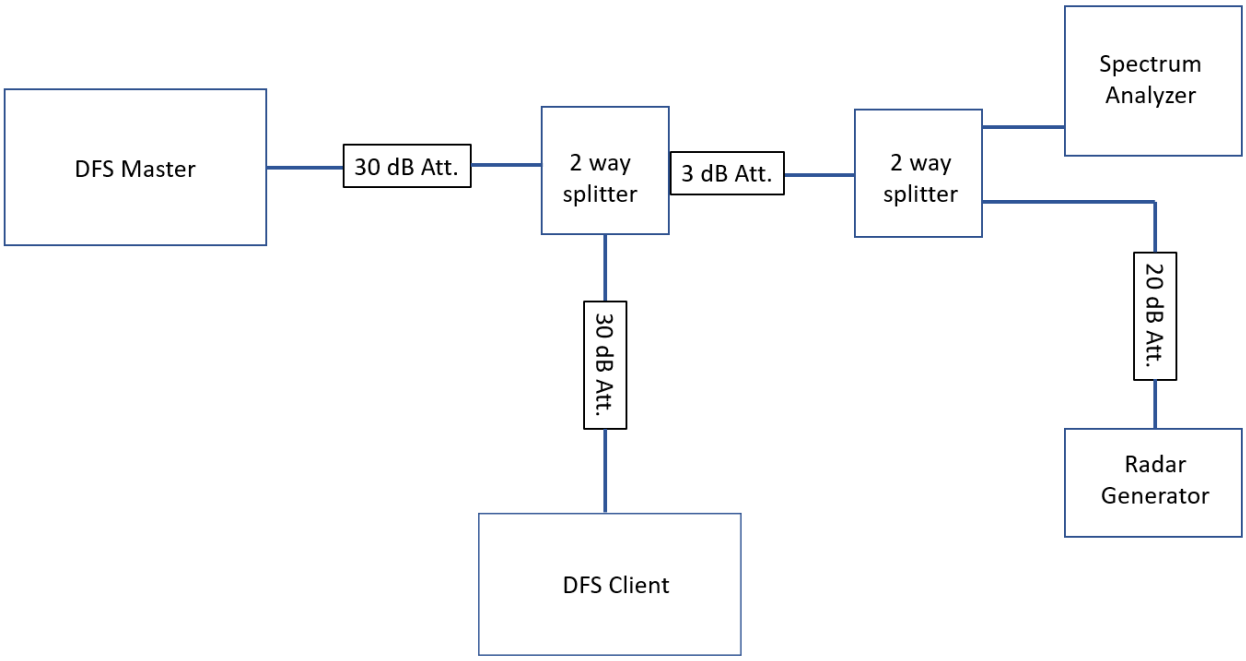
5.3 DYNAMIC FREQUENCY SELECTION, IN-SERVICE MONITORING FOR CHANNEL MOVE TIME, CHANNEL CLOSING TRANSMISSION TIME AND NON-OCCUPANCY PERIOD

Standard **FCC Part 15 Subpart E**

The test was performed according to:
KDB 905462 D02

5.3.1 TEST DESCRIPTION

The Equipment Under Test (EUT) was set up in a shielded room for the DFS measurements.



The Master and Client EUT were powered.
Afterwards the master and client were configured for connection on a DFS channel using the respective scripts provided by the applicant using the maximum supported bandwidth.
Once the Channel Availability Check was completed and connection was established, the channel loading scripts were started.

With established connection, a radar pulse of type 0 was send from the radar pulse generator. At the same time the spectrum analyser is triggered by the radar signal generator and a trace is recorded:

Analyzer settings:
•Resolution Bandwidth (RBW): 3 MHz
•Video Bandwidth (VBW): 3 MHz
•Trace: Clear/Write
•Sweeps: Single Sweep
•Sweeptime: 20 s
•Detector: Peak
•Trigger: External

In addition to the plot also the trace data is recorded to calculate the Channel Closing Time.

Afterwards the test is repeated with a sweep time of 32 minutes to monitor the Non-occupancy period.

5.3.2 TEST REQUIREMENTS / LIMITS

FCC Part 15, Subpart E, §15.407 (h) (2) (iii)
Channel Move Time. After a radar's presence is detected, all transmissions shall cease on the operating channel within 10 seconds. Transmissions during this period shall consist of normal traffic for a maximum of 200 ms after detection of the radar signal. In addition, intermittent management and control signals can be sent during the remaining time to facilitate vacating the operating channel.

FCC Part 15, Subpart E, §15.407 (h) (2) (iii)
Non-occupancy Period. A channel that has been flagged as containing a radar system, either by a channel availability check or in-service monitoring, is subject to a non-occupancy period of at least 30 minutes. The non-occupancy period starts at the time when the radar system is detected.

Limits according KDB 905462 D02 UNII DFS Compliance Procedures New Rules

Parameter	Value
Non-occupancy period	Minimum 30 minutes
Channel Availability Check Time	60 seconds
Channel Move Time	10 seconds See Note 1.
Channel Closing Transmission Time	200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period. See Notes 1 and 2.
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. 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.	

5.3.3 TEST PROTOCOL

Master

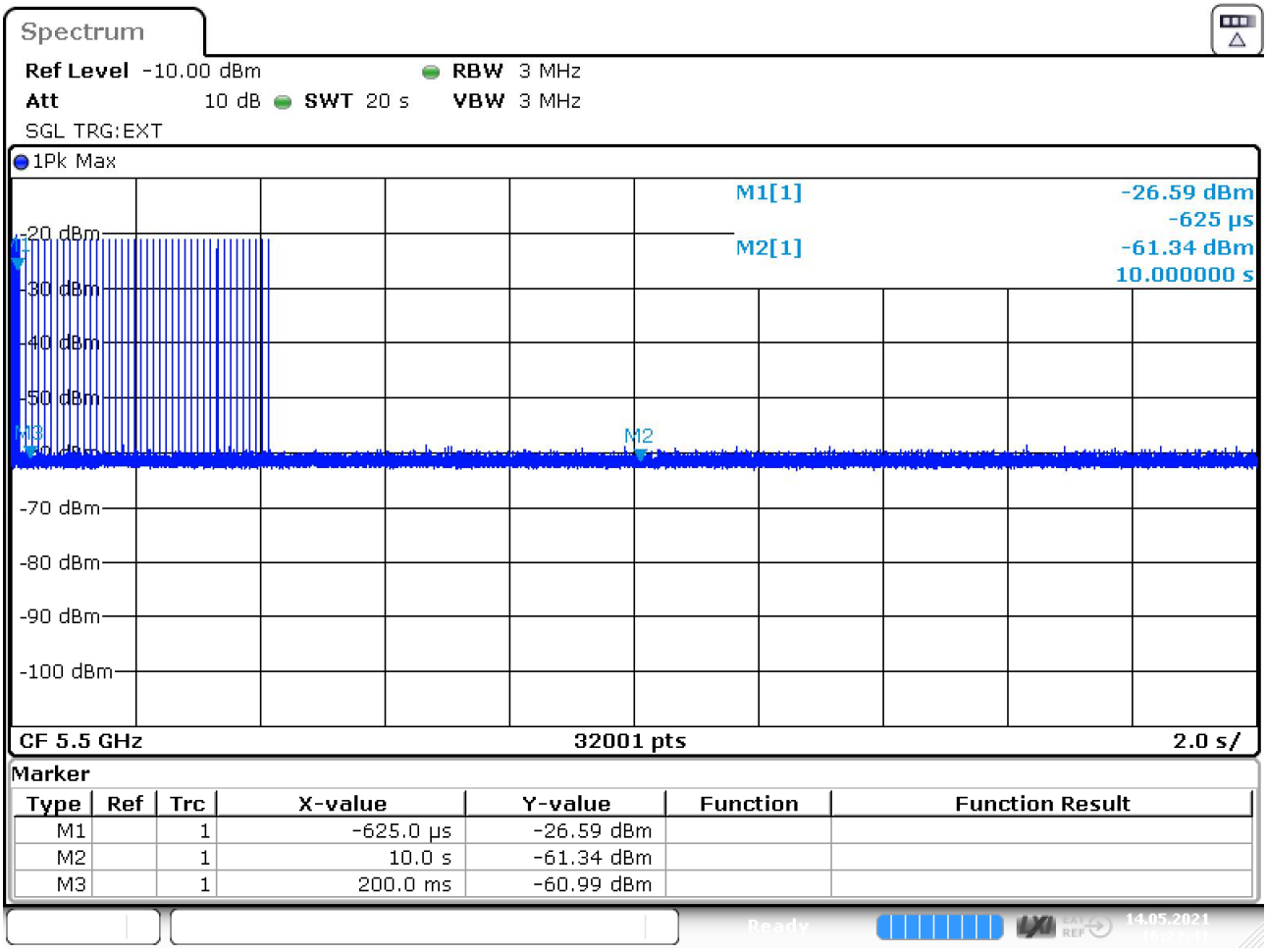
Ambient temperature: 28 °C
Air Pressure: 1002 hPa
Humidity: 32 %

WLAN a

Mode	TX Frequency [MHz]	Radar Test Signal #	Channel Closing Transmission Time [ms]	Limit [ms]	Channel Move Time [s]	Limit [s]	Transmissions in Non-Occupancy Period?
Master	5500	Type 0	200 + 48.75	200 + 60	4.0	10	None
Client	5500	Type 0	200 + 12.5	200 + 60	3.6	10	None

