



RF – TEST REPORT

- FCC Part 15.407, RSS-247 -

Type / Model Name : S2

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

Applicant : BSH Hausgeräte GmbH

Address : Carl-Wery-Straße 34

81739 München

Manufacturer : BSH Hausgeräte GmbH

Address : Carl-Wery-Straße 34

81739 München

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

POSITIVE

Test Report No. : **80178099-03 Rev_2**

03. June 2024

Date of issue



Deutsche
Akkreditierungsstelle
D-PL-12030-01-03
D-PL-12030-01-04

Contents

1	<u>TEST STANDARDS</u>	<u>3</u>
2	<u>EQUIPMENT UNDER TEST</u>	<u>4</u>
2.1	Information provided by the Client	4
2.2	Sampling	4
2.3	Photo documentation	4
2.4	General remarks	4
2.5	Equipment category	4
2.6	Short description of the equipment under test (EUT)	4
2.7	Variants of the EUT	5
2.8	Operation frequency and channel plan	5
2.9	Transmit operating modes	6
2.10	Antenna	6
2.11	Power supply system utilised	6
2.12	Peripheral devices and interface cables	6
2.13	Determination of worst-case conditions for final measurement	7
3	<u>TEST RESULT SUMMARY</u>	<u>8</u>
3.1	Revision history of test report	8
3.2	Final assessment	8
4	<u>TEST ENVIRONMENT</u>	<u>9</u>
4.1	Address of the test laboratory	9
4.2	Environmental conditions	9
4.3	Statement of the measurement uncertainty	9
4.4	Conformity Decision Rule	10
4.5	Measurement protocol for FCC and IC	10
5	<u>TEST CONDITIONS AND RESULTS</u>	<u>13</u>
5.1	Conducted emission	13
5.2	Undesirable emissions	18
6	<u>USED TEST EQUIPMENT AND ACCESSORIES</u>	<u>39</u>

ATTACHMENT A as separate supplement
ATTACHMENT B as separate supplement

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

1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15, Subpart A - General (November 2023)

Part 15, Subpart A, Section 15.31	Measurement standards
Part 15, Subpart A, Section 15.33	Frequency range of radiated measurements
Part 15, Subpart A, Section 15.35	Measurement detector functions and bandwidths

FCC Rules and Regulations Part 15, Subpart C - Intentional Radiators (November 2023)

Part 15, Subpart C, Section 15.203	Antenna requirement
Part 15, Subpart C, Section 15.204	External radio frequency power amplifiers and antenna modifications
Part 15, Subpart C, Section 15.205	Restricted bands of operation
Part 15, Subpart C, Section 15.207	Conducted limits
Part 15, Subpart C, Section 15.209	Radiated emission limits, general requirements
Part 15, Subpart C, Section 15.212	Modular transmitters

FCC Rules and Regulations Part 15, Subpart E – Unlicensed National Information Infrastructure Devices (September 2020)

Part 15, Subpart E, Section 15.407	Operation within the bands 5.15 - 5.25 GHz, 5.25 - 5.35 GHz, 5.47 - 5.725 GHz and 5.725 - 5.85 GHz
ANSI C63.10: 2013	Testing Unlicensed Wireless Devices
KDB 789033 D02 v02r01	Guidelines for compliance testing of UNII-Devices Part 15, Subpart E, December 14, 2017.

ISED Canada Rules and Regulations (November 2023)

RSS-Gen, Issue 5 + Amendment 1 + 2	General Requirements for Compliance of Radio Apparatus
RSS-247, Issue 3	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
ANSI C63.10: 2013	Testing Unlicensed Wireless Devices

2 EQUIPMENT UNDER TEST

2.1 Information provided by the Client

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

2.2 Sampling

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

2.3 Photo documentation

Attachment A : Detailed photos of EUT
Attachment B : Photo documentation of test setup

2.4 General remarks

This report covers the emissions of the module "SMB" (FCC ID 2AHES-SMB / IC: 21152-SMB) in combination with the host device S2.

Performed tests:

- AC powerline conducted Emissions
- Transmitter unwanted emissions, radiated

2.5 Equipment category

WLAN - Client

2.6 Short description of the equipment under test (EUT)

The EUT is a communication module for assembling into household devices. The firmware does not support ad-hoc modes and gives the user no possibility to choose the data transmission of power setting. The EUT supports the 2.4 GHz frequency band and supports no beam forming.

Tested sample: : 1 radiated sample
Serial number : 80012153030000440335000001216
SW : BSH Embedded Linux Platform (SMM S2pro default) - debug [HWTEST]
62.1.0-104-g5104f097c
WLAN Firmware version : 1.28 RC0.0 wI0: Nov 16 2022 18:14:34 version 7.45.251 (16ca9cf CY
WLTEST) FWID 01-95f2057d

Tested sample: : 1 conducted sample
Serial number : 80012153030000440335000001222
SW : BSH Embedded Linux Platform (SMM S2pro default) - debug [HWTEST]
62.1.0-104-g5104f097c
WLAN Firmware version : 1.28 RC0.0 wI0: Nov 16 2022 18:14:34 version 7.45.251 (16ca9cf CY
WLTEST) FWID 01-95f2057d

2.7 Variants of the EUT

Tests in this report are performed with the fully populated variant S2-V99.

