FCC Measurement/Technical Report on

WLAN and Bluetooth module JODY-W2

FCC ID: XPYJODYW263
IC: 8595A-JODYW263

Test Report Reference: MDE_UBLOX_2008_FCC_05

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 (10-1-19 Edition) 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: 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: 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: 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: 8.3
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	S01_AI01	2021-03-03	Passed	Passed
WLAN ac 40 MHz, 5510 MHz	S01_AI01	2021-03-03	Passed	Passed
WLAN ac 80 MHz, 5530 MHz	S01_AI01	2021-03-03	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 ac 80 MHz, 5530 MHz	S01_AI01	2021-03-03	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 ac 80 MHz, 5530 MHz	S01_AI01	2021-03-11	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	S01_AI01	2021-04-12	Passed	Passed
WLAN ac 40 MHz, 5510 MHz	S01_AI01	2021-04-12	Passed	Passed
WLAN ac 80 MHz, 5530 MHz	S01_AI01	2021-04-12	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	2021-07-15	--	valid
--	--	--	--

COMMENT: This report is a DFS report only. The other applicable tests are not part of this report.

(responsible for accreditation scope)
Dipl.-Ing. Marco Kullik

(responsible for testing and report)
Dipl.-Ing. Daniel Gall

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. Marco Kullik
Report Template Version:	2021-01-13

3.2 PROJECT DATA

Responsible for testing and report:	Dipl.-Ing. Daniel Gall
Employees who performed the tests:	documented internally at 7Layers
Date of Report:	2021-07-15
Testing Period:	2021-03-03 to 2021-04-12

3.3 APPLICANT DATA

Company Name:	u-blox AG
Address:	Zürcherstrasse 68 8800 Thalwil Switzerland
Contact Person:	Mr. Filip Kruzela

3.4 MANUFACTURER DATA

Company Name:	please see Applicant Data
Address:	
Contact Person:	

4 TEST OBJECT DATA

4.1 GENERAL EUT DESCRIPTION

Kind of Device product description	Host-based module with Wi-Fi and Bluetooth 5.0
Product name	JODY-W263-01A
Type	JODY-W263-01A
Declared EUT data by the supplier	
Voltage Type	DC
Voltage Level	1.8 and 3.3 V at Module (voltage is generated on the auxiliary carrier board, which is supplied by USB from the computer board)
Tested Modulation Type	OFDM
Specific product description	The EUT is a Bluetooth and WLAN module. In the 5 GHz band it supports SISO Mode only. Supported WLAN modes are a, n and ac, with a 20 MHz BW, n 20 and 40 MHz BW as well as ac in 20, 40 and 80 MHz 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.
Ports of the device	Enclosure Data DC Power Antenna
Data Rates	WLAN a: up to 56 Mbit WLAN n: up to 150 Mbit WLAN ac: up to 433 Mbit
Antennas	External. 4.6 dBi
Antenna Connector Impedance	50 Ohms
Special software used for testing	The test modes were set by scripts and command line commands provided by the applicant on an auxiliary computer board.
Transmit Power Control	Not Supported
Power level of the EUT (E.I.R.P.)	19.7 dBm, 7.5 dBm/MHz
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.
Antenna Assembly gain used for DFS Threshold Level	0 dBi
Used threshold level	-62 dBm (EIRP < 200 mW and power spectral density < 10 dBm/MHz)
Channel loading	The applicant provided a script that generates traffic at irregular intervals. The amount of traffic was set by the laboratory to comply with the > 17 % DC criterion.
Pulse Type Generation	Pulses were randomly generated using Rohde & Schwarz K6 Pulse sequencer.

4.2 EUT MAIN COMPONENTS

Sample Name	Sample Code	Description
EUT ai01	DE1015121ai01	
Sample Parameter	**Value**	
Serial No.	E98CCF957E012880300	
HW Version	00	
SW Version	16.80.205.p164	
Comment	EUT used as Master	

Sample Name	Sample Code	Description
EUT al01	DE1015121al01	
Sample Parameter	**Value**	
Serial No.	E98CCF957E012440300	
HW Version	00	
SW Version	16.80.205.p164	
Comment	EUT used as Client	

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**
AUX2	Toradex, Ixora, V 1.2a, Angstrom v2017.12 Apalis-TK1_console-Image 2.8b5 20200801, 10629806	Board Computer
AUX6	UBLOX, JODY-Carrier Board , Rev. C, - , 10000001898798003001	Carrier Board for module providing ports
AUX7	UBLOX, JODY-Carrier Board , Rev. C, - , 10000001914323007002	Carrier Board for module providing ports
AUX10	Toradex, Ixora, V 1.2a, Angstrom v2017.12 Apalis-TK1_console-Image 2.8b5 20200801, 10629857	Board Computer

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**
S01_AA01	EUT ai01, EUT al01, AUX2, AUX6, AUX7, AUX10	Conducted DFS Setup

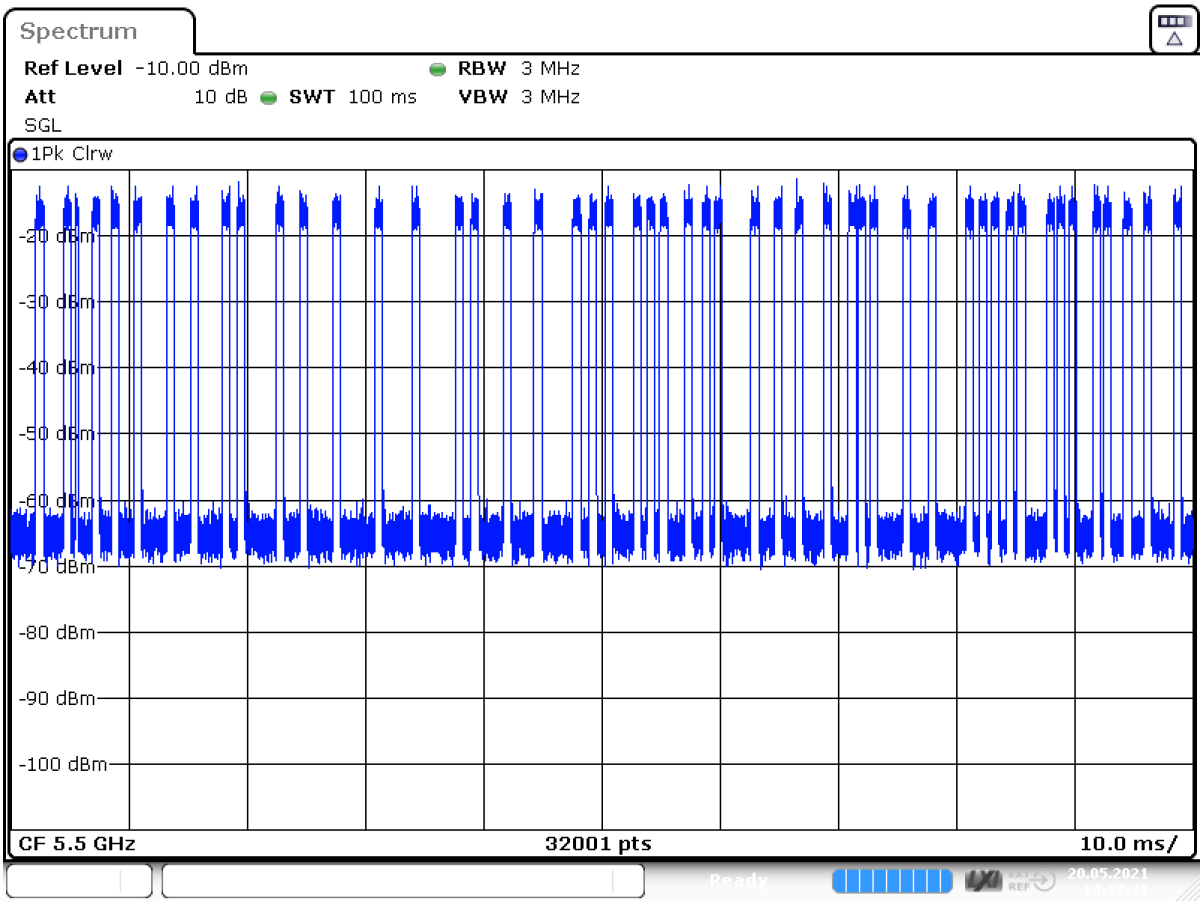
4.6 OPERATING MODES / TEST CHANNELS

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
low	mid	high	low	mid	high	40 MHz
-	-	-	102	-	-	Ch.-No.
-	-	-	5510	-	-	MHz
low	mid	high	low	mid	high	80 MHz
-	-	-	108	-	-	Ch.-No.
-	-	-	5530	-	-	MHz