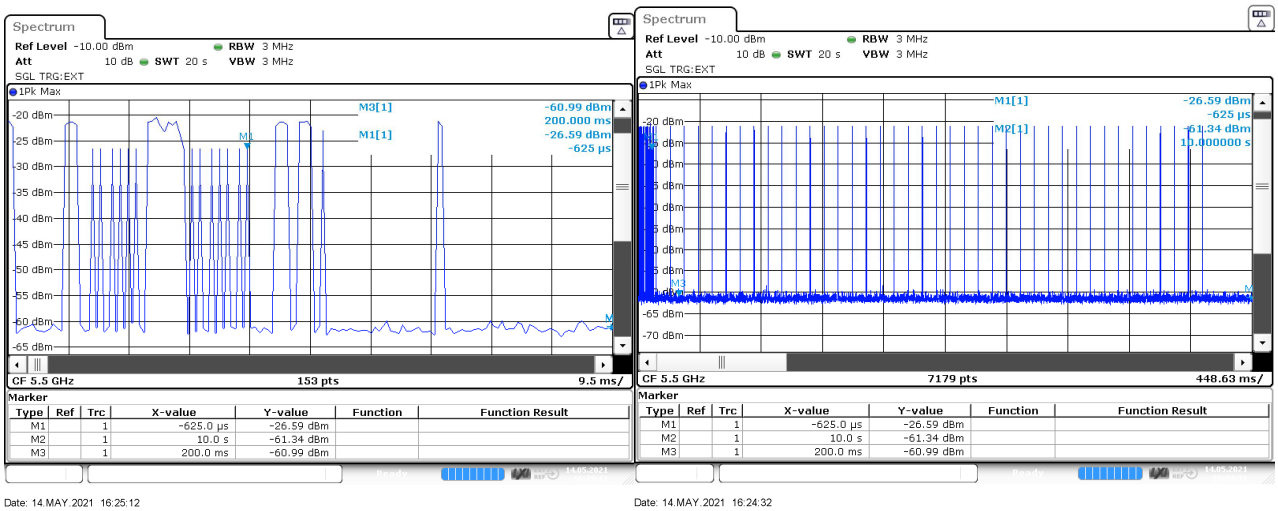
Remark: Please see next sub-clause for the measurement plot.
For radar pulse calibration see test case U-NII detection BW.

5.3.4 MEASUREMENT PLOT (EXAMPLE PLOT, SHOWING WORST CASE, IF APPLICABLE)



Date: 14.MAY.2021 16:23:41

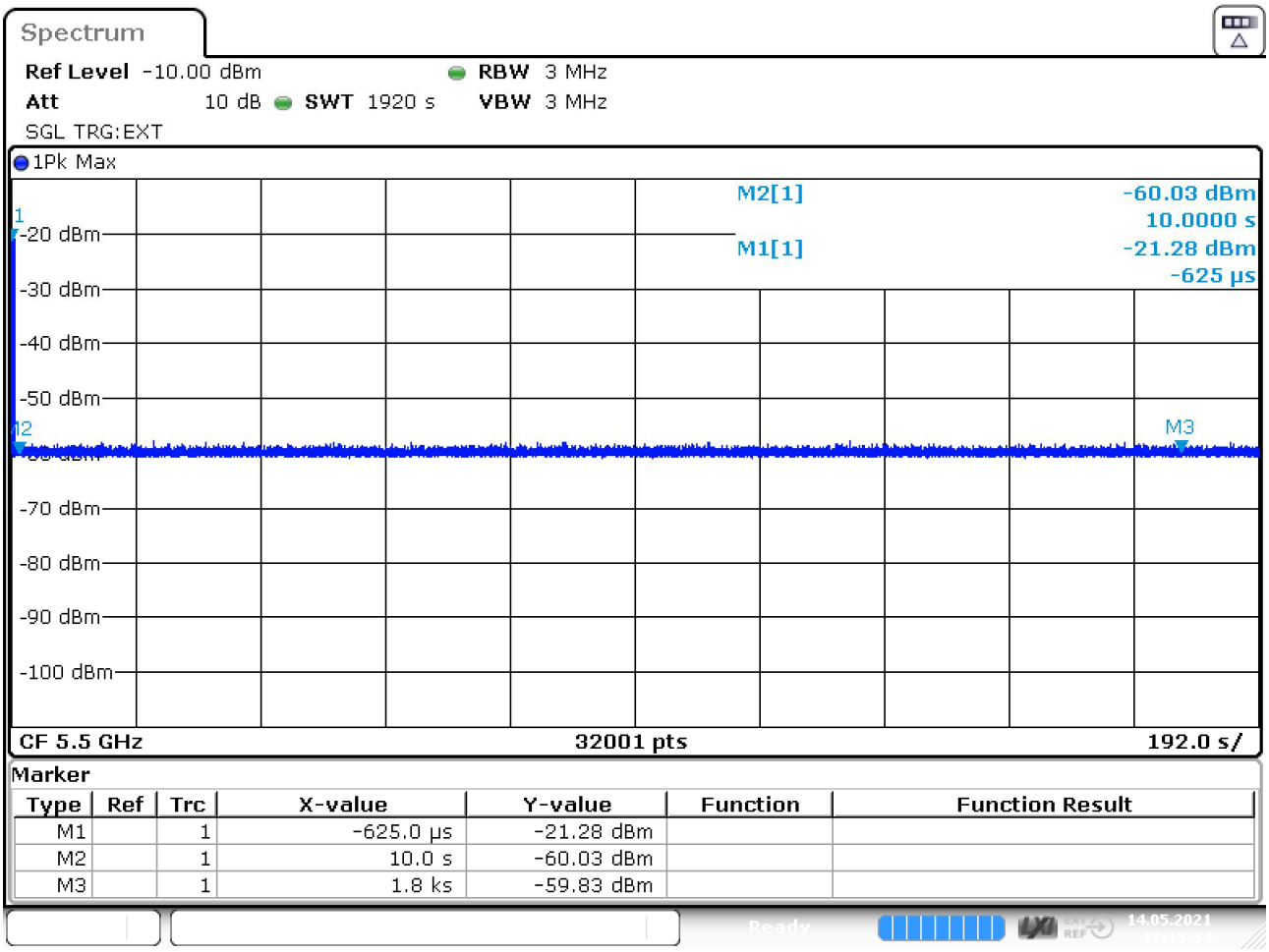
M1 = Radar Pulse, M3 = 200 ms after Radar Pulse end, M2 = End of 10s period



Date: 14.MAY.2021 16:25:12

Date: 14.MAY.2021 16:24:32

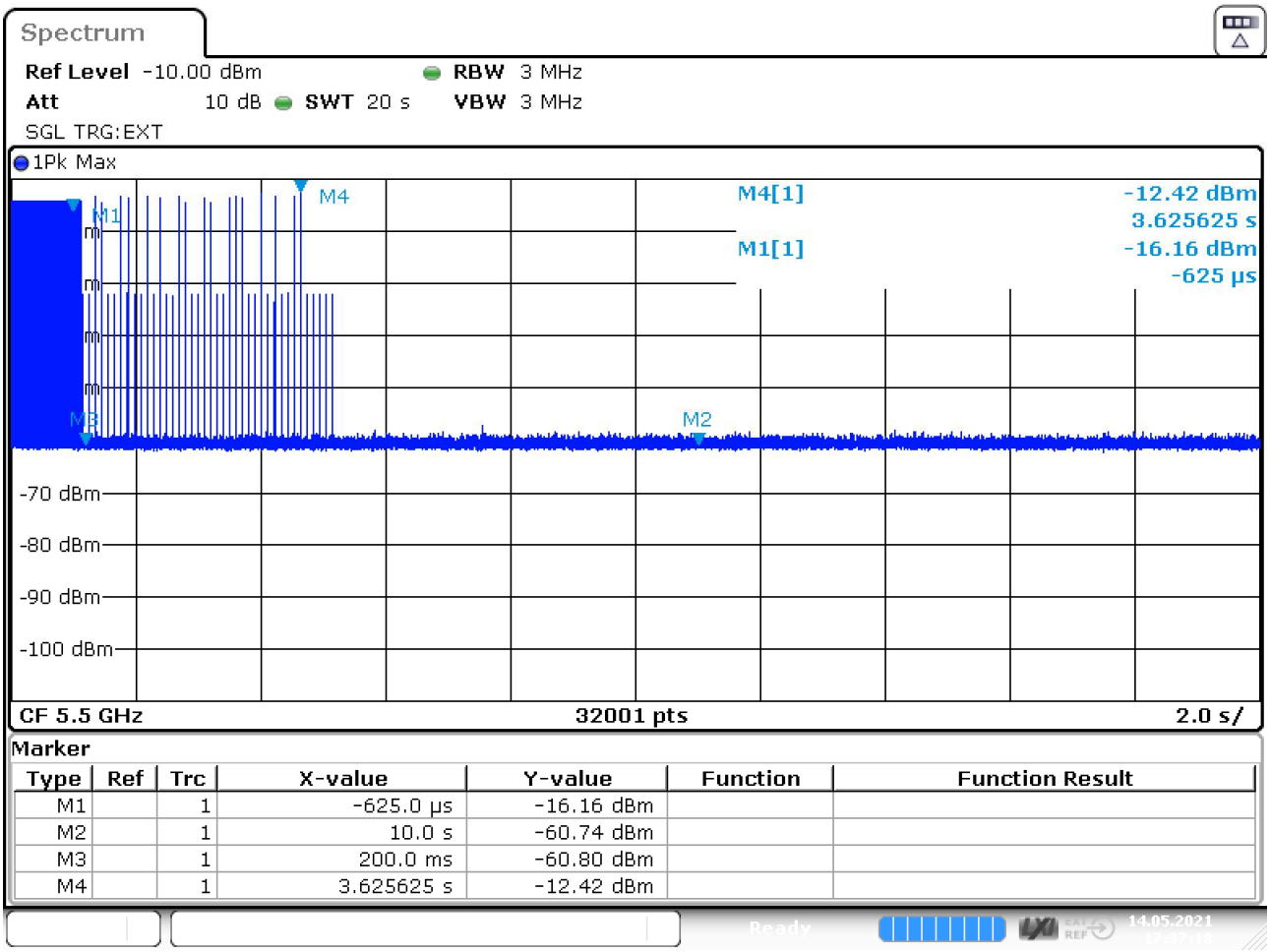
Zoom of trace.