Other variants are:

- S2-V11
- S2-V12

2.8 Operation frequency and channel plan

The operating frequency is 5150 MHz to 5350 MHz and 5470 MHz to 5850 MHz (U-NII-1, U-NII-2A, U-NII-2C, U-NII-3).

Channel plan: WLAN Standard 802.11

a / n HT20 / ac VHT20:

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

n HT40 / ac VHT40:

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

ac VHT80:

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

2.9 Transmit operating modes

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

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

2.10 Antenna

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

Number	Characteristic	Model number	Plug	Frequency range (GHz)	Gain (dBi)
1	Omni	PCB antenna (Ant0)	-	5	5.83
2	Omni	PCB antenna (Ant1)	-	5	6.84

The EUT is equipped with two internal antennas with diversity mode. Only one antenna (Ant0) was active for testing.

For conducted tests a special prepared sample with an U.FL Port instead of Ant0 was used.

2.11 Power supply system utilised

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

2.12 Peripheral devices and interface cables

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

- USB to serial converter cable Model : _____
- Laptop Model : _____

2.13 Determination of worst-case conditions for final measurement

The following channels and test modes are selected for radiated measurements:

Measurements are made in all three orthogonal axes and the settings of the EUT are changed to locate at which position and at what setting of the EUT produce the maximum of the emissions.

Technology	Available channels	Tested channels	Modulation	Modulation Type	Data rate (Mbps)
802.11n HT20	36 – 165	36, 64, 100, 140, 149, 165	OFDM	64-QAM	MCS=7 (BW=20 MHz)
802.11n HT40	38 – 159	38, 62, 102, 134, 151, 159	OFDM	64-QAM	MCS=7 (BW=40 MHz)
802.11ac VHT80	42 – 155	42, 58, 106, 122, 155	OFDM	64-QAM	MCS=7 (BW=80 MHz)

2.13.1 Test jig

No test jig is used.

2.13.2 Test software

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

3 TEST RESULT SUMMARY

FCC Rule Part	RSS Rule Part	Description	Result
15.207(a)	RSS Gen, 8.8	AC power line conducted emissions	Passed
15.407(a)	RSS-247, 6.2.1.1	EBW, OBW 99 %	Not tested
15.407(a)	RSS-247, 6.2.1.1	Output power	Not tested
15.407(a)	RSS-247, 6.2.1.1	PSD	Not tested
15.407(b)	RSS-247, 6.2.1.2	Undesirable emissions	Passed
15.205(a)	RSS-Gen, 8.10	Emissions in restricted bands	Passed
15.407(g)	RSS-Gen, 6.11	Transmitter frequency stability	Not tested
15.407(h)(1)	RSS-247, 6.2.1.1	TPC	Not tested
15.407(a)	-	Antenna requirement	Not tested

3.1 Revision history of test report

Test report No	Rev.	Issue Date	Changes
80178099-03	0	15 January 2024	Initial test report
80178099-03	1	21 February 2024	Reduced report to AC power line conducted emissions & spurious emissions
80178099-03	2	03 June 2024	Updated CH62 Undesireble emissions

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

3.2 Final assessment

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

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

Testing commenced on : 09 November 2023

Testing concluded on : 29 April 2024

Checked by:


Jürgen Pessinger
2024.06.03
14:51:32 +02'00'

Jürgen Pessinger
Radio Team

Tested by:


Lukas Scheuermann
2024.06.03 14:13:05
+02'00'

Lukas Scheuermann
Radio Team

4 TEST ENVIRONMENT

4.1 Address of the test laboratory

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

4.2 Environmental conditions

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

Temperature:	<u>15 - 35 °C</u>
Humidity:	<u>30 - 60 %</u>
Atmospheric pressure:	<u>86 - 106 kPa</u>

4.3 Statement of the measurement uncertainty

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

Measurement Type	Range	Confidence Level	Calculated Uncertainty
AC power line conducted emissions	0.15 MHz to 30 MHz	95%	$\pm 3.29 \text{ dB}$
EBW and OBW	2400 MHz to 30000 MHz	95%	$\pm 2.5 \times 10^{-7}$
Output power ERP, radiated	1000 MHz to 7000 MHz	95%	$\pm 2.71 \text{ dB}$
Field strength of the fundamental	1000 MHz to 7000 MHz	95%	$\pm 2.71 \text{ dB}$
Power spectral density	2400 MHz to 3000 MHz	95%	$\pm 0.62 \text{ dB}$
Spurious Emissions, conducted	9 kHz to 10000 MHz	95%	$\pm 2.15 \text{ dB}$
Spurious Emissions, conducted	10000 MHz to 40000 MHz	95%	$\pm 3.47 \text{ dB}$
Spurious Emissions, radiated	9 kHz to 30 MHz	95%	$\pm 3.53 \text{ dB}$
Spurious Emissions, radiated	30 MHz to 1000 MHz	95%	$\pm 4.44 \text{ dB}$
Spurious Emissions, radiated	1000 MHz to 30000 MHz	95%	$\pm 2.34 \text{ dB}$
Spurious Emissions, radiated	30000 MHz to 40000 MHz	95%	$\pm 5.13 \text{ dB}$

4.4 Conformity Decision Rule

The conformity decision rule is based on the ILAC G8 published at the time of reporting.