Channel Loading Duty Cycle

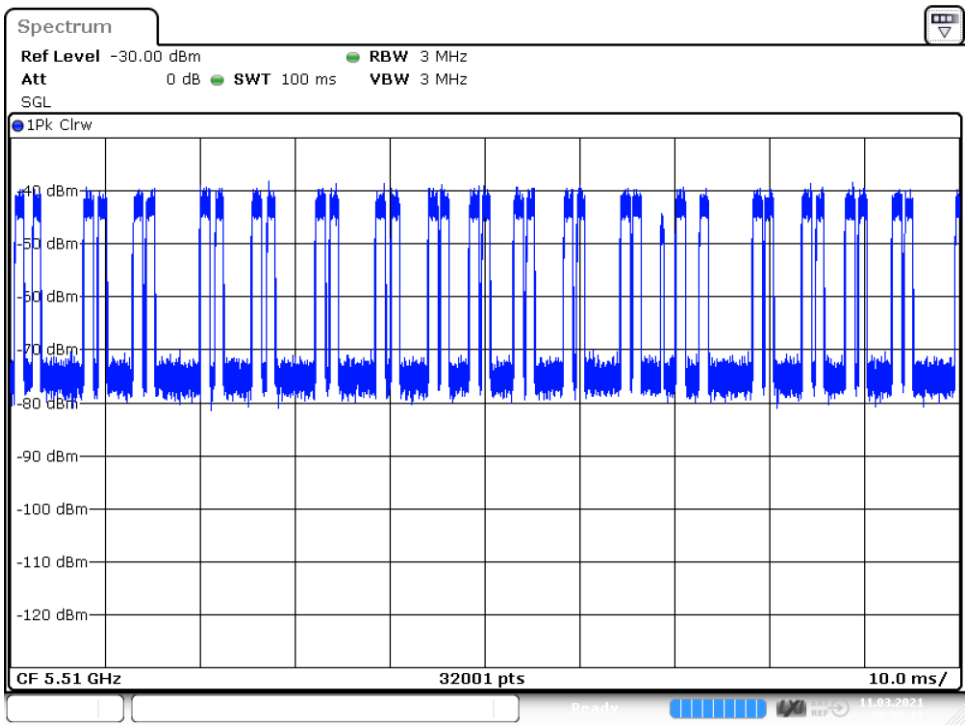
WLAN a



Date: 20.MAY.2021 14:17:32

Comment: 10289 points above -40 dBm corresponds to 32 % DC

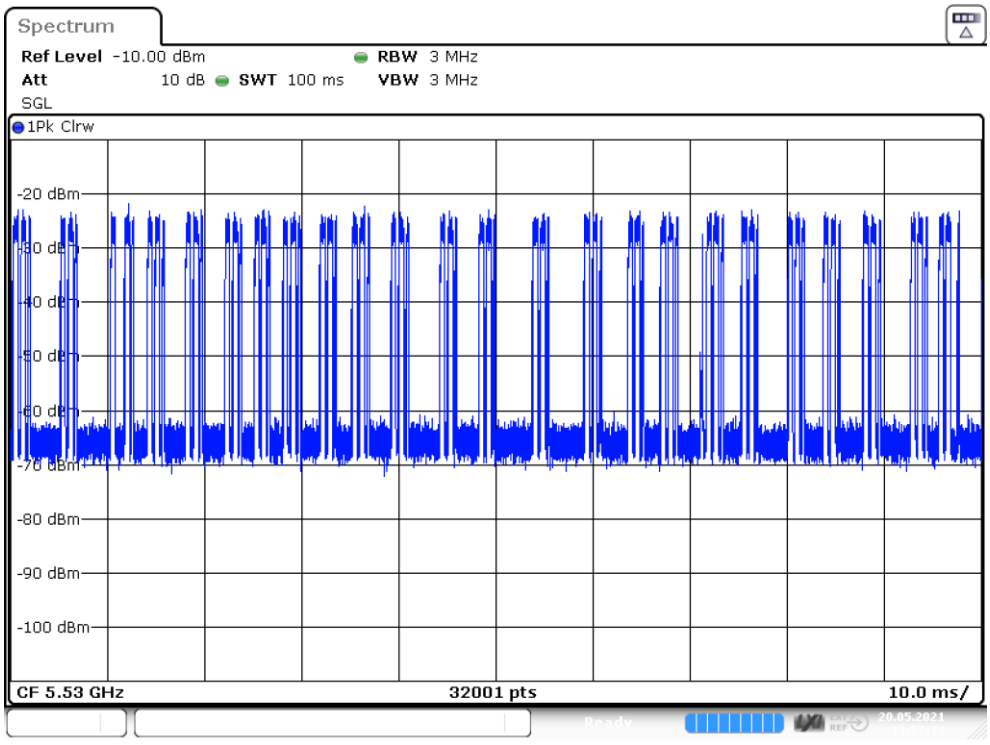
WLAN ac 40 MHz



Date: 11.MAR.2021 22:05:13

Comment: 10601 points above -50 dBm corresponds to 33 % DC

WLAN ac 80 MHz



Date: 20.MAY.2021 13:57:15

Comment: 9638 points above -40 dBm corresponds to 30 % DC

4.7 PRODUCT LABELLING

4.7.1 FCC ID LABEL

Please refer to the documentation of the applicant.

4.7.2 LOCATION OF THE LABEL ON THE EUT

Please refer to the documentation of the applicant.

5 TEST RESULTS

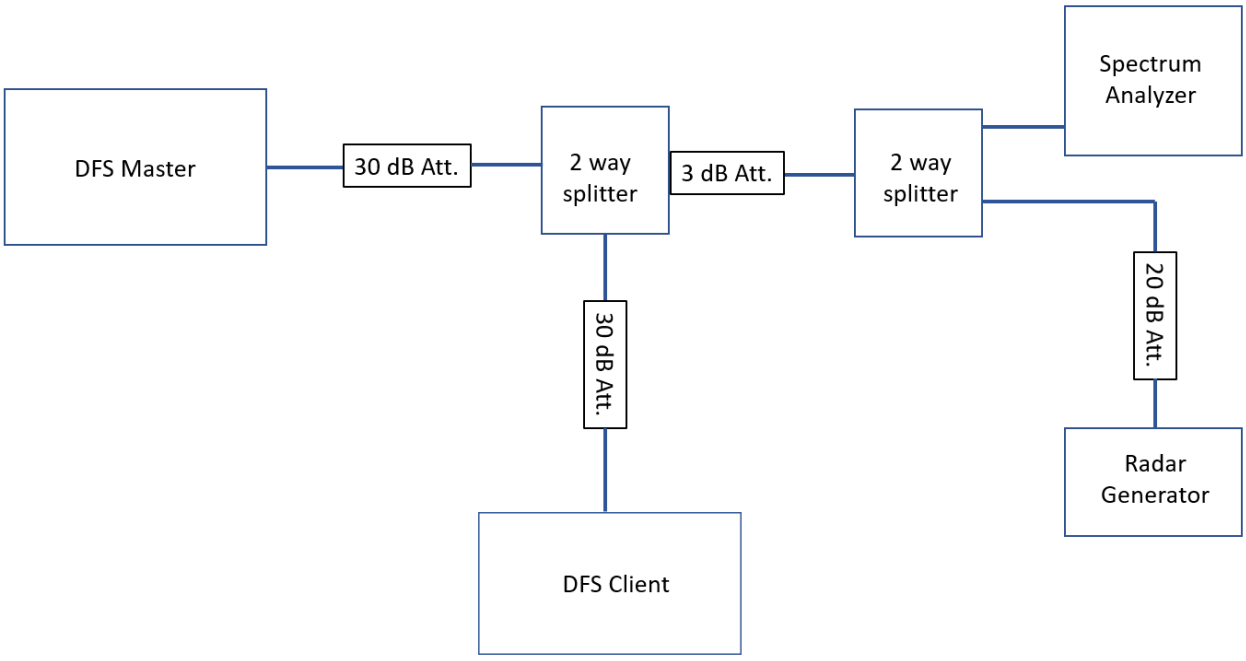
5.1 DYNAMIC FREQUENCY SELECTION, U-NII DETECTION BANDWIDTH

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: 24 °C
Air Pressure: 990 hPa
Humidity: 30 %

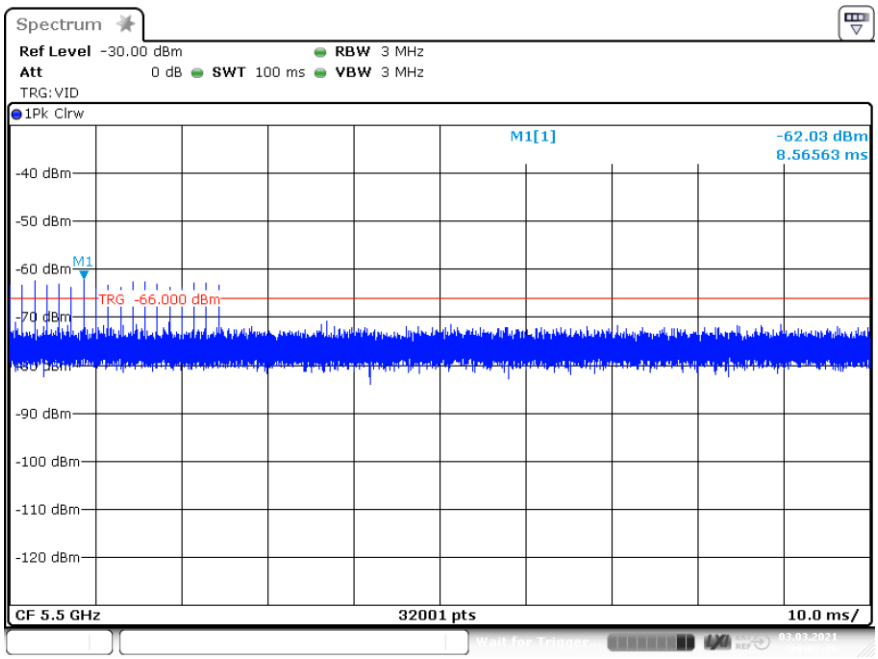
Mode	TX Frequency [MHz]	Channel BW [MHz]	Radar Test Signal #	F_L [MHz]	F_H [MHz]	Detection BW [MHz]	99 % BW [MHz]
WLAN a	5500	20	Radar Type 0	5491	5509	18	17.7
WLAN ac 40 MHz	5510	40	Radar Type 0	5491	5529	38	36.5
WLAN ac 80 MHz	5530	80	Radar Type 0	5491	5569	78	76.5

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

5.1.4 MEASUREMENT RESULT

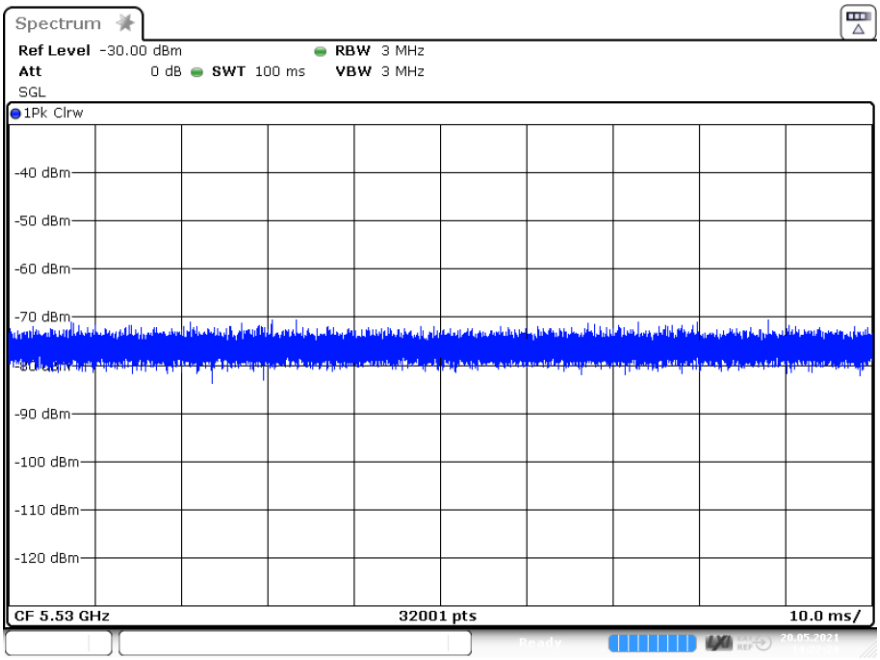
MHz from Centre	TX Frequency [MHz]	Channel BW [MHz]	Detected	TX Freq. [MHz]	Channel BW [MHz]	Detected	TX Freq. [MHz]	Channel BW [MHz]	Detected
-40							5530	80	0
-39							5530	80	10
-38							5530	80	10
-37							5530	80	10
-36							5530	80	10
-35							5530	80	10
-30							5530	80	10
-25							5530	80	10
-20				5510	40	0	5530	80	10
-19				5510	40	9	5530	80	
-18				5510	40	10	5530	80	
-17				5510	40	10	5530	80	
-16				5510	40	10	5530	80	
-15				5510	40	10	5530	80	9
-10	5500	20	0	5510	40	10	5530	80	10
-9	5500	20	9	5510	40		5530	80	
-8	5500	20	10	5510	40		5530	80	
-7	5500	20	10	5510	40		5530	80	
-6	5500	20	10	5510	40		5530	80	
-5	5500	20	10	5510	40	10	5530	80	10
0	5500	20	10	5510	40	10	5530	80	10
5	5500	20	10	5510	40	10	5530	80	10
6	5500	20	10	5510	40		5530	80	
7	5500	20	10	5510	40		5530	80	
8	5500	20	10	5510	40		5530	80	
9	5500	20	10	5510	40		5530	80	
10	5500	20	0	5510	40	10	5530	80	10
15				5510	40	10	5530	80	10
16				5510	40	10	5530	80	
17				5510	40	10	5530	80	
18				5510	40	10	5530	80	
19				5510	40	10	5530	80	
20				5510	40	0	5530	80	10
25							5530	80	10
30							5530	80	10
35							5530	80	10
36							5530	80	10
37							5530	80	10
38							5530	80	10
39							5530	80	10
40							5530	80	10