Date: 14.MAY.2021 17:15:54

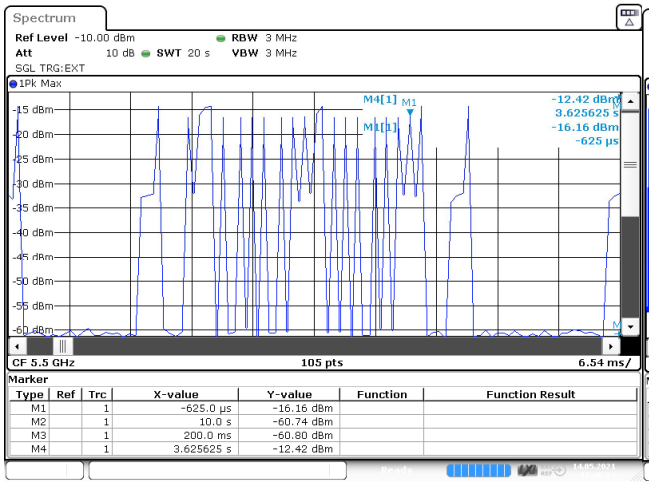
Non Occupancy Period

Slave Plots:

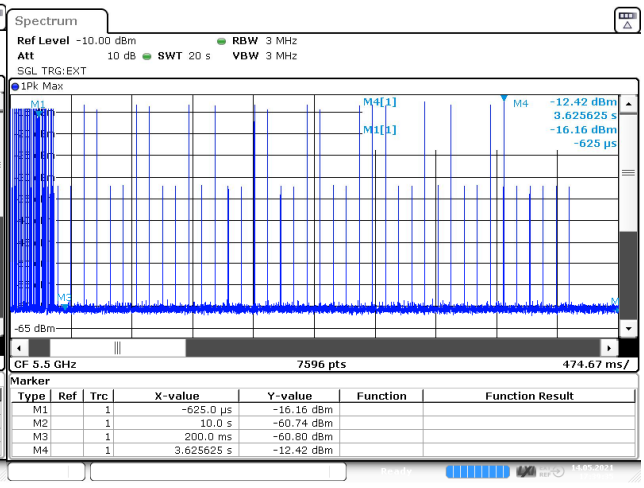


Date: 14.MAY.2021 17:37:18

M1 = Radar Pulse, M3 = 200 ms after Radar Pulse end, M2 = End of 10s period

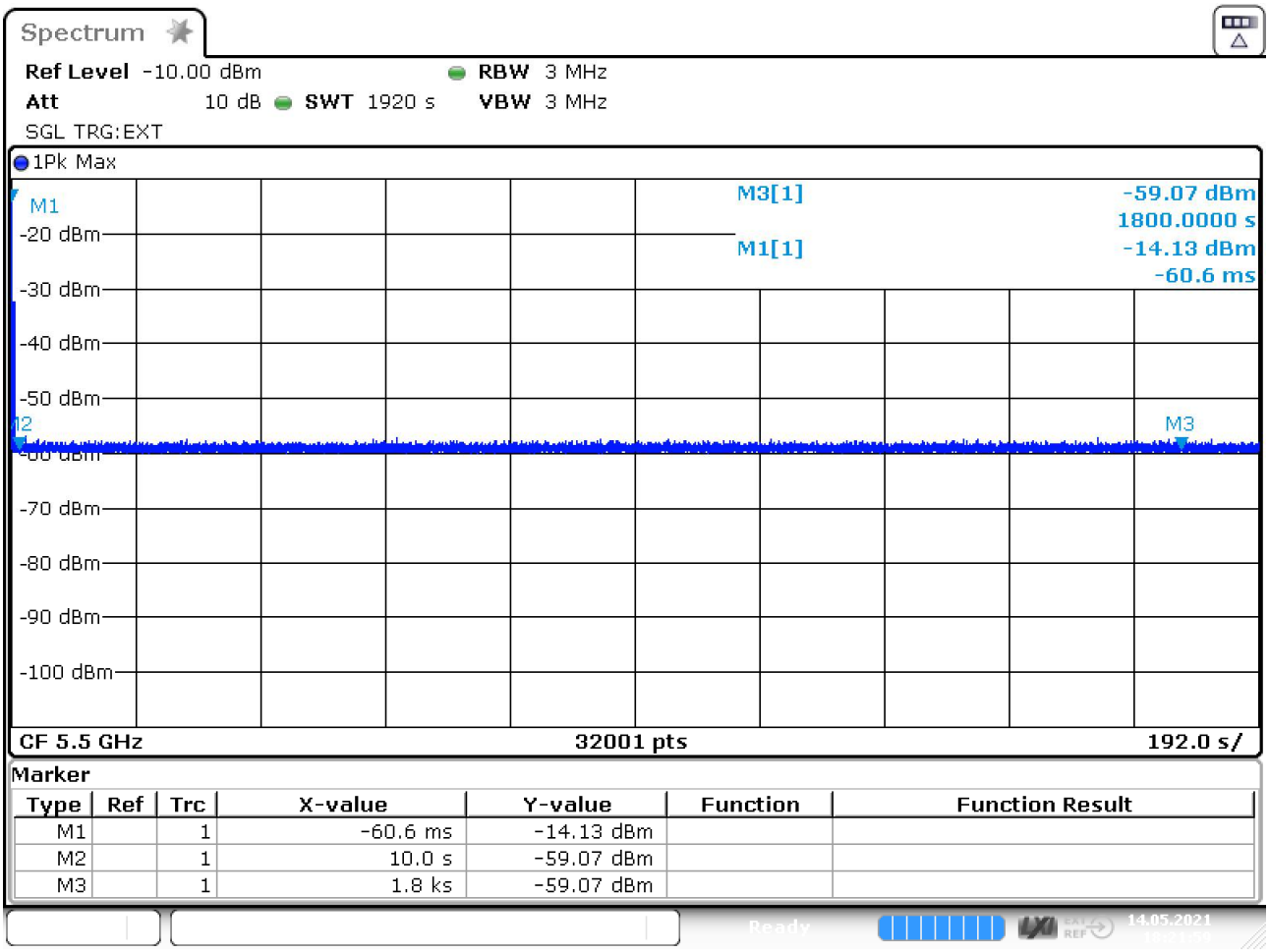


Date: 14.MAY.2021 17:40:24



Date: 14.MAY.2021 17:39:36

Zoom of trace.



Date: 14.MAY.2021 18:21:59

Non Occupancy Period

5.3.5 TEST EQUIPMENT USED

- R&S TS8997

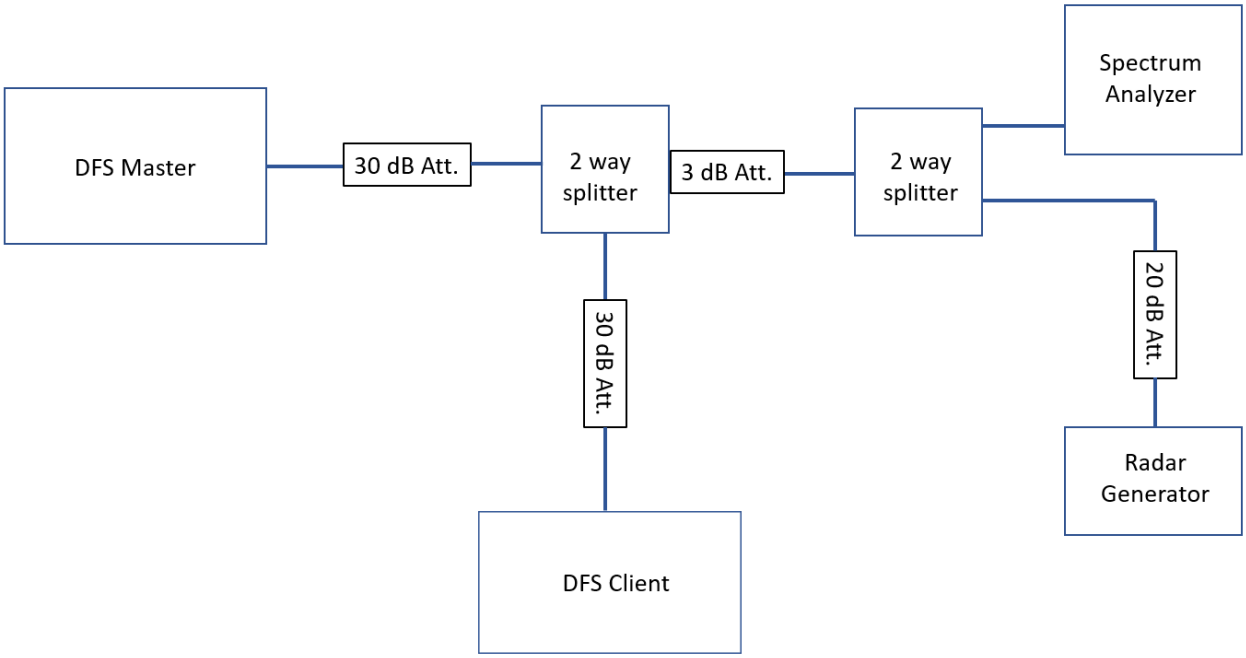
5.4 DYNAMIC FREQUENCY SELECTION, STATISTICAL PERFORMANCE CHECK

Standard **FCC Part 15 Subpart E**

The test was performed according to:
KDB 905462 D02

5.4.1 TEST DESCRIPTION

The Equipment Under Test (EUT) was set up in a shielded room for the DFS measurements.