4.5 Measurement protocol for FCC and IC

4.5.1 General information

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

FCC: DE 0011
ISED: DE0009

4.5.2 General Standard information

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

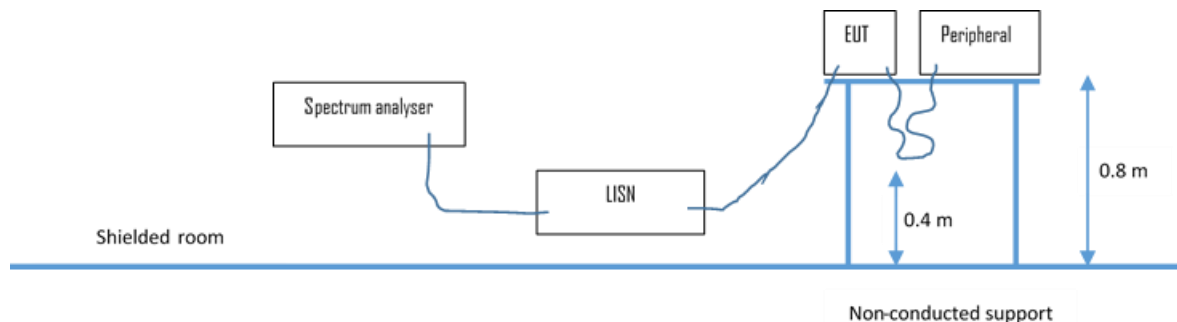
4.5.2.1 Justification

The equipment under test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral using the appropriate impedance characteristic or left unterminated. Where appropriate, cables are manually manipulated with respect to each other thus obtaining maximum disturbances from the unit.

4.5.3 Details of test procedures

4.5.3.1 Conducted emission

Test setup according ANSI C63.10



The final level, expressed in dB μ V, is arrived at by taking the reading directly from the Spectrum analyser. This level is compared to the limit.

To convert between dB μ V and μ V, the following conversions apply:

$$\text{dB}\mu\text{V} = 20(\log \mu\text{V})$$

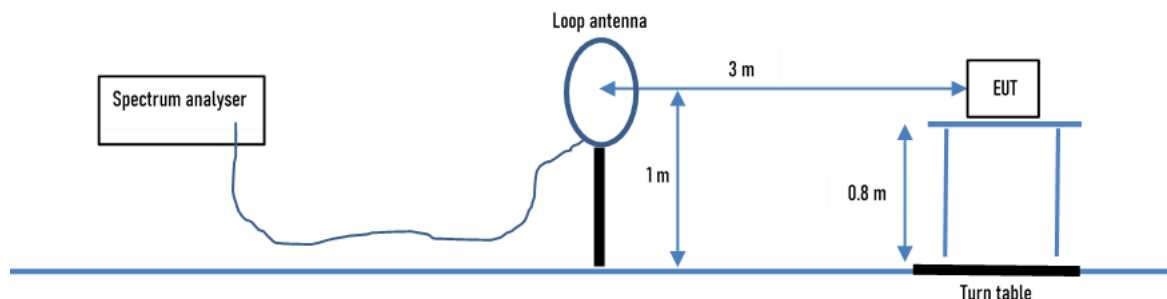
$$\mu\text{V} = \text{Inverse log}(\text{dB}\mu\text{V}/20)$$

Conducted emissions on the 50 Hz and/or 60 Hz power interface of the EUT are measured in the frequency range of 150 kHz to 30 MHz. The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi-peak detection and a Line Impedance Stabilization Network (LISN) with 50 Ω / 50 μ H (CISPR 16) characteristics. The receiver is protected by means of an impedance matched pulse limiter connected directly to the RF input. Table top equipment is placed on a non-conducting table 80 centimetres above the floor and is positioned 40 centimetres from the vertical ground plane (wall) of the screen room. If the minimum limit margin appears to be less than 20 dB with a peak mode measurement, the emission is re-measured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