Radar Pulse Level Calibration



Date: 3.MAR.2021 20:03:26

Radar Pulse level



Date: 20.MAY.2021 14:22:30

Noise Level

5.1.5 TEST EQUIPMENT USED

- R&S TS8997

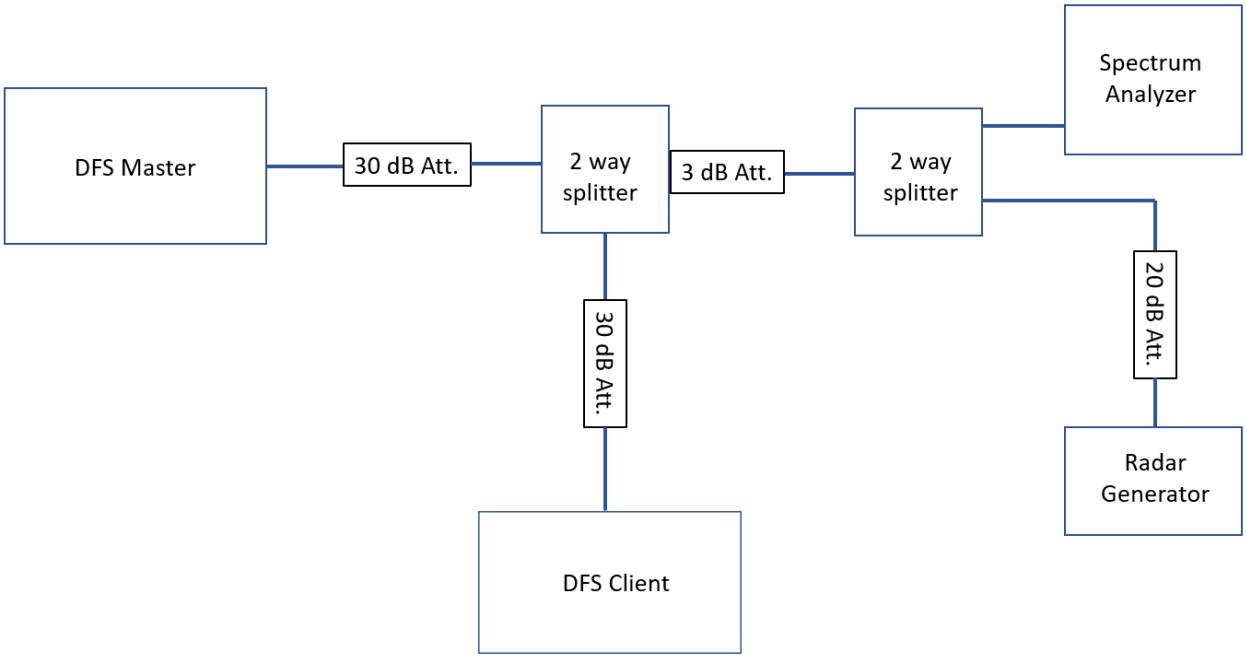
5.2 DYNAMIC FREQUENCY SELECTION, CHANNEL AVAILABILITY CHECK TIME

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 together with it's auxiliary computer board.

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.

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.

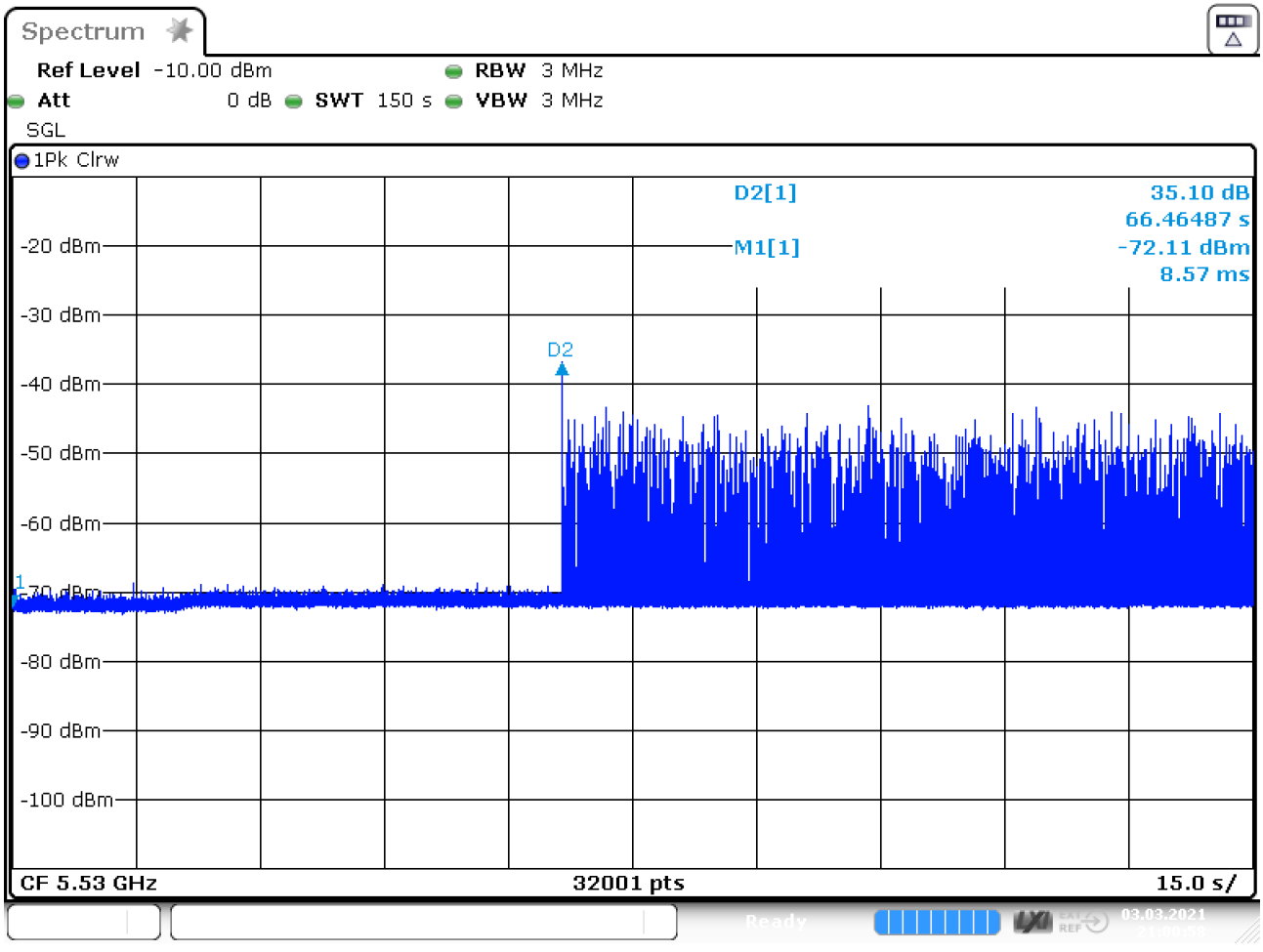
5.2.3 TEST PROTOCOL

Ambient temperature: 24 °C
Air Pressure: 990 hPa
Humidity: 30 %

Mode	TX Frequency [MHz]	Radar Test Signal #	Detected?	Transmissions within 150 s?
WLAN ac 80 MHz	5530	Type 0 @ 0 to 6 s	Yes	No
WLAN ac 80 MHz	5530	Type 0 @ 54 to 60 s	Yes	No