The Master and Client EUT were powered together with their auxiliary computer boards. Afterwards the master and client were configured for connection on a DFS channel using the respective scripts provided by the applicant using the maximum supported bandwidth.
Once the Channel Availability Check was completed and connection was established, the channel loading scripts were started.

Using command line commands and spectrum analyser, detection of radar pulse was monitored and the script restarted to set the EUT back to the test channel.

30 unique pulses of radar type 1 to 6 are sent while for each type 10 pulses are send at the lower end of the 99 % detection BW, 10 pulses at the higher end of the detection BW and 10 are send mid channel.

For each send pulse detection is recorded.

Testing is repeated for all supported channel bandwidths.

5.4.2 TEST REQUIREMENTS / LIMITS

FCC Part 15, Subpart E, §15.407 (h) (2)
U-NII devices operating with any part of its 26 dB emission bandwidth in the 5.25-5.35 GHz and 5.47-5.725 GHz bands shall employ a DFS radar detection mechanism to detect the presence of radar systems and to avoid co-channel operation with radar systems. Operators shall only use equipment with a DFS mechanism that is turned on when operating in these bands. The device must sense for radar signals at 100 percent of its emission bandwidth. The minimum DFS detection threshold for devices with a maximum e.i.r.p. of 200 mW to 1 W is −64 dBm. For devices that operate with less than 200 mW e.i.r.p. and a power spectral density of less than 10 dBm in a 1 MHz band, the minimum detection threshold is −62 dBm. The detection threshold is the received power averaged over 1 microsecond referenced to a 0 dBi antenna.

Limits according KDB 905462 D02 UNII DFS Compliance Procedures New Rules

Table 5 – Short Pulse Radar Test Waveforms

Radar Type	Pulse Width (µsec)	PRI (µsec)	Number of Pulses	Minimum Percentage of Successful Detection	Minimum Number of Trials
0	1	1428	18	See Note 1	See Note 1
1	1	Test A: 15 unique PRI values randomly selected from the list of 23 PRI values in Table 5a	Roundup $\left\{\left(\frac{1}{360}\right)\cdot\left(\frac{19\cdot 10^6}{PRI_{\mu sec}}\right)\right\}$	60%	30
		Test B: 15 unique PRI values randomly selected within the range of 518-3066 µsec, with a minimum increment of 1 µsec, excluding PRI values selected in Test A			
2	1-5	150-230	23-29	60%	30
3	6-10	200-500	16-18	60%	30
4	11-20	200-500	12-16	60%	30
Aggregate (Radar Types 1-4)				80%	120
Note 1: Short Pulse Radar Type 0 should be used for the detection bandwidth test, channel move time, and channel closing time tests.					

Table 6 – Long Pulse Radar Test Waveform

Radar Type	Pulse Width (µsec)	Chirp Width (MHz)	PRI (µsec)	Number of Pulses per *Burst*	Number of *Bursts*	Minimum Percentage of Successful Detection	Minimum Number of Trials
5	50-100	5-20	1000-2000	1-3	8-20	80%	30

Table 7 – Frequency Hopping Radar Test Waveform

Radar Type	Pulse Width (µsec)	PRI (µsec)	Pulses per Hop	Hopping Rate (kHz)	Hopping Sequence Length (msec)	Minimum Percentage of Successful Detection	Minimum Number of Trials
6	1	333	9	0.333	300	70%	30

5.4.3 TEST PROTOCOL

Ambient temperature: 25-27 °C
Air Pressure: 990-1011 hPa
Humidity: 28-34 %

Bandwidth	TX Frequency [MHz]	Radar Test Signal #	Number of send pulses	Number of detected pulses	Successful Detection Percentage [%]	Limit [%]
20 MHz	5500	Type 1	30	29	97	60
20 MHz	5500	Type 2	30	30	100	60
20 MHz	5500	Type 3	30	26	87	60
20 MHz	5500	Type 4	30	25	83	60
20 MHz	5500	Aggregate 1-4	120	110	92	80
20 MHz	5500	Type 5	30	27	90	80
20 MHz	5500	Type 6	30	30	100	70

Remark: Detection of radar pulses is monitored by console interface.
No plots are recorded.

5.4.4 MEASUREMENT RESULT

20 MHz Bandwidth Pulse Types 1 to 4 and 6

RADAR TYPE 1 Table 5a					RADAR TYPE 1 Random				
Trial #	Number of Pulses per Burst	Pulse Width (µsec)	PRI (µs)	Detection (yes/no)	Trial #	Number of Pulses per Burst	Pulse Width (µsec)	PRI (µs)	Detection (yes/no)
1	102	1	518	no	1	20	1	2692	yes
2	99	1	538	yes	2	19	1	2900	yes
3	95	1	558	yes	3	53	1	1004	yes
4	92	1	578	yes	4	24	1	2227	yes
5	89	1	598	yes	5	30	1	1806	yes
6	86	1	618	yes	6	86	1	619	yes
7	83	1	638	yes	7	22	1	2498	yes
8	81	1	658	yes	8	56	1	943	yes
9	78	1	678	yes	9	21	1	2609	yes
10	76	1	698	yes	10	63	1	845	yes
11	74	1	718	yes	11	59	1	1097	yes
12	72	1	738	yes	12	24	1	2271	yes
13	70	1	758	yes	13	18	1	3041	yes
14	68	1	778	yes	14	56	1	956	yes
15	67	1	798	yes	15	36	1	1503	yes

RADAR TYPE 2					RADAR TYPE 3				
Trial #	Number of Pulses per Burst	Pulse Width (µsec)	PRI (µs)	Detection (yes/no)	Trial #	Number of Pulses per Burst	Pulse Width (µsec)	PRI (µs)	Detection (yes/no)
1	28	2.4	203	yes	1	17	7.9	473	yes
2	26	3.1	207	yes	2	17	6.8	471	yes
3	28	4.2	185	yes	3	17	7.7	349	no
4	26	3.9	214	yes	4	17	7	308	yes
5	28	4.5	230	yes	5	17	7.4	418	yes
6	26	3.2	184	yes	6	17	9.4	289	yes
7	26	2.1	174	yes	7	17	7.2	315	yes
8	28	3	171	yes	8	17	9.8	451	no
9	25	1.7	177	yes	9	18	6.5	430	yes
10	25	5	223	yes	10	17	7.7	311	yes
11	28	4.1	165	yes	11	16	9.1	223	no
12	26	3.4	195	yes	12	16	7.4	309	yes
13	24	2.6	168	yes	13	17	8	391	yes
14	25	1.8	158	yes	14	16	7.7	369	yes
15	24	3.6	202	yes	15	17	7.6	216	yes
16	24	1.5	225	yes	16	17	6.3	393	yes
17	26	4.7	200	yes	17	17	7.8	423	yes
18	29	3.2	194	yes	18	16	6.6	465	yes
19	27	4	192	yes	19	16	9.4	299	yes
20	29	3.7	181	yes	20	16	6.1	225	yes
21	29	2.3	163	yes	21	18	6.3	479	no
22	25	2.4	172	yes	22	17	9.3	242	yes
23	24	2.1	193	yes	23	18	8.7	238	yes
24	28	5	159	yes	24	17	6.3	261	yes
25	23	1	174	yes	25	16	9.4	402	yes
26	27	2.8	186	yes	26	17	7	403	yes
27	26	4.9	223	yes	27	16	7.8	376	yes
28	28	4.5	173	yes	28	18	9.2	467	yes
29	29	1.6	224	yes	29	18	7.8	272	yes
30	27	5	199	yes	30	16	8.1	497	yes