4.5.3.2 Radiated emission

4.5.3.2.1 OATS1 test site (9 kHz - 30 MHz):

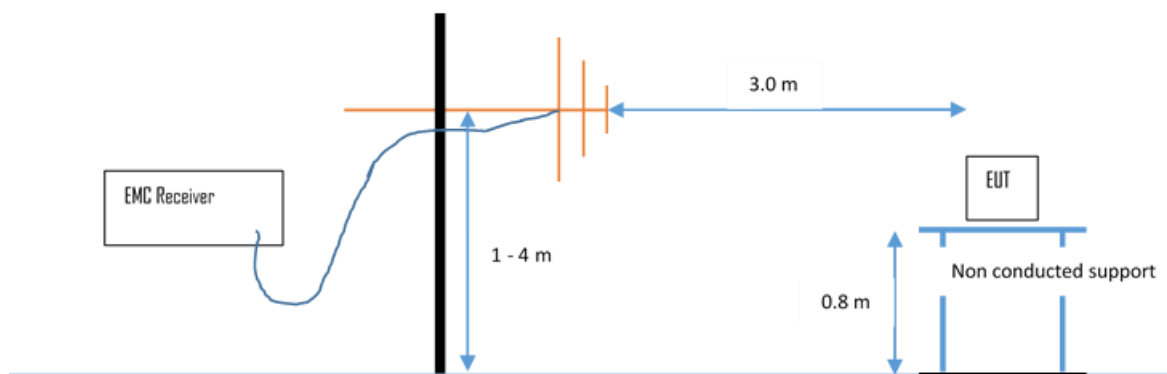
Test setup according ANSI C63.10



Emissions from the EUT are measured in the frequency range of 9 MHz to 30 MHz using a tuned receiver and a calibrated loop antenna. Table top equipment is placed on a 1.0 X 1.5 m non-conducting table 80 centimetres above the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screened room located outside the test area. The antenna is positioned 3, 10 or 30 metres horizontally from the EUT and is repeated vertically. To locate maximum emissions from the test sample the antenna is varied along the site axis and the EUT is rotated 360 degrees.

4.5.3.2.2 OATS1 test site (30 MHz - 1 GHz):

Test setup according ANSI C63.10.



Spurious emissions from the EUT are measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarised antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection. Table top equipment is placed on a 1.0 X 1.5 m non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screened room located outside the test area. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 metres and the EUT is rotated 360 degrees. The final level in dB μ V/m is calculated by taking the reading from the EMI receiver (Level dB μ V) and adding the correction factors and cable loss factor (dB). The FCC limit is subtracted from this result in order to provide the limit margin listed in the measurement protocol.

The resolution bandwidth setting:

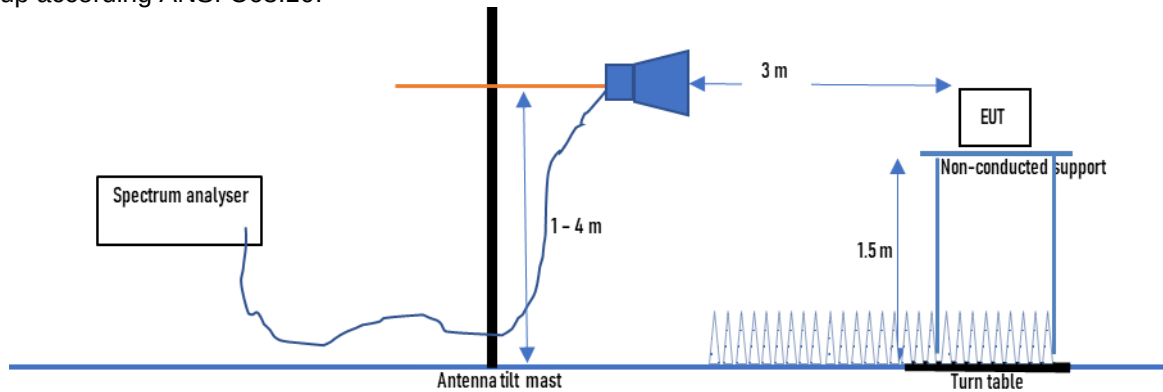
30 MHz – 1000 MHz: RBW: 120 kHz

Example:

Frequency (MHz)	Level (dB μ V)	+	Factor (dB)	=	Level (dB μ V/m)	-	Limit (dB μ V/m)	=	Delta (dB)
719.0	75.0	+	32.6	=	107.6	-	110.0	=	-2.4

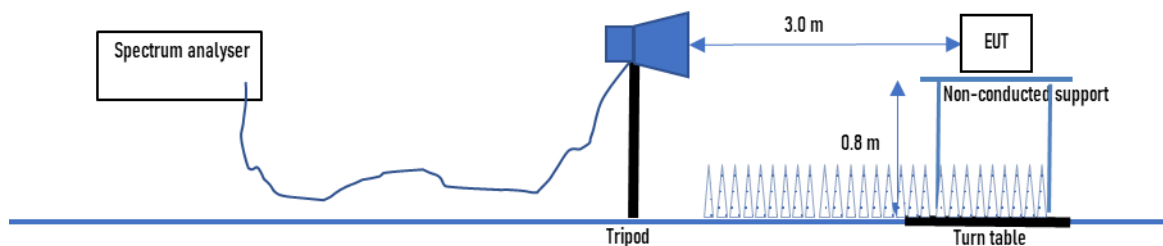
4.5.3.2.3 Anechoic chamber 1 (1000 MHz – 18000 MHz)

Test setup according ANSI C63.10.



Radiated emissions from the EUT are measured in the frequency range 1 GHz up to 18 GHz as specified in 47 CFR Part 15, Subpart A, Section 15.33, using a spectrum analyser and appropriate linearly polarized antennas. Table top equipment is placed on a non-conducting table, 1.5 metre above the ground plane. The turntable is fully covered with the appropriate absorber (Type VHP-12). Any controlling device is positioned such that it does not significantly influence the measurement results. Interconnecting cables that hang closer than 40 cm to the ground plane are folded back and forth in the center, forming a bundle 30 cm to 40 cm long. Measurements are made in three orientations of the EUT and the horizontal and vertical polarization planes of measurement antenna in a fully anechoic room. The measurement antenna is adjusted and the EUT orientated to permit the measurement of the maximum emission from the EUT. The conditions determined as worst-case will then be used for the final measurements.