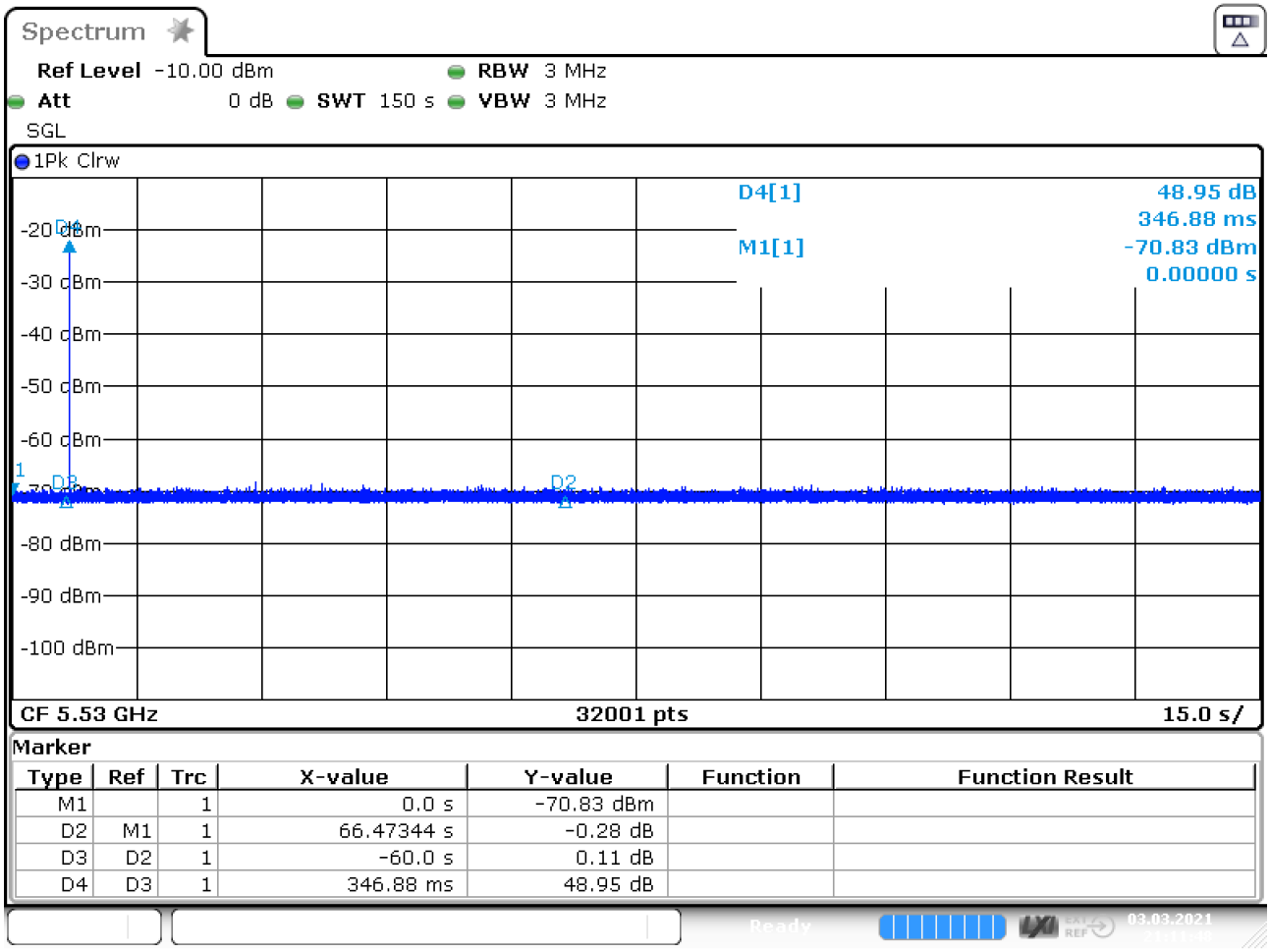
Remark: Please see next sub-clause for the measurement plot.
For radar pulse calibration see test case U-NII detection BW.

5.2.4 MEASUREMENT PLOT



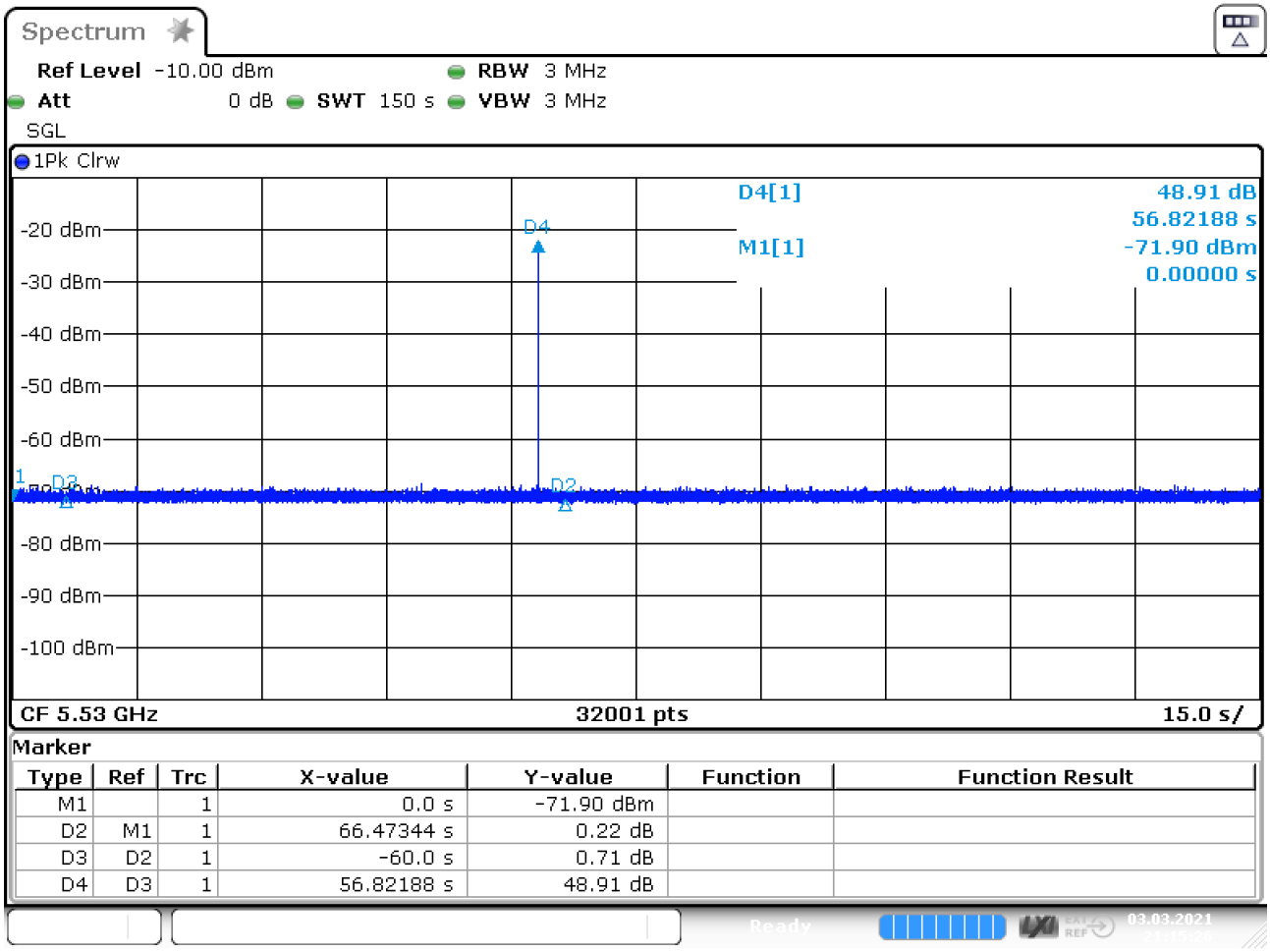
Date: 3.MAR.2021 21:00:59

Determination of startup time (no radar pulse send)
Resulting start up time: 6.5 s



Date: 3.MAR.2021 21:11:48

Radar Pulse at beginning of CAC period.
Emission of radar pulse at 0.3s after calculated startup (Marker D3)



Date: 3.MAR.2021 21:15:26

Radar Pulse at end of CAC period.
Emission of radar pulse at 56.8s after calculated startup (Marker D3)

5.2.5 TEST EQUIPMENT USED

- R&S TS8997

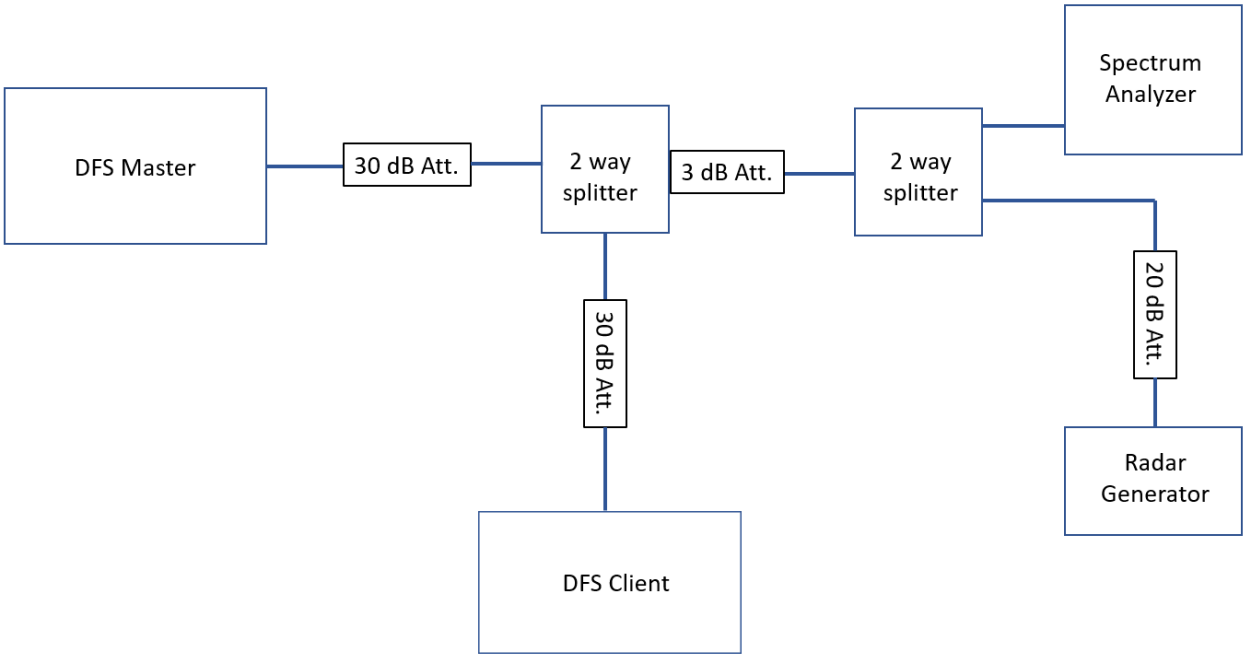
5.3 DYNAMIC FREQUENCY SELECTION, IN-SERVICE MONITORING FOR CHANNEL MOVE TIME, CHANNEL CLOSING TRANSMISSION TIME AND NON-OCCUPANCY PERIOD

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 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.