RADAR TYPE 4					RADAR TYPE 6				
Trial #	Number of Pulses per Burst	Pulse Width (µsec)	PRI (µs)	Detection (yes/no)	Trial #	Number of Pulses per Hop	Pulse Width (µsec)	PRI (µs)	Detection (yes/no)
1	15	14	250	no	1	9	1	333	yes
2	13	11.1	284	yes	2	9	1	333	yes
3	16	17.6	217	yes	3	9	1	333	yes
4	16	16.5	259	yes	4	9	1	333	yes
5	15	11.7	468	yes	5	9	1	333	yes
6	15	15.2	299	yes	6	9	1	333	yes
7	15	19.9	240	yes	7	9	1	333	yes
8	15	14.5	357	yes	8	9	1	333	yes
9	13	15	212	yes	9	9	1	333	yes
10	16	11.5	394	yes	10	9	1	333	yes
11	14	15.1	426	no	11	9	1	333	yes
12	12	19.5	477	no	12	9	1	333	yes
13	15	14.4	402	yes	13	9	1	333	yes
14	15	14.9	292	yes	14	9	1	333	yes
15	13	13.1	446	yes	15	9	1	333	yes
16	13	15.6	255	yes	16	9	1	333	yes
17	15	12.3	444	yes	17	9	1	333	yes
18	12	17.2	309	yes	18	9	1	333	yes
19	16	16.7	388	yes	19	9	1	333	yes
20	15	16.3	342	yes	20	9	1	333	yes
21	14	19.2	500	yes	21	9	1	333	yes
22	13	17.9	392	yes	22	9	1	333	yes
23	14	18.6	404	yes	23	9	1	333	yes
24	15	16.3	323	yes	24	9	1	333	yes
25	13	16.7	334	yes	25	9	1	333	yes
26	15	15.6	500	yes	26	9	1	333	yes
27	14	14.7	470	yes	27	9	1	333	yes
28	12	11.2	397	yes	28	9	1	333	yes
29	15	14.3	304	no	29	9	1	333	yes
30	16	17.3	323	no	30	9	1	333	yes

Pulse Type 5

TYPE 5 20 MHz		
Trial #	Detection (yes/no)	Radar Pulse Freq. [MHz]
1	no	5500
2	no	5500
3	yes	5500
4	yes	5500
5	yes	5500
6	yes	5500
7	yes	5500
8	yes	5500
9	yes	5500
10	yes	5500
11	yes	5492.9
12	yes	5496.1
13	yes	5496.9
14	no	5494.9
15	yes	5492.9
16	yes	5493.7
17	yes	5492.9
18	yes	5493.7
19	yes	5494.5
20	yes	5493.3
21	yes	5506.7
22	yes	5506.3
23	yes	5505.5
24	yes	5502.3
25	yes	5505.9
26	yes	5502.7
27	yes	5504.7
28	yes	5505.5
29	yes	5502.3
30	yes	5503.5

Trial Number : 1						
Bursts in Trial: 8						
Burst	**Number of Pulses**	**Pulse Width (µsec)**	**Chirp Width (MHz)**	**Pulse 1-to-2 Spacing (µsec)**	**Pulse 2-to-3 Spacing (µsec)**	**Start Location Within Interval (msec)**
1	3	60.8	9	983	1775	181
2	2	65.2	9	1185		855
3	2	61	9	1528		1453
4	1	93.3	9			1216
5	3	77.3	9	1452	1818	1344
6	2	99.4	9	1814		605
7	2	67.1	9	970		1122
8	2	94.1	9	1903		150

Trial Number : 2						
Bursts in Trial: 9						
Burst	**Number of Pulses**	**Pulse Width (µsec)**	**Chirp Width (MHz)**	**Pulse 1-to-2 Spacing (µsec)**	**Pulse 2-to-3 Spacing (µsec)**	**Start Location Within Interval (msec)**
1	2	96.8	20	1081		915
2	1	81.8	20			268
3	2	74.4	20	1849		189
4	2	65.2	20	1001		1097
5	1	58.2	20			381
6	2	85.3	20	1510		647
7	2	91.5	20	1598		367
8	2	52.9	20	947		1229
9	2	91.3	20	1885		1127

Trial Number : 3						
Bursts in Trial: 10						
Burst	**Number of Pulses**	**Pulse Width (µsec)**	**Chirp Width (MHz)**	**Pulse 1-to-2 Spacing (µsec)**	**Pulse 2-to-3 Spacing (µsec)**	**Start Location Within Interval (msec)**
1	2	64.8	8	1096		1125
2	2	83	8	1563		1148
3	3	76.7	8	1778	1627	661
4	1	55	8			486
5	3	93.7	8	1532	1525	852
6	2	87	8	1079		304
7	2	66.3	8	1678		54
8	2	94.1	8	1650		503
9	2	57.7	8	1215		381
10	3	74.1	8	1452	1346	304

Trial Number : 4						
Bursts in Trial: 11						
Burst	**Number of Pulses**	**Pulse Width (µsec)**	**Chirp Width (MHz)**	**Pulse 1-to-2 Spacing (µsec)**	**Pulse 2-to-3 Spacing (µsec)**	**Start Location Within Interval (msec)**
1	2	65.9	19	1730		643
2	2	53.9	19	1500		566
3	2	74.4	19	1151		459
4	2	85.6	19	990		415
5	1	73.8	19			403
6	2	100	19	1790		517
7	2	60.5	19	1555		783
8	1	56.1	19			830
9	1	54.2	19			717
10	3	72	19	1436	1530	558
11	2	61.3	19	1422		932

Trial Number : 5						
Bursts in Trial: 12						
Burst	**Number of Pulses**	**Pulse Width (µsec)**	**Chirp Width (MHz)**	**Pulse 1-to-2 Spacing (µsec)**	**Pulse 2-to-3 Spacing (µsec)**	**Start Location Within Interval (msec)**
1	2	54.3	10	1580		151
2	2	71	10	1514		810
3	3	70.5	10	1372	1770	189
4	3	69.5	10	1306	1892	160
5	2	93.7	10	1746		267
6	3	84.6	10	1244	1227	22
7	2	54.5	10	1106		203
8	1	82.5	10			298
9	2	91.1	10	1628		237
10	1	95.3	10			807
11	2	88.5	10	1243		128
12	3	92.6	10	1561	938	621

Trial Number : 6						
Bursts in Trial: 13						
Burst	**Number of Pulses**	**Pulse Width (µsec)**	**Chirp Width (MHz)**	**Pulse 1-to-2 Spacing (µsec)**	**Pulse 2-to-3 Spacing (µsec)**	**Start Location Within Interval (msec)**
1	1	80	8			403
2	2	87.4	8	1062		185
3	2	61.2	8	1235		804
4	2	63.2	8	1536		289
5	2	63.9	8	1833		557
6	2	85.3	8	1792		349
7	1	92.2	8			759
8	2	59.2	8	1203		915
9	1	88.8	8			586
10	2	67.6	8	1084		186
11	1	96.7	8			544
12	2	57	8	1176		208
13	2	51.3	8	1073		509

Trial Number : 7						
Bursts in Trial: 14						
Burst	**Number of Pulses**	**Pulse Width (µsec)**	**Chirp Width (MHz)**	**Pulse 1-to-2 Spacing (µsec)**	**Pulse 2-to-3 Spacing (µsec)**	**Start Location Within Interval (msec)**
1	3	91.2	16	1400	1322	557
2	3	100	16	962	1817	367
3	2	76.3	16	1751		572
4	2	74.7	16	1352		550
5	3	60.8	16	1697	1426	656
6	2	51.9	16	1936		70
7	2	92.6	16	1435		73
8	2	61.2	16	1101		1
9	1	66.8	16			740
10	2	79.5	16	1458		691
11	2	88.2	16	1422		653
12	1	61	16			55
13	1	77.1	16			304
14	1	53.7	16			532

Trial Number : 8						
Bursts in Trial: 15						
Burst	**Number of Pulses**	**Pulse Width (µsec)**	**Chirp Width (MHz)**	**Pulse 1-to-2 Spacing (µsec)**	**Pulse 2-to-3 Spacing (µsec)**	**Start Location Within Interval (msec)**
1	2	76.8	19	1129		707
2	2	65.8	19	1205		91
3	2	55.8	19	1024		84
4	1	61.6	19			132
5	2	79	19	1360		777
6	1	80.2	19			687
7	2	72.4	19	1279		658
8	2	98	19	1391		200
9	1	80.8	19			466
10	3	61.8	19	1306	1292	485
11	3	79.8	19	1768	1294	721
12	1	98.9	19			300
13	1	95.3	19			474
14	2	99.4	19	1793		355
15	2	86.8	19	1818		180

Trial Number : 9						
Bursts in Trial: 16						
Burst	**Number of Pulses**	**Pulse Width (µsec)**	**Chirp Width (MHz)**	**Pulse 1-to-2 Spacing (µsec)**	**Pulse 2-to-3 Spacing (µsec)**	**Start Location Within Interval (msec)**
1	2	53.8	19	1707		647
2	2	70.9	19	1476		237
3	3	60.7	19	1713	1285	698
4	3	98.1	19	1162	1217	395
5	1	54.7	19			177
6	2	86.8	19	1479		387
7	1	72	19			535
8	1	98.4	19			421
9	2	61	19	1535		102
10	1	85	19			294
11	3	99.2	19	1403	1339	25
12	2	99.1	19	1221		704
13	3	68.6	19	1486	1389	231
14	2	53.8	19	1309		617
15	3	60.8	19	1780	1855	430
16	3	87.3	19	1728	1293	192

Trial Number : 10						
Bursts in Trial: 17						
Burst	**Number of Pulses**	**Pulse Width (µsec)**	**Chirp Width (MHz)**	**Pulse 1-to-2 Spacing (µsec)**	**Pulse 2-to-3 Spacing (µsec)**	**Start Location Within Interval (msec)**
1	3	70.9	12	1617	1560	78
2	3	92.5	12	1361	1593	560
3	2	65.5	12	1539		171
4	2	57.4	12	1059		401
5	2	63	12	1084		188
6	2	54.1	12	1271		362
7	3	84.9	12	1190	1421	693
8	3	69.9	12	1561	1822	107
9	2	81.3	12	970		99
10	3	69	12	1534	1215	689
11	2	68.9	12	1044		418
12	3	60.7	12	1361	1349	65
13	2	65.8	12	1565		368
14	2	58.3	12	1788		212
15	3	82.3	12	983	1592	432
16	2	58.4	12	962		239
17	3	54.8	12	1207	1584	592