4.5.3.2.4 Anechoic chamber 1 (18 GHz – 40 GHz)



Emissions from the EUT are measured in the frequency range 18 GHz up to 40 GHz as specified in 47 CFR Part 15, Subpart A, Section 15.33, using a spectrum analyser and appropriate linearly polarized antennas. Table top equipment is placed on a non-conducting table, 0.8 metre above the ground plane. The turntable is fully covered with the appropriate absorber (Type VHP-12). Any controlling device is positioned such that it does not significantly influence the measurement results. Interconnecting cables that hang closer than 40 cm to the ground plane are folded back and forth in the centre, forming a bundle 30 cm to 40 cm long. Measurements are made in in three orientations of the EUT and the horizontal and vertical polarization planes of measurement antenna in a fully anechoic room. The measurement antenna is adjusted and the EUT orientated to permit the measurement of the maximum emission from the EUT. The conditions determined as worst-case will then be used for the final measurements. Where appropriate, the test distance may be reduced in order to detect emissions under better uncertainty. The limit are adopted.

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5 TEST CONDITIONS AND RESULTS

5.1 Conducted emission

For test instruments and accessories used see section 6 Part A 4.

5.1.1 Description of the test location

Test location: Shielded Room S2

5.1.2 Applicable standard

According to FCC Part 15C, Section 15.207(a):

Except as shown in paragraphs (b) and (c) of this Section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of Emission (MHz)	Conducted Limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency

5.1.3 Description of Measurement

The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi-peak detection and a line impedance stabilization network (LISN) with 50Ω/50 μH (CISPR 16) characteristics. Table top equipment is placed on a non-conducting table 80 centimetres above the floor and is positioned 40 centimetres from the vertical ground plane (wall) of the screen room. If the minimum limit margin appears to be less than 20 dB with a peak mode measurement, the emissions are re-measured using a tuned receiver with quasi-peak and average detection and recorded.

To convert between dBμV and μV, the following conversions apply:

$$\text{dB}\mu\text{V} = 20 \log \mu\text{V}$$

$$\mu\text{V} = 10^{(\text{dB}\mu\text{V}/20)}$$

5.1.4 Test result

Frequency range: 0.15 MHz - 30 MHz

Min. limit margin -17.4 dB

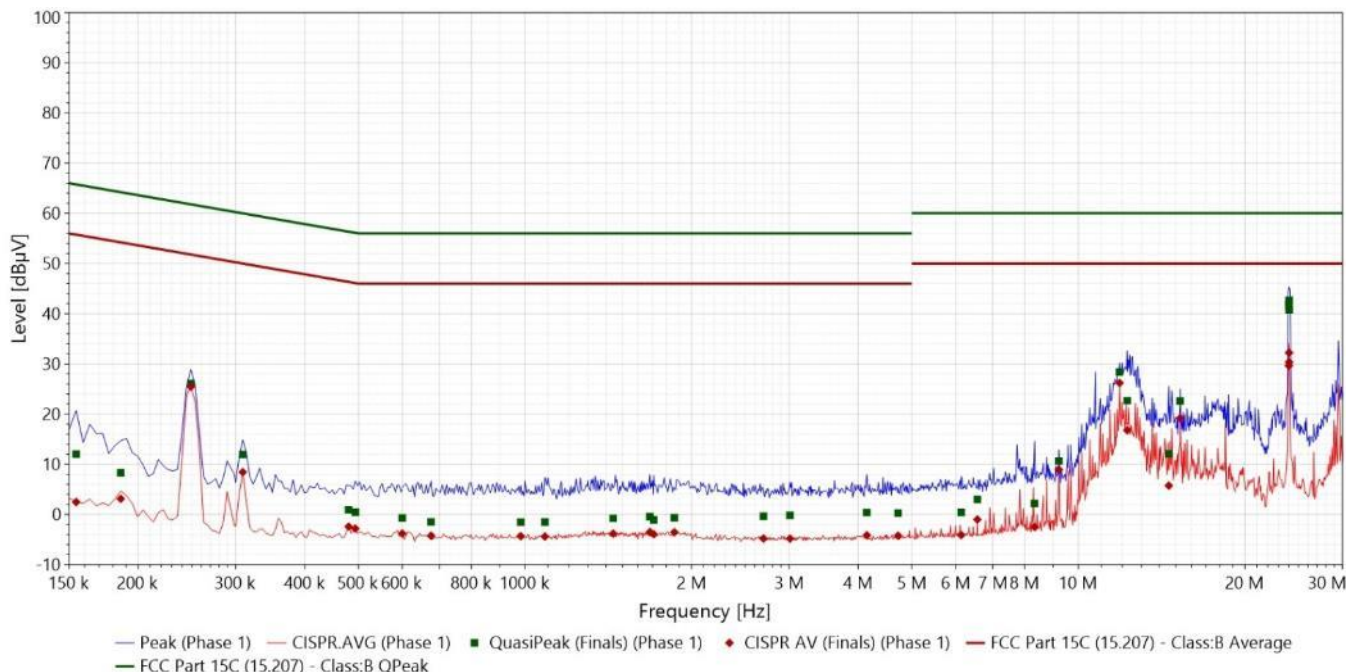
The requirements are **FULFILLED**.

Remarks: For detailed test result please see following test protocols.