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

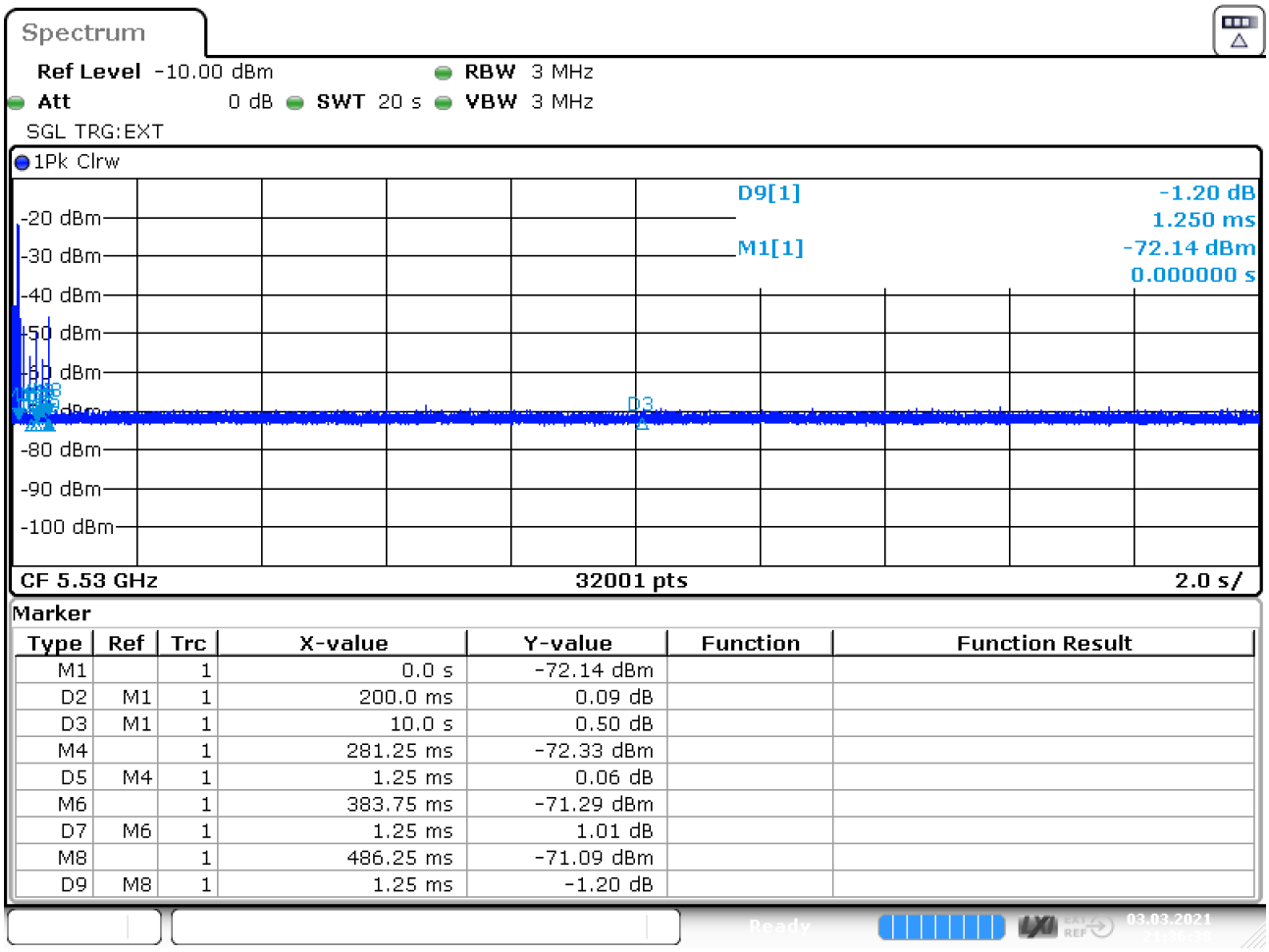
Master

Ambient temperature: 25 °C
Air Pressure: 990 hPa
Humidity: 30 %

WLAN ac 80 MHz						
TX Frequency [MHz]	**Radar Test Signal #**	**Channel Closing Transmission Time [ms]**	**Limit [ms]**	**Channel Move Time [s]**	**Limit [s]**	**Transmissions in Non-Occupancy Period?**
5530	Type 0	200 + 3.75	200 + 60	0.4875	10	None

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

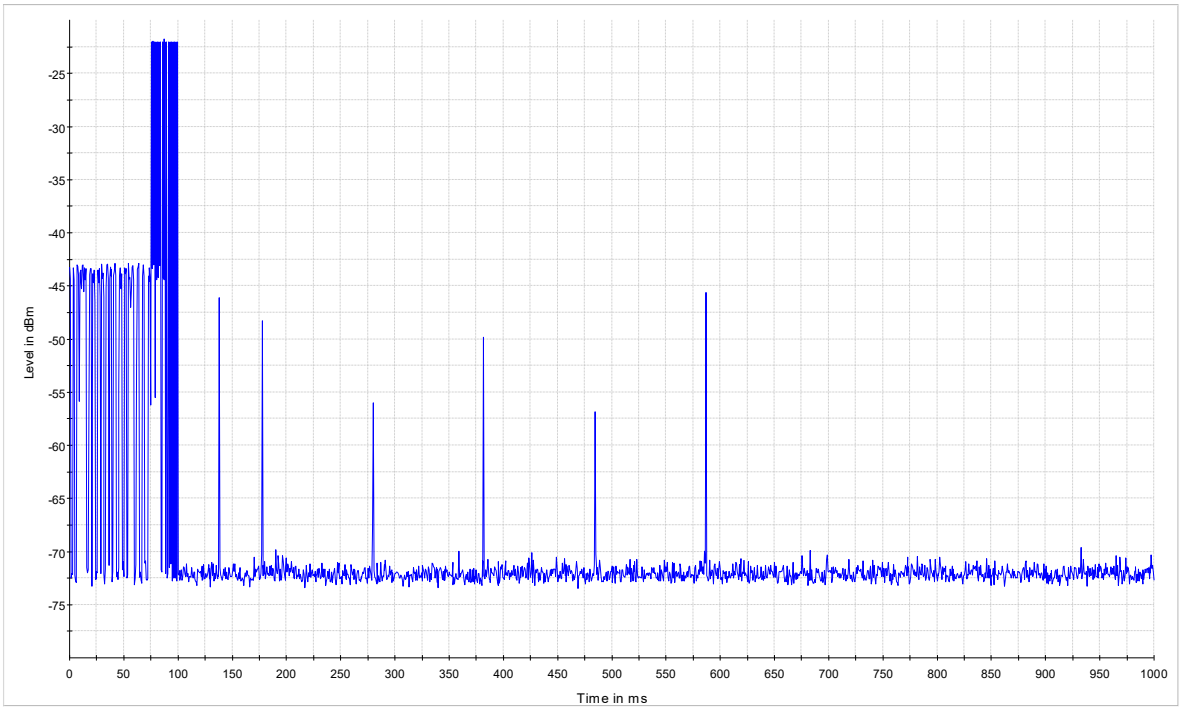
5.3.4 MEASUREMENT PLOT (EXAMPLE PLOT, SHOWING WORST CASE, IF APPLICABLE)



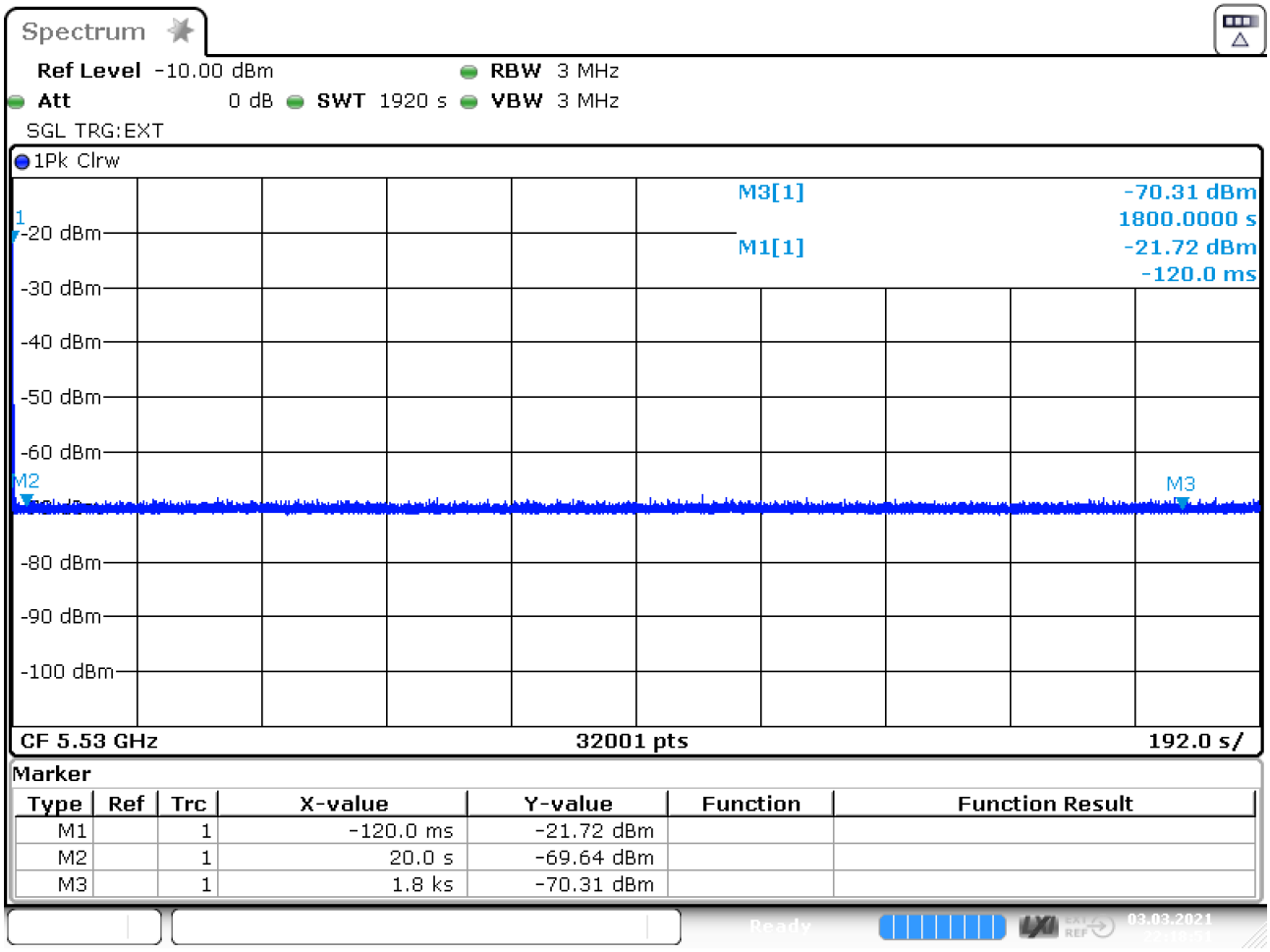
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	0.0 s	-72.14 dBm		
D2	M1	1	200.0 ms	0.09 dB		
D3	M1	1	10.0 s	0.50 dB		
M4		1	281.25 ms	-72.33 dBm		
D5	M4	1	1.25 ms	0.06 dB		
M6		1	383.75 ms	-71.29 dBm		
D7	M6	1	1.25 ms	1.01 dB		
M8		1	486.25 ms	-71.09 dBm		
D9	M8	1	1.25 ms	-1.20 dB		

Date: 3.MAR.2021 21:36:38

M1 = Radar Pulse, D2 = 200 ms after Radar Pulse end, D3 = Last Transmission end



Zoomed into trace data of channel move and channel closing time plot.
Time code is offset by trigger offset (100ms).