Trial Number : 11						
Bursts in Trial: 18						
Burst	**Number of Pulses**	**Pulse Width (µsec)**	**Chirp Width (MHz)**	**Pulse 1-to-2 Spacing (µsec)**	**Pulse 2-to-3 Spacing (µsec)**	**Start Location Within Interval (msec)**
1	2	92.6	6	909		37
2	2	53	6	1898		534
3	2	77	6	1284		627
4	1	96.3	6			463
5	2	74.4	6	1573		212
6	1	94.7	6			439
7	2	82.8	6	1041		267
8	2	51.2	6	1120		83
9	2	55.3	6	1558		578
10	2	52.3	6	1690		636
11	3	68.4	6	1221	1854	500
12	2	91.6	6	1753		51
13	2	81.7	6	1593		657
14	1	85.3	6			606
15	3	78.5	6	1627	1587	221
16	3	63.8	6	1065	1237	330
17	2	78.5	6	1206		217
18	2	83.6	6	1815		506

Trial Number : 12						
Bursts in Trial: 19						
Burst	**Number of Pulses**	**Pulse Width (µsec)**	**Chirp Width (MHz)**	**Pulse 1-to-2 Spacing (µsec)**	**Pulse 2-to-3 Spacing (µsec)**	**Start Location Within Interval (msec)**
1	2	84.3	14	1354		306
2	1	73.8	14			154
3	3	80.7	14	1586	1630	572
4	1	83.4	14			383
5	1	55.1	14			557
6	1	98.6	14			355
7	2	91.1	14	1852		75
8	2	69.9	14	1075		609
9	2	74.2	14	1476		131
10	1	72.9	14			243
11	3	85.5	14	1676	1318	280
12	3	58.8	14	1932	946	573
13	2	52.8	14	1594		613
14	1	88.6	14			522
15	2	52.2	14	1665		452
16	3	98.9	14	1160	1784	55
17	2	77.8	14	1059		234
18	2	79.1	14	1718		433
19	2	72.1	14	1912		451

Trial Number : 13						
Bursts in Trial: 20						
Burst	**Number of Pulses**	**Pulse Width (µsec)**	**Chirp Width (MHz)**	**Pulse 1-to-2 Spacing (µsec)**	**Pulse 2-to-3 Spacing (µsec)**	**Start Location Within Interval (msec)**
1	2	73.1	16	941		23
2	1	87.2	16			393
3	2	70.7	16	1233		435
4	3	88.4	16	1544	1097	102
5	2	54.9	16	995		415
6	2	75.6	16	1277		315
7	3	56.7	16	1778	1786	422
8	2	77.4	16	1166		153
9	2	63.3	16	1668		432
10	3	63.3	16	1202	1887	573
11	1	76.7	16			387
12	3	50.9	16	1131	1905	368
13	2	75	16	1262		177
14	2	56.7	16	1314		412
15	2	82.4	16	1007		28
16	3	54.8	16	1805	1672	131
17	2	98.9	16	1128		468
18	2	99	16	1618		259
19	2	68.1	16	1378		233
20	2	82.6	16	1331		298

Trial Number : 14						
Bursts in Trial: 8						
Burst	**Number of Pulses**	**Pulse Width (µsec)**	**Chirp Width (MHz)**	**Pulse 1-to-2 Spacing (µsec)**	**Pulse 2-to-3 Spacing (µsec)**	**Start Location Within Interval (msec)**
1	2	87.9	11	1229		825
2	2	95.7	11	1678		1170
3	1	55.3	11			222
4	1	51	11			900
5	2	64.2	11	959		881
6	2	55.7	11	1028		1403
7	2	95.2	11	1000		85
8	1	92.9	11			1313

Trial Number : 15						
Bursts in Trial: 9						
Burst	**Number of Pulses**	**Pulse Width (µsec)**	**Chirp Width (MHz)**	**Pulse 1-to-2 Spacing (µsec)**	**Pulse 2-to-3 Spacing (µsec)**	**Start Location Within Interval (msec)**
1	1	67.1	6			668
2	1	99.7	6			1297
3	1	74.6	6			455
4	2	79.6	6	1381		245
5	1	82.7	6			929
6	2	89.6	6	1739		878
7	1	58.3	6			625
8	3	70.7	6	953	1007	375
9	1	59	6			975

Trial Number : 16						
Bursts in Trial: 10						
Burst	**Number of Pulses**	**Pulse Width (µsec)**	**Chirp Width (MHz)**	**Pulse 1-to-2 Spacing (µsec)**	**Pulse 2-to-3 Spacing (µsec)**	**Start Location Within Interval (msec)**
1	2	91	8	1513		529
2	2	57.6	8	1915		869
3	3	84	8	1083	1098	853
4	2	56.3	8	1339		621
5	2	99.7	8	1764		155
6	2	64.8	8	1829		304
7	3	78.4	8	1217	1154	686
8	1	82.4	8			646
9	2	73.3	8	1756		1016
10	2	52.1	8	1389		191

Trial Number : 17						
Bursts in Trial: 11						
Burst	**Number of Pulses**	**Pulse Width (µsec)**	**Chirp Width (MHz)**	**Pulse 1-to-2 Spacing (µsec)**	**Pulse 2-to-3 Spacing (µsec)**	**Start Location Within Interval (msec)**
1	2	50.3	6	1548		570
2	3	77.6	6	952	1575	534
3	1	96	6			12
4	2	79.2	6	1356		516
5	1	91.2	6			541
6	2	74	6	1454		1056
7	2	60.9	6	946		240
8	1	64.9	6			764
9	2	66.7	6	1475		849
10	1	97	6			429
11	2	56.6	6	1120		135

Trial Number : 18						
Bursts in Trial: 12						
Burst	**Number of Pulses**	**Pulse Width (µsec)**	**Chirp Width (MHz)**	**Pulse 1-to-2 Spacing (µsec)**	**Pulse 2-to-3 Spacing (µsec)**	**Start Location Within Interval (msec)**
1	2	94.9	8	1002		765
2	3	58.3	8	1860	1654	968
3	2	65	8	1135		746
4	3	91.5	8	1490	1591	758
5	1	59.5	8			32
6	3	93.8	8	1756	1765	357
7	1	81.3	8			631
8	2	62	8	1379		977
9	1	73.6	8			513
10	2	71.2	8	1920		269
11	2	95.2	8	1177		108
12	3	75.1	8	1706	1806	39

Trial Number : 19						
Bursts in Trial: 13						
Burst	**Number of Pulses**	**Pulse Width (µsec)**	**Chirp Width (MHz)**	**Pulse 1-to-2 Spacing (µsec)**	**Pulse 2-to-3 Spacing (µsec)**	**Start Location Within Interval (msec)**
1	2	56.8	10	1907		284
2	2	73.7	10	1202		276
3	2	53.5	10	1521		829
4	1	51	10			679
5	3	80.4	10	1693	1318	671
6	2	84.2	10	1196		743
7	2	89.6	10	960		785
8	3	97.4	10	1293	1164	496
9	2	82.8	10	1589		312
10	2	69.9	10	1602		180
11	3	75.8	10	1425	1517	390
12	3	69.7	10	1405	1062	567
13	1	70.6	10			750

Trial Number : 20						
Bursts in Trial: 14						
Burst	**Number of Pulses**	**Pulse Width (µsec)**	**Chirp Width (MHz)**	**Pulse 1-to-2 Spacing (µsec)**	**Pulse 2-to-3 Spacing (µsec)**	**Start Location Within Interval (msec)**
1	3	74.8	7	1764	1680	825
2	2	66.4	7	1933		90
3	2	83	7	1621		739
4	2	82	7	1277		798
5	2	86.8	7	1247		355
6	2	65.1	7	1814		607
7	2	83.6	7	1892		421
8	2	92.7	7	1239		392
9	3	68	7	1169	1616	679
10	1	78.6	7			267
11	3	60.4	7	1000	1056	54
12	3	60.9	7	1844	1819	396
13	2	51	7	1182		207
14	3	62.9	7	1106	1070	320

Trial Number : 21						
Bursts in Trial: 15						
Burst	**Number of Pulses**	**Pulse Width (µsec)**	**Chirp Width (MHz)**	**Pulse 1-to-2 Spacing (µsec)**	**Pulse 2-to-3 Spacing (µsec)**	**Start Location Within Interval (msec)**
1	2	99.8	7	1259		719
2	2	98.7	7	1199		229
3	1	96.2	7			68
4	3	87.9	7	1528	1606	552
5	1	69.2	7			641
6	2	85.9	7	1276		373
7	3	82.2	7	1394	1396	219
8	2	90.9	7	940		754
9	2	65.9	7	1520		435
10	2	96.9	7	1626		88
11	2	85.5	7	1426		351
12	2	98.4	7	1878		19
13	1	94.7	7			734
14	3	71.8	7	1540	1365	320
15	3	66.3	7	1751	1912	83