5.1.5 Test protocol

Test point L1
Operation mode: Continuous TX at CH36

Result: passed



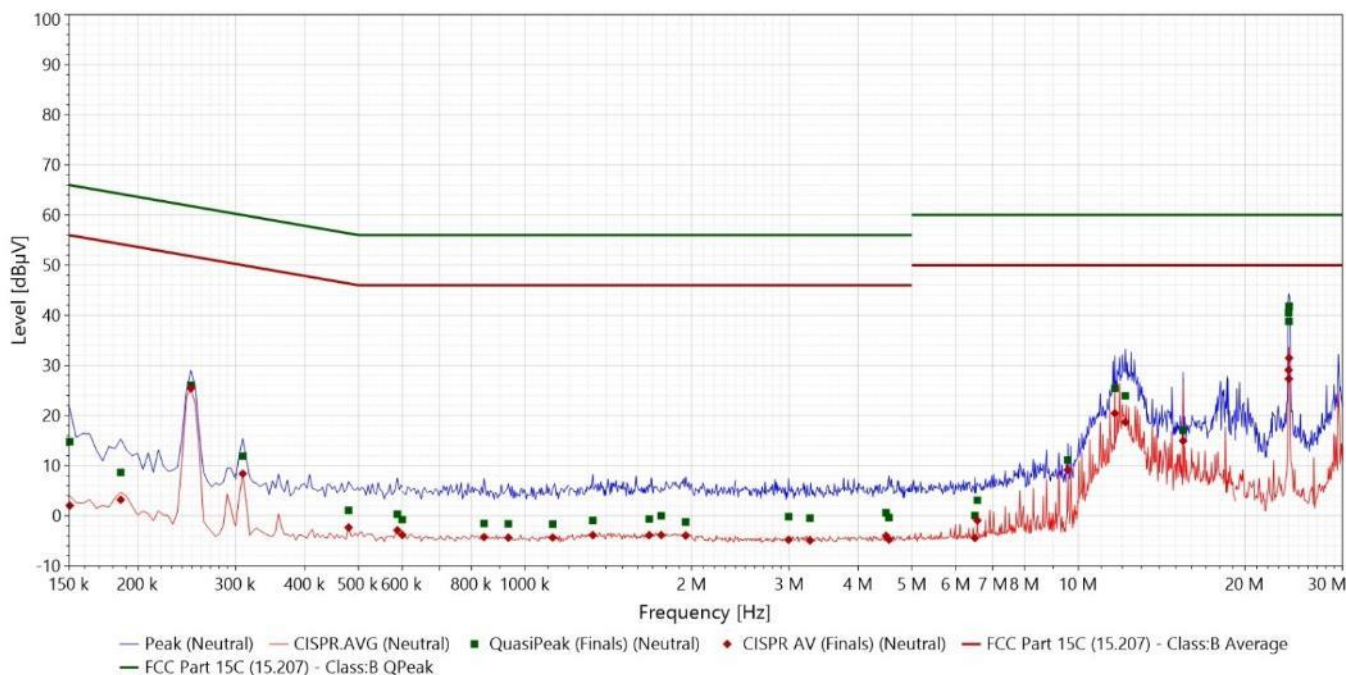
Frequency (MHz)	SR#	QuasiPeak (dBμV)	QP Margin (dB)	QP Limit (dBμV)	CISPR AV (dBμV)	CISPR AV Margin (dB)	AV Limit (dBμV)	Line	RBW	Meas.Time	Correction (dB)
0,1545	1	12,02	-53,73	65,75	2,47	-53,29	55,75	Phase 1	9k	1,00	10,10
0,186	1	8,33	-55,89	64,21	3,13	-51,09	54,21	Phase 1	9k	1,00	10,11
0,249	1	26,09	-35,70	61,79	25,45	-26,34	51,79	Phase 1	9k	1,00	10,13
0,309	2	11,95	-48,05	60,00	8,44	-41,56	50,00	Phase 1	9k	1,00	10,14
0,48	2	0,92	-55,42	56,34	-2,41	-48,75	46,34	Phase 1	9k	1,00	10,19
0,4935	2	0,43	-55,68	56,11	-2,81	-48,92	46,11	Phase 1	9k	1,00	10,19
0,6	3	-0,71	-56,71	56,00	-3,80	-49,80	46,00	Phase 1	9k	1,00	10,19
0,6765	3	-1,48	-57,48	56,00	-4,23	-50,23	46,00	Phase 1	9k	1,00	10,20
0,9825	3	-1,52	-57,52	56,00	-4,33	-50,33	46,00	Phase 1	9k	1,00	10,25
1,086	3	-1,50	-57,50	56,00	-4,39	-50,39	46,00	Phase 1	9k	1,00	10,26
1,443	4	-0,77	-56,77	56,00	-3,81	-49,81	46,00	Phase 1	9k	1,00	10,31
16,815	4	-0,42	-56,42	56,00	-3,50	-49,50	46,00	Phase 1	9k	1,00	10,32
17,085	4	-1,09	-57,09	56,00	-3,94	-49,94	46,00	Phase 1	9k	1,00	10,32
18,615	4	-0,67	-56,67	56,00	-3,54	-49,54	46,00	Phase 1	9k	1,00	10,32
2,697	5	-0,34	-56,34	56,00	-4,79	-50,79	46,00	Phase 1	9k	1,00	10,38
3,012	5	-0,18	-56,18	56,00	-4,81	-50,81	46,00	Phase 1	9k	1,00	10,39
4,146	5	0,38	-55,62	56,00	-4,13	-50,13	46,00	Phase 1	9k	1,00	10,47