Date: 3.MAR.2021 22:18:51

Non Occupancy Period

5.3.5 TEST EQUIPMENT USED

- R&S TS8997

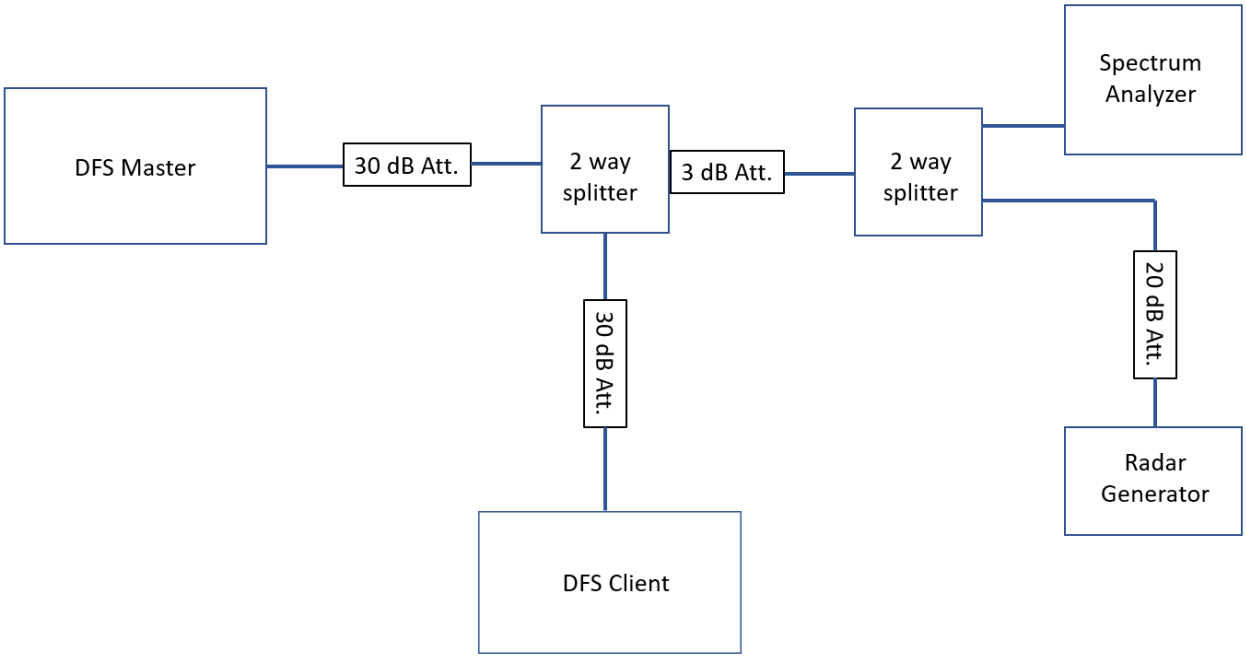
5.4 DYNAMIC FREQUENCY SELECTION, STATISTICAL PERFORMANCE CHECK

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 provided by the customer, the devices channel change functionality was deactivated and non-occupancy period reduced to 1 s to reduce testing time.

Detection of radar pulse is monitored by console interface.

30 unique pulses of radar type 1 to 6 are send 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 $\left\{\left(\frac{1}{360}\right)\cdot\left(\frac{19\cdot 10^6}{\text{PRI}_{\mu\text{sec}}}\right)\right\}$	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 °C
Air Pressure: 990 hPa
Humidity: 30 %

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	30	100	60
20 MHz	**5500**	Type 4	30	29	97	60
20 MHz	**5500**	Aggregate 1-4	120	118	98	80
20 MHz	**5500**	Type 5	30	30	100	80
20 MHz	**5500**	Type 6	30	30	100	70
40 MHz	**5510**	Type 1	30	30	100	60
40 MHz	**5510**	Type 2	30	27	90	60
40 MHz	**5510**	Type 3	30	28	93	60
40 MHz	**5510**	Type 4	30	27	90	60
40 MHz	**5510**	Aggregate 1-4	120	112	93	80
40 MHz	**5510**	Type 5	30	30	100	80
40 MHz	**5510**	Type 6	30	29	97	70
80 MHz	**5530**	Type 1	30	28	93	60
80 MHz	**5530**	Type 2	30	28	93	60
80 MHz	**5530**	Type 3	30	28	93	60
80 MHz	**5530**	Type 4	30	28	93	60
80 MHz	**5530**	Aggregate 1-4	120	112	93	80
80 MHz	**5530**	Type 5	30	30	100	80
80 MHz	**5530**	Type 6	30	29	97	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	yes	1	20	1	2692	yes
2	99	1	538	yes	2	19	1	2900	yes
3	95	1	558	yes	3	53	1	1004	no
4	92	1	578	no	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	yes
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	yes
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	yes
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	yes
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	yes	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	yes	11	9	1	333	yes
12	12	19.5	477	yes	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	no	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	yes	29	9	1	333	yes
30	16	17.3	323	yes	30	9	1	333	yes

40 MHz Bandwidth Pulse Types 1 to 4 and 6

RADAR TYPE 1 Table 5a					RADAR TYPE 1				
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	yes	1	20	1	2692	yes
2	99	1	538	yes	2	19	1	2900	yes
3	95	1	558	yes	3	53	1	1004	no
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	yes
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	yes
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	no	11	16	9.1	223	yes
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	yes
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	no
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					RARAR 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	yes	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	yes	11	9	1	333	yes
12	12	19.5	477	yes	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	yes	29	9	1	333	yes
30	16	17.3	323	yes	30	9	1	333	yes

Pulse Type 5

TYPE 5 20 MHz			TYPE 5 40 MHz		
Trial #	Detection (yes/no)	Radar Pulse Freq. [MHz]	Trial #	Detection (yes/no)	Radar Pulse Freq. [MHz]
1	yes	5500	1	yes	5510
2	yes	5500	2	yes	5510
3	yes	5500	3	yes	5510
4	yes	5500	4	yes	5510
5	yes	5500	5	yes	5510
6	no	5500	6	yes	5510
7	yes	5500	7	no	5510
8	no	5500	8	no	5510
9	yes	5500	9	yes	5510
10	yes	5500	10	yes	5510
11	no	5494.6	11	no	5496.7
12	yes	5497.8	12	yes	5499.9
13	yes	5498.6	13	yes	5500.7
14	yes	5496.6	14	yes	5498.7
15	no	5494.6	15	no	5496.7
16	no	5495.4	16	yes	5497.5
17	yes	5494.6	17	no	5496.7
18	yes	5495.4	18	yes	5497.5
19	yes	5496.2	19	yes	5498.3
20	no	5495	20	yes	5497.1
21	yes	5505	21	yes	5522.9
22	yes	5504.6	22	yes	5522.5
23	yes	5503.8	23	yes	5521.7
24	yes	5500.6	24	yes	5518.5
25	yes	5504.2	25	yes	5522.1
26	yes	5501	26	yes	5518.9
27	yes	5503	27	yes	5520.9
28	yes	5503.8	28	yes	5521.7
29	yes	5500.6	29	yes	5518.5
30	yes	5501.8	30	yes	5519.7

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

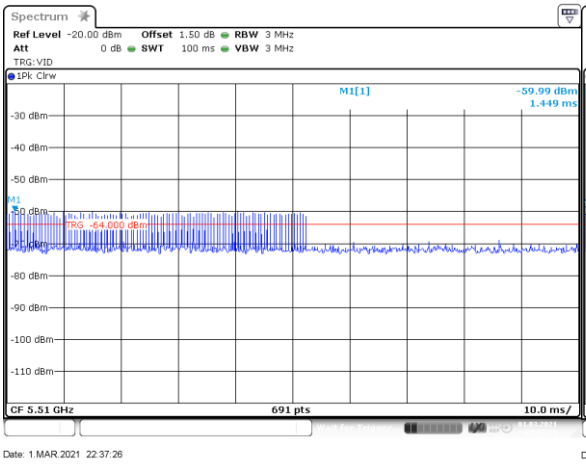
Trial Number : 29						
Bursts in Trial: 14						
Burst	**Number of Pulses**	**Pulse Width (µsec)**	**Chirp Width (MHz)**	**Pulse 1-to-2 Spacing (µsec)**	**Pulse 2-to-3 Spacing (µsec)**	**Start Location Within Interval (msec)**
1	3	69.3	18	1346	1256	225
2	3	80.3	18	1839	1142	256
3	2	77.5	18	1031		294
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