Trial Number : 22						
Bursts in Trial: 16						
Burst	**Number of Pulses**	**Pulse Width (µsec)**	**Chirp Width (MHz)**	**Pulse 1-to-2 Spacing (µsec)**	**Pulse 2-to-3 Spacing (µsec)**	**Start Location Within Interval (msec)**
1	1	66.5	8			331
2	2	56.4	8	1345		9
3	1	66.8	8			233
4	1	85.1	8			193
5	1	79.2	8			83
6	3	84.5	8	1091	1573	451
7	2	52.2	8	1038		304
8	2	80.1	8	996		65
9	3	84.6	8	1546	1505	732
10	2	64.1	8	976		668
11	1	63.1	8			678
12	1	60.7	8			486
13	3	66.8	8	1894	1234	419
14	1	72.5	8			704
15	2	96.2	8	1678		34
16	2	92.5	8	1218		156

Trial Number : 23						
Bursts in Trial: 17						
Burst	**Number of Pulses**	**Pulse Width (µsec)**	**Chirp Width (MHz)**	**Pulse 1-to-2 Spacing (µsec)**	**Pulse 2-to-3 Spacing (µsec)**	**Start Location Within Interval (msec)**
1	2	78.4	10	1769		244
2	2	83.6	10	1312		347
3	2	57.6	10	1196		552
4	2	61.3	10	1216		402
5	1	95.2	10			11
6	3	64.8	10	1846	1405	479
7	2	96.1	10	1851		41
8	2	67.4	10	1146		123
9	1	70.4	10			62
10	1	90.5	10			152
11	2	69.6	10	1257		458
12	2	57.8	10	1724		492
13	1	54.5	10			163
14	1	69.7	10			362
15	1	81.6	10			128
16	2	51	10	1144		288
17	3	90	10	1573	1485	643

Trial Number : 24						
Bursts in Trial: 18						
Burst	**Number of Pulses**	**Pulse Width (µsec)**	**Chirp Width (MHz)**	**Pulse 1-to-2 Spacing (µsec)**	**Pulse 2-to-3 Spacing (µsec)**	**Start Location Within Interval (msec)**
1	3	72.7	18	1460	1225	368
2	3	65.6	18	1769	1797	587
3	2	69.9	18	1851		486
4	2	51.2	18	1215		355
5	3	82.4	18	999	1053	60
6	2	73.9	18	1742		61
7	1	93	18			482
8	3	61.7	18	1641	1921	657
9	2	77.1	18	991		394
10	1	98.7	18			118
11	1	71.7	18			81
12	2	53	18	1907		352
13	2	91.3	18	1570		343
14	1	69.9	18			215
15	2	91.4	18	1276		641
16	2	70.9	18	1466		651
17	2	77.8	18	1101		464
18	2	94.4	18	1596		433

Trial Number : 25						
Bursts in Trial: 19						
Burst	**Number of Pulses**	**Pulse Width (µsec)**	**Chirp Width (MHz)**	**Pulse 1-to-2 Spacing (µsec)**	**Pulse 2-to-3 Spacing (µsec)**	**Start Location Within Interval (msec)**
1	3	95.3	9	1152	1683	152
2	2	54.5	9	1137		370
3	3	90.4	9	1524	1142	579
4	2	51.8	9	995		278
5	1	80.7	9			511
6	2	69.2	9	1762		369
7	3	90.1	9	1202	1665	355
8	2	87.8	9	984		307
9	3	94.2	9	960	1328	88
10	3	82.9	9	1686	1625	402
11	3	94.1	9	1277	1456	312
12	3	98.5	9	1054	1360	591
13	2	84.9	9	1214		306
14	2	57.7	9	1682		349
15	2	97.9	9	1454		28
16	1	77	9			169
17	1	74.4	9			257
18	1	50	9			563
19	1	95.4	9			464

Trial Number : 26						
Bursts in Trial: 20						
Burst	**Number of Pulses**	**Pulse Width (µsec)**	**Chirp Width (MHz)**	**Pulse 1-to-2 Spacing (µsec)**	**Pulse 2-to-3 Spacing (µsec)**	**Start Location Within Interval (msec)**
1	3	94.5	17	1034	1142	555
2	1	72.9	17			144
3	2	89.8	17	1547		240
4	1	62.9	17			438
5	1	57.2	17			271
6	3	56.2	17	1027	1476	112
7	1	84.5	17			383
8	3	90.2	17	1781	1428	421
9	1	86.6	17			161
10	3	58.7	17	1267	974	144
11	2	62.5	17	1777		403
12	1	91.2	17			458
13	2	93.5	17	927		536
14	3	71.5	17	1001	1305	582
15	3	91.7	17	1530	938	77
16	1	71.9	17			130
17	2	72.8	17	1661		38
18	1	54.6	17			140
19	2	55.8	17	1671		185
20	2	69.7	17	962		528

Trial Number : 27						
Bursts in Trial: 12						
Burst	Number of Pulses	Pulse Width (µsec)	Chirp Width (MHz)	Pulse 1-to-2 Spacing (µsec)	Pulse 2-to-3 Spacing (µsec)	Start Location Within Interval (msec)
1	2	59.6	12	966		379
2	3	73.1	12	1244	1696	561
3	2	54.6	12	1225		931
4	3	92.2	12	1272	1503	714
5	2	65.1	12	1381		283
6	3	69.4	12	1471	1883	150
7	1	52.2	12			984
8	3	99.3	12	1355	1819	666
9	1	60.2	12			651
10	1	80.4	12			859
11	1	70	12			163
12	2	85.5	12	1350		518

Trial Number : 28						
Bursts in Trial: 13						
Burst	Number of Pulses	Pulse Width (µsec)	Chirp Width (MHz)	Pulse 1-to-2 Spacing (µsec)	Pulse 2-to-3 Spacing (µsec)	Start Location Within Interval (msec)
1	1	85.1	10			388
2	2	87.7	10	1791		474
3	3	73.6	10	1566	1479	830
4	3	59.7	10	1363	1271	498
5	2	77.7	10	1345		312
6	1	56.3	10			248
7	1	56.7	10			368
8	2	75.6	10	1639		480
9	2	55.3	10	1175		637
10	2	66.6	10	1756		175
11	3	57.2	10	963	1051	462
12	3	70.1	10	1792	1216	516
13	1	89.3	10			240

Trial Number : 29						
Bursts in Trial: 14						
Burst	Number of Pulses	Pulse Width (µsec)	Chirp Width (MHz)	Pulse 1-to-2 Spacing (µsec)	Pulse 2-to-3 Spacing (µsec)	Start Location Within Interval (msec)
1	3	69.3	18	1346	1256	225
2	3	80.3	18	1839	1142	256
3	2	77.5	18	1031		294
4	2	63	18	1237		103
5	3	53.1	18	985	1485	842
6	1	61.8	18			487
7	3	61.2	18	1801	1341	701
8	2	93.6	18	1073		354
9	2	69.1	18	979		597
10	3	78.4	18	1367	1856	548
11	2	62.8	18	1675		435
12	1	77.7	18			32
13	2	97.1	18	1891		518
14	2	89.6	18	1597		509

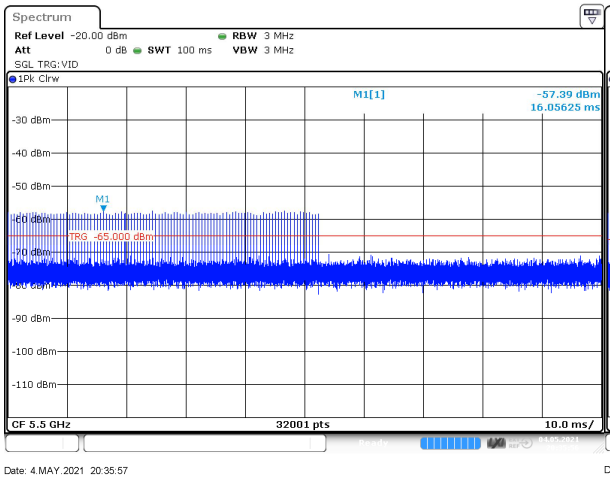
Trial Number : 30						
Bursts in Trial: 15						
Burst	**Number of Pulses**	**Pulse Width (µsec)**	**Chirp Width (MHz)**	**Pulse 1-to-2 Spacing (µsec)**	**Pulse 2-to-3 Spacing (µsec)**	**Start Location Within Interval (msec)**
1	2	72.7	15	1801		182
2	2	65.1	15	1686		758
3	3	55	15	1451	993	266
4	3	62.7	15	1250	1380	290
5	2	57.9	15	1524		669
6	1	92.3	15			206
7	3	86.4	15	1791	1690	498
8	2	60.5	15	1259		490
9	2	54.4	15	1554		557
10	2	87.4	15	938		716
11	2	99.4	15	1858		289
12	2	91.7	15	1407		544
13	2	67.5	15	1021		727
14	2	70.2	15	1220		548
15	2	98	15	993		653