4,722	5	0,27	-55,73	56,00	-4,22	-50,22	46,00	Phase 1	9k	1,00	10,50
6,141	6	0,40	-59,60	60,00	-4,09	-54,09	50,00	Phase 1	9k	1,00	10,63
65,685	6	3,01	-56,99	60,00	-1,00	-51,00	50,00	Phase 1	9k	1,00	10,66
83,325	6	2,20	-57,80	60,00	-2,47	-52,47	50,00	Phase 1	9k	1,00	10,74
9,219	6	10,67	-49,33	60,00	8,93	-41,07	50,00	Phase 1	9k	1,00	10,75
11,868	7	28,37	-31,63	60,00	26,21	-23,79	50,00	Phase 1	9k	1,00	10,95
122,505	7	22,68	-37,32	60,00	16,77	-33,23	50,00	Phase 1	9k	1,00	10,97
14,568	7	12,09	-47,91	60,00	5,75	-44,25	50,00	Phase 1	9k	1,00	11,14
15,27	7	22,62	-37,38	60,00	19,21	-30,79	50,00	Phase 1	9k	1,00	11,19
240,015	8	41,78	-18,22	60,00	29,66	-20,34	50,00	Phase 1	9k	1,00	11,61
24,024	8	42,65	-17,35	60,00	32,22	-17,78	50,00	Phase 1	9k	1,00	11,61
240,285	8	40,75	-19,25	60,00	30,35	-19,65	50,00	Phase 1	9k	1,00	11,61

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

Test point N
Operation mode: Continuous TX at CH1

Result: passed



Frequency (MHz)	SR#	QuasiPeak (dBµV)	QP Margin (dB)	QP Limit (dBµV)	CISPR AV (dBµV)	CISPR AV Margin (dB)	AV Limit (dBµV)	Line	RBW	Meas.Time	Correction (dB)
0,15	9	14,79	-51,21	66,00	2,04	-53,96	56,00	Neutral	9k	1,00	10,13
0,186	9	8,64	-55,57	64,21	3,21	-51,00	54,21	Neutral	9k	1,00	10,14
0,249	9	26,06	-35,73	61,79	25,41	-26,38	51,79	Neutral	9k	1,00	10,16
0,309	10	11,89	-48,11	60,00	8,39	-41,60	50,00	Neutral	9k	1,00	10,18
0,48	10	1,08	-55,26	56,34	-2,33	-48,67	46,34	Neutral	9k	1,00	10,21
0,588	10	0,32	-55,68	56,00	-2,89	-48,89	46,00	Neutral	9k	1,00	10,22
0,6	11	-0,77	-56,77	56,00	-3,83	-49,83	46,00	Neutral	9k	1,00	10,22
0,843	11	-1,52	-57,52	56,00	-4,25	-50,25	46,00	Neutral	9k	1,00	10,25
0,933	11	-1,60	-57,60	56,00	-4,36	-50,36	46,00	Neutral	9k	1,00	10,25
1,122	11	-1,67	-57,67	56,00	-4,34	-50,34	46,00	Neutral	9k	1,00	10,28
1,326	12	-0,93	-56,93	56,00	-3,86	-49,86	46,00	Neutral	9k	1,00	10,31
1,677	12	-0,65	-56,65	56,00	-3,86	-49,86	46,00	Neutral	9k	1,00	10,34
17,625	12	0,00	-56,00	56,00	-3,84	-49,84	46,00	Neutral	9k	1,00	10,35
19,515	12	-1,25	-57,25	56,00	-3,96	-49,96	46,00	Neutral	9k	1,00	10,34
2,994	13	-0,18	-56,18	56,00	-4,79	-50,79	46,00	Neutral	9k	1,00	10,44
3,273	13	-0,46	-56,46	56,00	-4,90	-50,90	46,00	Neutral	9k	1,00	10,44
44,925	13	0,61	-55,39	56,00	-3,98	-49,98	46,00	Neutral	9k	1,00	10,51
45,465	13	-0,34	-56,34	56,00	-4,74	-50,74	46,00	Neutral	9k	1,00	10,51

6,501	14	0,05	-59,95	60,00	-4,43	-54,43	50,00	Neutral	9k	1,00	10,64
65,685	14	3,10	-56,90	60,00	-0,94	-50,94	50,00	Neutral	9k	1,00	10,65
95,655	14	11,13	-48,87	60,00	9,13	-40,87	50,00	Neutral	9k	1,00	10,74
116,385	15	25,43	-34,57	60,00	20,45	-29,55	50,00	Neutral	9k	1,00	10,86
12,156	15	23,91	-36,09	60,00	18,69	-31,31	50,00	Neutral	9k	1,00	10,89
15,459	15	17,06	-42,94	60,00	14,94	-35,06	50,00	Neutral	9k	1,00	11,05
239,745	16	40,54	-19,46	60,00	29,09	-20,91	50,00	Neutral	9k	1,00	11,25
23,997	16	38,79	-21,21	60,00	27,33	-22,67	50,00	Neutral	9k	1,00	11,25
24,024	16	41,83	-18,17	60,00	31,47	-18,53	50,00	Neutral	9k	1,00	11,25

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

5.2 Undesirable emissions

For test instruments and accessories used see section 6 Part **SER 1**, **SER 2** and **SER 3**.