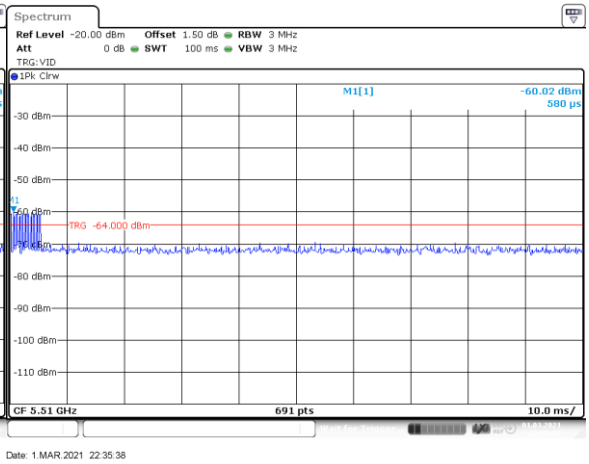
Pulse Type 6

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

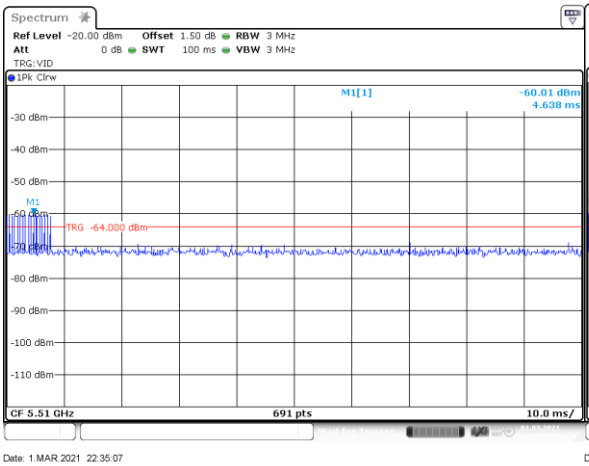
Radar Pulse Calibrations



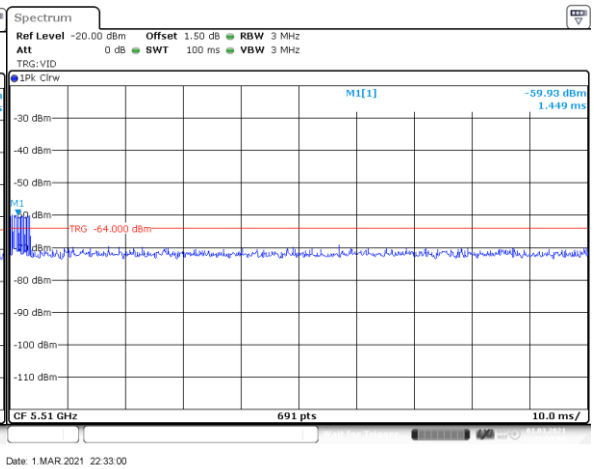
Pulse Type 1



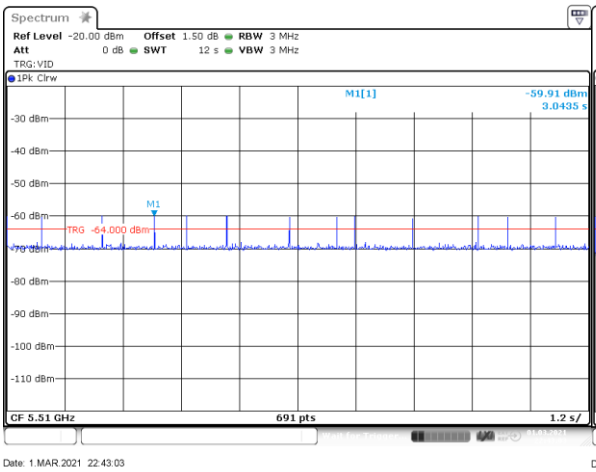
Pulse Type 2



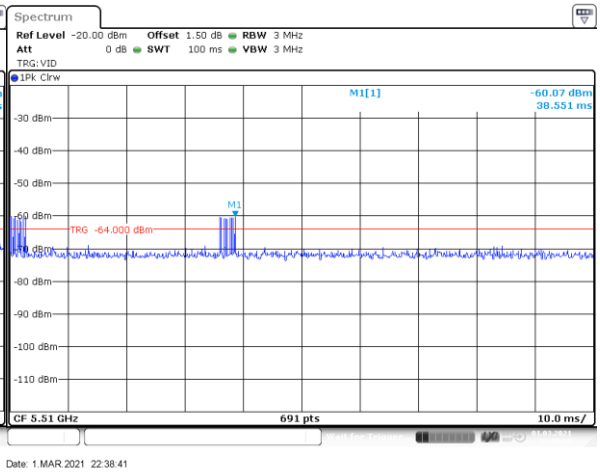
Pulse Type 3



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 ANTENNA FACTORS, CABLE LOSS AND SAMPLE CALCULATIONS

This chapter contains the antenna factors with their corresponding path loss of the used measurement path for all antennas as well as the insertion loss of the LISN.

7.1 LISN R&S ESH3-Z5 (150 KHZ – 30 MHZ)

Frequency		Corr.	LISN insertion loss ESH3-Z5	cable loss (incl. 10 dB atten-uator)
MHz		dB	dB	dB
0.15		10.1	0.1	10.0
5		10.3	0.1	10.2
7		10.5	0.2	10.3
10		10.5	0.2	10.3
12		10.7	0.3	10.4
14		10.7	0.3	10.4
16		10.8	0.4	10.4
18		10.9	0.4	10.5
20		10.9	0.4	10.5
22		11.1	0.5	10.6
24		11.1	0.5	10.6
26		11.2	0.5	10.7
28		11.2	0.5	10.7
30		11.3	0.5	10.8

Sample calculation

U_{LISN} (dB µV) = U (dB µV) + Corr. (dB)
U = Receiver reading
LISN Insertion loss = Voltage Division Factor of LISN
Corr. = sum of single correction factors of used LISN, cables, switch units (if used)
Linear interpolation will be used for frequencies in between the values in the table.

7.2 ANTENNA R&S HFH2-Z2 (9 KHZ – 30 MHZ)

Frequency	AF HFH-Z2)	Corr.	cable loss 1 (inside chamber)	cable loss 2 (outside chamber)	cable loss 3 (switch unit)	cable loss 4 (to receiver)	distance corr. (-40 dB/ decade)	d_{Limit} (meas. distance (limit)	d_{used} (meas. distance (used)
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB	m	m
0.009	20.50	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.01	20.45	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.015	20.37	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.02	20.36	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.025	20.38	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.03	20.32	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.05	20.35	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.08	20.30	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.1	20.20	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.2	20.17	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.3	20.14	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.49	20.12	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.490001	20.12	-39.6	0.1	0.1	0.1	0.1	-40	30	3
0.5	20.11	-39.6	0.1	0.1	0.1	0.1	-40	30	3
0.8	20.10	-39.6	0.1	0.1	0.1	0.1	-40	30	3
1	20.09	-39.6	0.1	0.1	0.1	0.1	-40	30	3
2	20.08	-39.6	0.1	0.1	0.1	0.1	-40	30	3
3	20.06	-39.6	0.1	0.1	0.1	0.1	-40	30	3
4	20.05	-39.5	0.2	0.1	0.1	0.1	-40	30	3
5	20.05	-39.5	0.2	0.1	0.1	0.1	-40	30	3
6	20.02	-39.5	0.2	0.1	0.1	0.1	-40	30	3
8	19.95	-39.5	0.2	0.1	0.1	0.1	-40	30	3
10	19.83	-39.4	0.2	0.1	0.2	0.1	-40	30	3
12	19.71	-39.4	0.2	0.1	0.2	0.1	-40	30	3
14	19.54	-39.4	0.2	0.1	0.2	0.1	-40	30	3
16	19.53	-39.3	0.3	0.1	0.2	0.1	-40	30	3
18	19.50	-39.3	0.3	0.1	0.2	0.1	-40	30	3
20	19.57	-39.3	0.3	0.1	0.2	0.1	-40	30	3
22	19.61	-39.3	0.3	0.1	0.2	0.1	-40	30	3
24	19.61	-39.3	0.3	0.1	0.2	0.1	-40	30	3
26	19.54	-39.3	0.3	0.1	0.2	0.1	-40	30	3
28	19.46	-39.2	0.3	0.1	0.3	0.1	-40	30	3
30	19.73	-39.1	0.4	0.1	0.3	0.1	-40	30	3

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
distance correction = -40 * LOG (d_{Limit}/ d_{used})
Linear interpolation will be used for frequencies in between the values in the table.
Table shows an extract of values

7.3 ANTENNA R&S HL562 (30 MHZ – 1 GHZ)

(d_{Limit} = 3 m)

Frequency	AF R&S HL562	Corr.	cable loss 1 (inside chamber)	cable loss 2 (outside chamber)	cable loss 3 (switch unit)	cable loss 4 (to receiver)	distance corr. (-20 dB/ decade)	d_{Limit} (meas. distance (limit)	d_{used} (meas. distance (used)
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB	m	m
30	18.6	0.6	0.29	0.04	0.23	0.02	0.0	3	3
50	6.0	0.9	0.39	0.09	0.32	0.08	0.0	3	3
100	9.7	1.2	0.56	0.14	0.47	0.08	0.0	3	3
150	7.9	1.6	0.73	0.20	0.59	0.12	0.0	3	3
200	7.6	1.9	0.84	0.21	0.70	0.11	0.0	3	3
250	9.5	2.1	0.98	0.24	0.80	0.13	0.0	3	3
300	11.0	2.3	1.04	0.26	0.89	0.15	0.0	3	3
350	12.4	2.6	1.18	0.31	0.96	0.13	0.0	3	3
400	13.6	2.9	1.28	0.35	1.03	0.19	0.0	3	3
450	14.7	3.1	1.39	0.38	1.11	0.22	0.0	3	3
500	15.6	3.2	1.44	0.39	1.20	0.19	0.0	3	3
550	16.3	3.5	1.55	0.46	1.24	0.23	0.0	3	3
600	17.2	3.5	1.59	0.43	1.29	0.23	0.0	3	3
650	18.1	3.6	1.67	0.34	1.35	0.22	0.0	3	3
700	18.5	3.6	1.67	0.42	1.41	0.15	0.0	3	3
750	19.1	4.1	1.87	0.54	1.46	0.25	0.0	3	3
800	19.6	4.1	1.90	0.46	1.51	0.25	0.0	3	3
850	20.1	4.4	1.99	0.60	1.56	0.27	0.0	3	3
900	20.8	4.7	2.14	0.60	1.63	0.29	0.0	3	3
950	21.1	4.8	2.22	0.60	1.66	0.33	0.0	3	3
1000	21.6	4.9	2.23	0.61	1.71	0.30	0.0	3	3

(d_{Limit} = 10 m)

30	18.6	-9.9	0.29	0.04	0.23	0.02	-10.5	10	3
50	6.0	-9.6	0.39	0.09	0.32	0.08	-10.5	10	3
100	9.7	-9.2	0.56	0.14	0.47	0.08	-10.5	10	3
150	7.9	-8.8	0.73	0.20	0.59	0.12	-10.5	10	3
200	7.6	-8.6	0.84	0.21	0.70	0.11	-10.5	10	3
250	9.5	-8.3	0.98	0.24	0.80	0.13	-10.5	10	3
300	11.0	-8.1	1.04	0.26	0.89	0.15	-10.5	10	3
350	12.4	-7.9	1.18	0.31	0.96	0.13	-10.5	10	3
400	13.6	-7.6	1.28	0.35	1.03	0.19	-10.5	10	3
450	14.7	-7.4	1.39	0.38	1.11	0.22	-10.5	10	3
500	15.6	-7.2	1.44	0.39	1.20	0.19	-10.5	10	3
550	16.3	-7.0	1.55	0.46	1.24	0.23	-10.5	10	3
600	17.2	-6.9	1.59	0.43	1.29	0.23	-10.5	10	3
650	18.1	-6.9	1.67	0.34	1.35	0.22	-10.5	10	3
700	18.5	-6.8	1.67	0.42	1.41	0.15	-10.5	10	3
750	19.1	-6.3	1.87	0.54	1.46	0.25	-10.5	10	3
800	19.6	-6.3	1.90	0.46	1.51	0.25	-10.5	10	3
850	20.1	-6.0	1.99	0.60	1.56	0.27	-10.5	10	3
900	20.8	-5.8	2.14	0.60	1.63	0.29	-10.5	10	3
950	21.1	-5.6	2.22	0.60	1.66	0.33	-10.5	10	3
1000	21.6	-5.6	2.23	0.61	1.71	0.30	-10.5	10	3

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
distance correction = -20 * LOG (d_{Limit}/ d_{used})
Linear interpolation will be used for frequencies in between the values in the table.
Tables show an extract of values.