Pulse Type 6

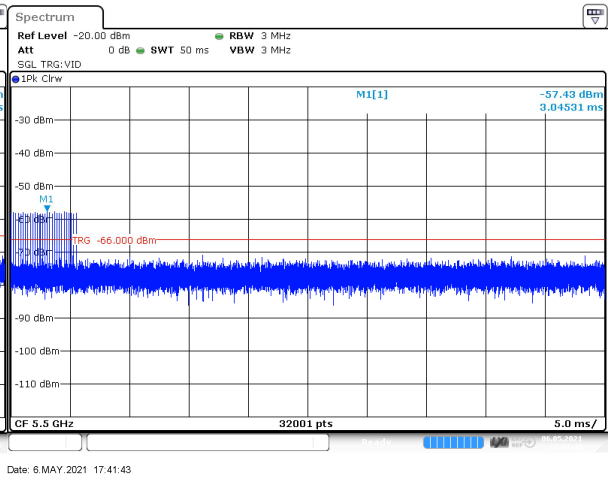
Radar Type	Pulse Width (µsec)	PRI (µsec)	Pulses per Hop	Hopping Rate (kHz)	Hopping Sequence Length (msec)	Minimum Percentage of Successful Detection	Minimum Number of Trials
6	1	333	9	0.333	300	70%	30

Radar Pulse Calibrations

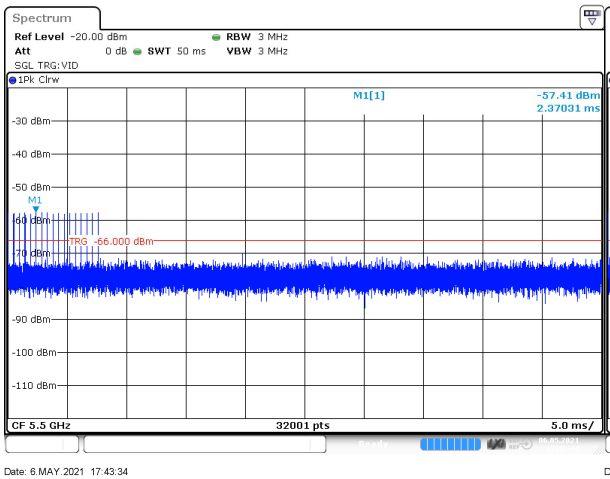
For Radar Pulse level calibration an additional 3.5 dBi antenna gain and 1.2 dB cable attenuation of temporary antenna connector were added to the -62 dBm threshold level.



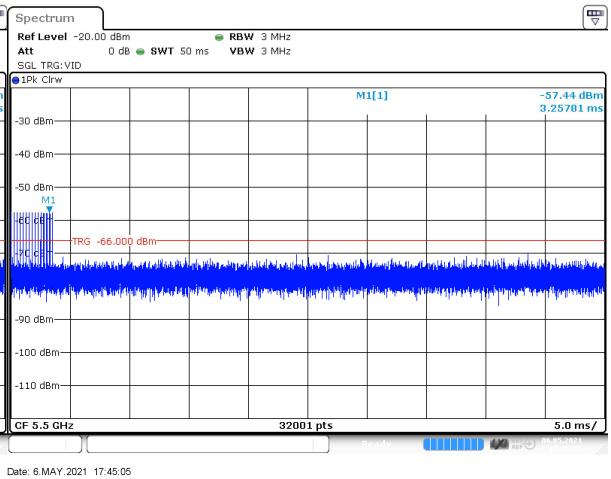
Pulse Type 1



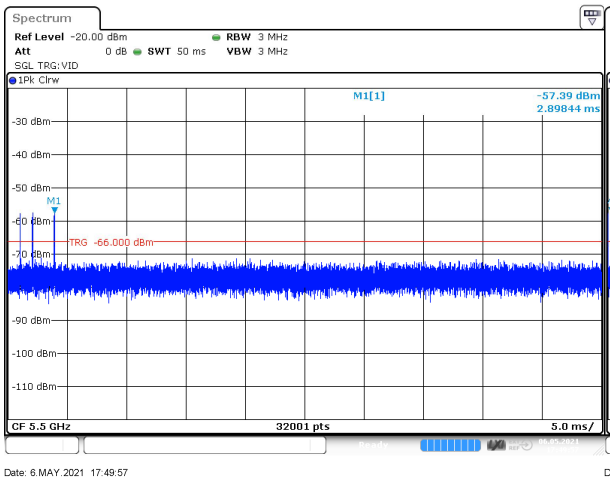
Pulse Type 2



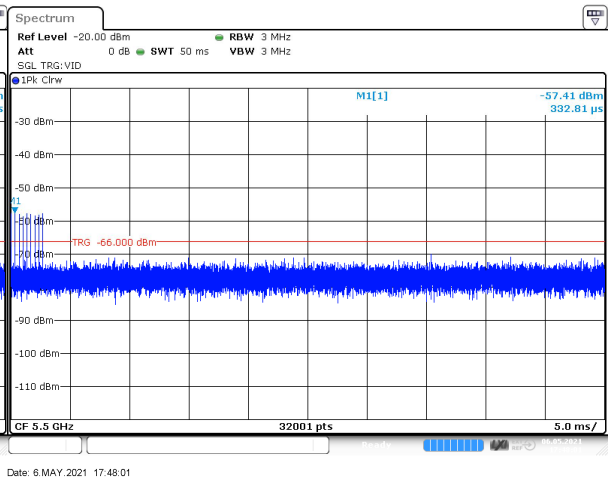
Pulse Type 3



Pulse Type 4



Pulse Type 5



Pulse Type 6

5.4.5 TEST EQUIPMENT USED

- R&S TS8997

6 TEST EQUIPMENT

1 R&S TS8997
2.4 and 5 GHz Bands Conducted Test Lab

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
1.1	FSV30	Signal Analyzer 10 Hz - 30 GHz	Rohde & Schwarz	103005	2020-05	2022-05
1.2	Opus10 THI (8152.00)	T/H Logger 15	Lufft Mess- und Regeltechnik GmbH	13985	2019-06	2021-06
1.3	Opus10 THI (8152.00)	T/H Logger 14	Lufft Mess- und Regeltechnik GmbH	13993	2019-06	2021-06
1.4	SMBV100A	Vector Signal Generator 9 kHz - 6 GHz	Rohde & Schwarz	259291	2019-11	2022-11

The calibration interval is the time interval between “Last Calibration” and “Calibration Due”

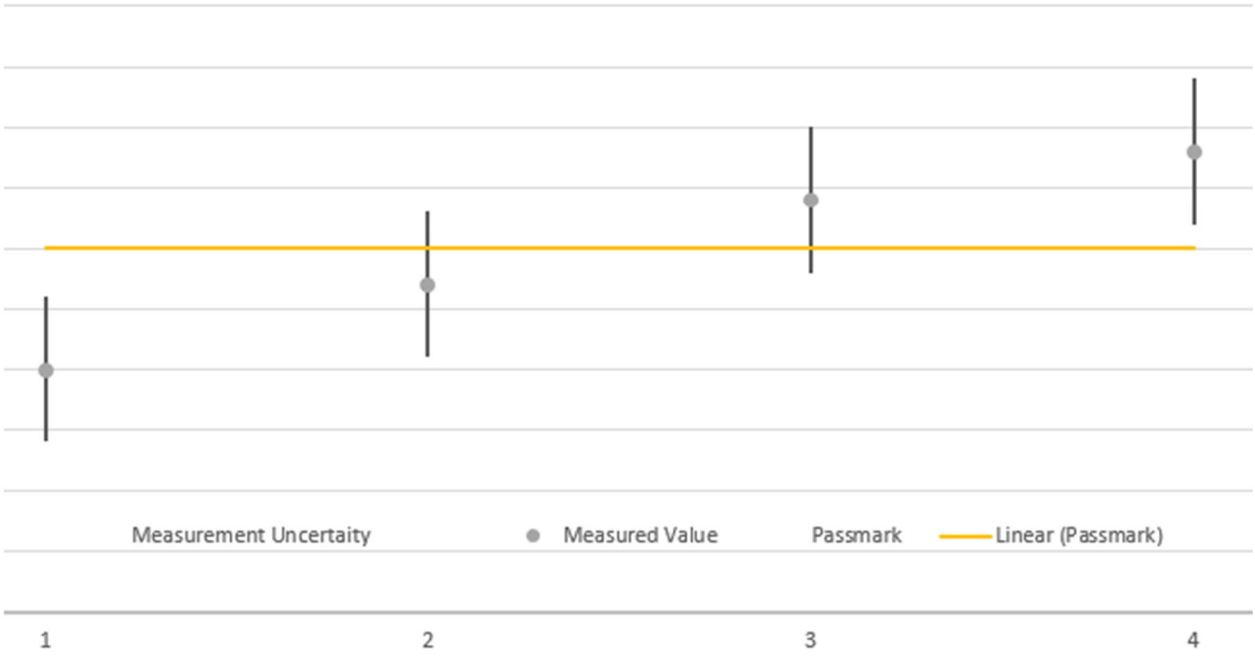
7 PHOTO REPORT

Please see separate photo report.

8 MEASUREMENT UNCERTAINTIES

Test Case	Parameter	Uncertainty
Conducted Output Power	Power	± 2.2 dB
Level of Radar Signal	Power	± 2.7 dB
Timing, Duration	Time	± 5%

The measurement uncertainties for all parameters are calculated with an expansion factor (coverage factor) k = 1.96. This means, that the true value is in the corresponding interval with a probability of 95 %.



The verdicts in this test report are given according the above diagram:

Case	Measured Value	Uncertainty Range	Verdict
1	below pass mark	below pass mark	Passed
2	below pass mark	within pass mark	Passed
3	above pass mark	within pass mark	Failed
4	above pass mark	above pass mark	Failed

That means, the laboratory applies, as decision rule (see ISO/IEC 17025:2017), the so-called shared risk principle.