7.4 ANTENNA R&S HF907 (1 GHZ – 18 GHZ)

Frequency	AF R&S HF907	Corr.	cable loss 1 (relay + cable inside chamber)	cable loss 2 (outside chamber)	cable loss 3 (switch unit, atten-uator & pre-amp)	cable loss 4 (to receiver)		
MHz	dB (1/m)	dB	dB	dB	dB	dB		
1000	24.4	-19.4	0.99	0.31	-21.51	0.79		
2000	28.5	-17.4	1.44	0.44	-20.63	1.38		
3000	31.0	-16.1	1.87	0.53	-19.85	1.33		
4000	33.1	-14.7	2.41	0.67	-19.13	1.31		
5000	34.4	-13.7	2.78	0.86	-18.71	1.40		
6000	34.7	-12.7	2.74	0.90	-17.83	1.47		
7000	35.6	-11.0	2.82	0.86	-16.19	1.46		

Frequency	AF R&S HF907	Corr.	cable loss 1 (relay inside chamber)	cable loss 2 (inside chamber)	cable loss 3 (outside chamber)	cable loss 4 (switch unit, atten-uator & pre-amp)	cable loss 5 (to receiver)	used for FCC 15.247
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB	
3000	31.0	-23.4	0.47	1.87	0.53	-27.58	1.33	
4000	33.1	-23.3	0.56	2.41	0.67	-28.23	1.31	
5000	34.4	-21.7	0.61	2.78	0.86	-27.35	1.40	
6000	34.7	-21.2	0.58	2.74	0.90	-26.89	1.47	
7000	35.6	-19.8	0.66	2.82	0.86	-25.58	1.46	

Frequency	AF R&S HF907	Corr.	cable loss 1 (relay inside chamber)	cable loss 2 (High Pass)	cable loss 3 (pre-amp)	cable loss 4 (inside chamber)	cable loss 5 (outside chamber)	cable loss 6 (to receiver)
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB	dB
7000	35.6	-57.3	0.56	1.28	-62.72	2.66	0.94	1.46
8000	36.3	-56.3	0.69	0.71	-61.49	2.84	1.00	1.53
9000	37.1	-55.3	0.68	0.65	-60.80	3.06	1.09	1.60
10000	37.5	-56.2	0.70	0.54	-61.91	3.28	1.20	1.67
11000	37.5	-55.3	0.80	0.61	-61.40	3.43	1.27	1.70
12000	37.6	-53.7	0.84	0.42	-59.70	3.53	1.26	1.73
13000	38.2	-53.5	0.83	0.44	-59.81	3.75	1.32	1.83
14000	39.9	-56.3	0.91	0.53	-63.03	3.91	1.40	1.77
15000	40.9	-54.1	0.98	0.54	-61.05	4.02	1.44	1.83
16000	41.3	-54.1	1.23	0.49	-61.51	4.17	1.51	1.85
17000	42.8	-54.4	1.36	0.76	-62.36	4.34	1.53	2.00
18000	44.2	-54.7	1.70	0.53	-62.88	4.41	1.55	1.91

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
Linear interpolation will be used for frequencies in between the values in the table.
Tables show an extract of values.

7.5 ANTENNA EMCO 3160-09 (18 GHZ – 26.5 GHZ)

Frequency	AF EMCO 3160-09	Corr.	cable loss 1 (inside chamber)	cable loss 2 (pre-amp)	cable loss 3 (inside chamber)	cable loss 4 (switch unit)	cable loss 5 (to receiver)
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB
18000	40.2	-23.5	0.72	-35.85	6.20	2.81	2.65
18500	40.2	-23.2	0.69	-35.71	6.46	2.76	2.59
19000	40.2	-22.0	0.76	-35.44	6.69	3.15	2.79
19500	40.3	-21.3	0.74	-35.07	7.04	3.11	2.91
20000	40.3	-20.3	0.72	-34.49	7.30	3.07	3.05
20500	40.3	-19.9	0.78	-34.46	7.48	3.12	3.15
21000	40.3	-19.1	0.87	-34.07	7.61	3.20	3.33
21500	40.3	-19.1	0.90	-33.96	7.47	3.28	3.19
22000	40.3	-18.7	0.89	-33.57	7.34	3.35	3.28
22500	40.4	-19.0	0.87	-33.66	7.06	3.75	2.94
23000	40.4	-19.5	0.88	-33.75	6.92	3.77	2.70
23500	40.4	-19.3	0.90	-33.35	6.99	3.52	2.66
24000	40.4	-19.8	0.88	-33.99	6.88	3.88	2.58
24500	40.4	-19.5	0.91	-33.89	7.01	3.93	2.51
25000	40.4	-19.3	0.88	-33.00	6.72	3.96	2.14
25500	40.5	-20.4	0.89	-34.07	6.90	3.66	2.22
26000	40.5	-21.3	0.86	-35.11	7.02	3.69	2.28
26500	40.5	-21.1	0.90	-35.20	7.15	3.91	2.36

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
Linear interpolation will be used for frequencies in between the values in the table.
Table shows an extract of values.

7.6 ANTENNA EMCO 3160-10 (26.5 GHZ – 40 GHZ)

Frequency	AF EMCO 3160-10	Corr.	cable loss 1 (inside chamber)	cable loss 2 (outside chamber)	cable loss 3 (switch unit)	cable loss 4 (to receiver)	distance corr. (-20 dB/ decade)	d_{Limit} (meas. distance (limit)	d_{used} (meas. distance (used)
GHz	dB (1/m)	dB	dB	dB	dB	dB	dB	m	m
26.5	43.4	-11.2	4.4				-9.5	3	1.0
27.0	43.4	-11.2	4.4				-9.5	3	1.0
28.0	43.4	-11.1	4.5				-9.5	3	1.0
29.0	43.5	-11.0	4.6				-9.5	3	1.0
30.0	43.5	-10.9	4.7				-9.5	3	1.0
31.0	43.5	-10.8	4.7				-9.5	3	1.0
32.0	43.5	-10.7	4.8				-9.5	3	1.0
33.0	43.6	-10.7	4.9				-9.5	3	1.0
34.0	43.6	-10.6	5.0				-9.5	3	1.0
35.0	43.6	-10.5	5.1				-9.5	3	1.0
36.0	43.6	-10.4	5.1				-9.5	3	1.0
37.0	43.7	-10.3	5.2				-9.5	3	1.0
38.0	43.7	-10.2	5.3				-9.5	3	1.0
39.0	43.7	-10.2	5.4				-9.5	3	1.0
40.0	43.8	-10.1	5.5				-9.5	3	1.0

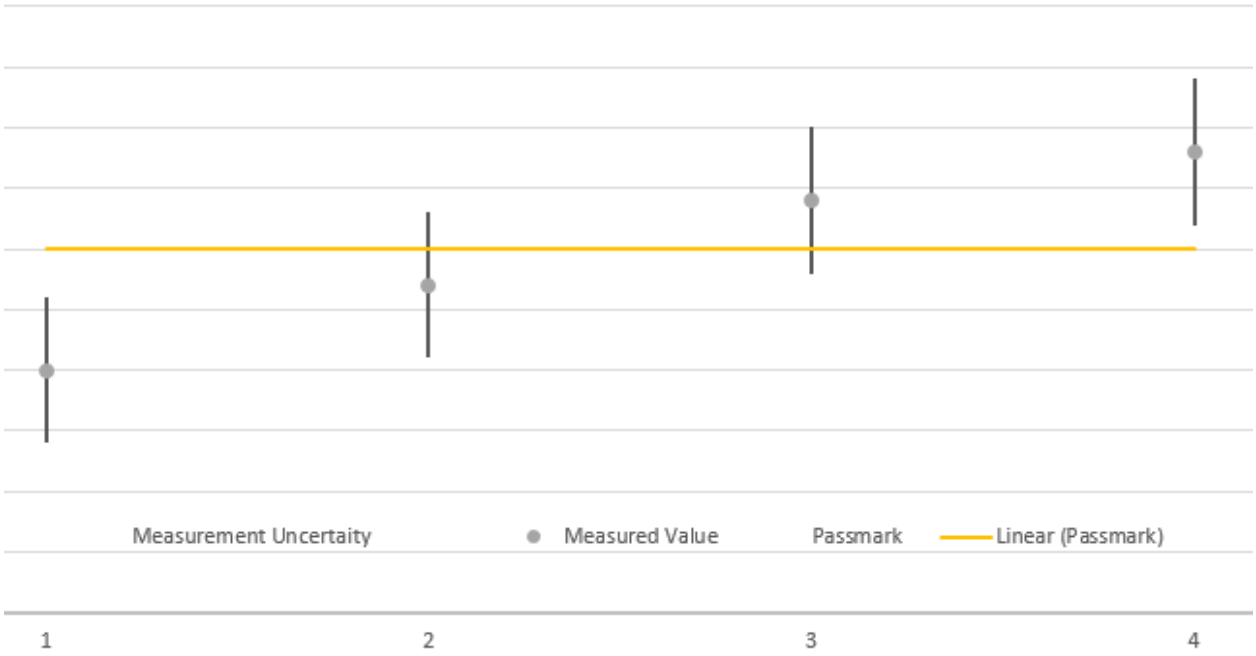
Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
Linear interpolation will be used for frequencies in between the values in the table.
distance correction = -20 * LOG (d_{Limit}/ d_{used})
Linear interpolation will be used for frequencies in between the values in the table.
Table shows an extract of values.

8 MEASUREMENT UNCERTAINTIES

Test Case	Parameter	Uncertainty
AC Power Line	Power	± 3.4 dB
Field Strength of spurious radiation	Power	± 5.5 dB
6 dB / 26 dB / 99% Bandwidth	Power Frequency	± 2.9 dB ± 11.2 kHz
Conducted Output Power	Power	± 2.2 dB
Band Edge Compliance	Power Frequency	± 2.2 dB ± 11.2 kHz
Frequency Stability	Frequency	± 25 Hz
Power Spectral Density	Power	± 2.2 dB

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.

9 PHOTO REPORT

Please see separate photo report.