5.2.1 Description of the test location

Test location: OATS 1
 Test location: Anechoic chamber 1
 Test distance: 3 m

5.2.2 Applicable standard

According to FCC Part 15E, Section 15.407(b):

For transmitters operating in the defined bands shall not exceed the appropriate emission limit outside of the operating bands.

Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

5.2.3 Description of Measurement

The restricted bands are measured radiated. The span of the spectrum analyser is set wide enough to capture the restricted band and measure the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation. The restricted bands are measured falling emissions into it and the nearest restricted band are checked for emissions also the restricted band for the harmonics of the carrier.

The radiated power of the spurious emission from the EUT is measured in a test setup following the procedures set out in ANSI C63.10. If the emission level of the EUT in peak mode complies with the average limit is 20 dB lower, then testing will be stopped and peak values of the EUT will be reported, otherwise the emission will be measured in average mode again and reported.

The restricted bands are measured radiated. The span of the spectrum analyser is set wide enough to capture the restricted band and measure the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation. The restricted bands are measured falling emissions into it and the nearest restricted band are checked for emissions also the restricted band for the harmonics of the carrier.

Measurements are performed in following order:

1) Measurement of emissions according to General Limit specified in section 15.209(a):

Test receiver settings for SER1, SER2:

9kHz-150kHz	RBW: 200 Hz	Detector: Quasi peak*	Meas. Time: 1 s,
150kHz-30MHz	RBW: 9 kHz	Detector: Quasi peak*	Meas. Time: 1 s,
30MHz-1GHz	RBW: 120 MHz	Detector: Quasi peak	Meas. Time: 1 s,

*AV Detector in the ranges 9-90kHz and 110-490kHz

Spectrum analyser settings for SER3:

1GHz-26GHz	RBW: 1 MHz	Detector: Max. peak	Trace: Max. hold	Sweep: Auto
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2) If emissions outside the Restricted Bands are above General Limit additional measurements of emissions according to Spurious Emissions Limit specified in section 15.247(d) are performed:

Spectrum analyser settings:

RBW: 100 kHz	VBW: 300 kHz	Detector: Max. peak	Trace: Max. hold	Sweep: Auto
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5.2.4 Test result

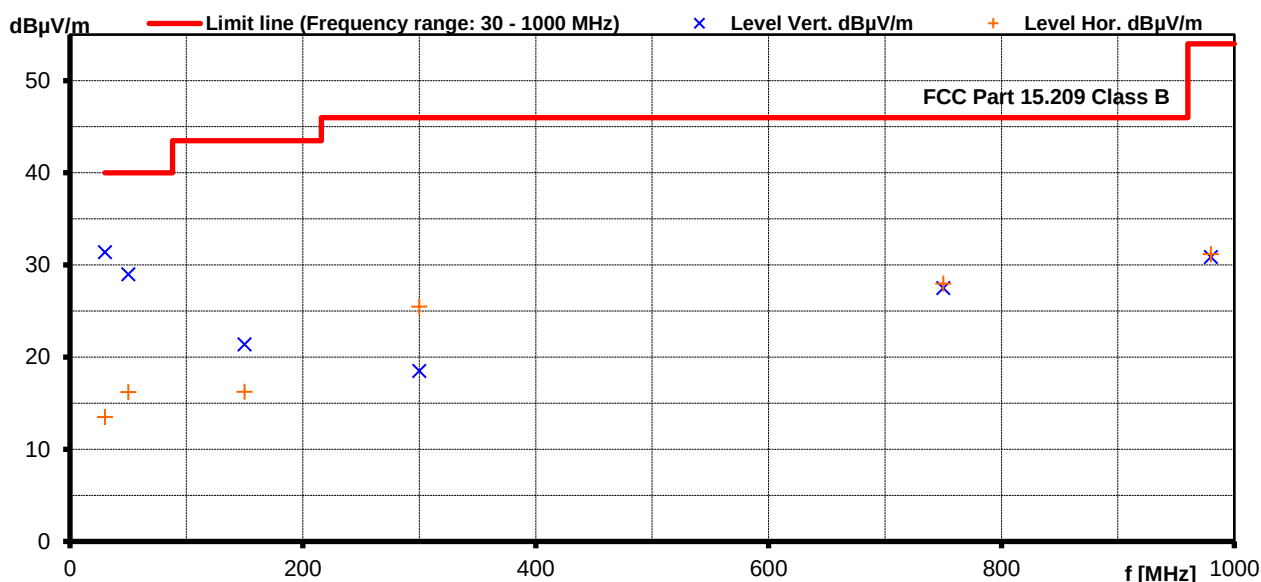
9 kHz < f < 30 MHz

Frequency (MHz)	Reading (dBμV)	Correction * (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Dlimit (dB)
0.009	-4.0	-58.8	-62.8	48.5	-111.3
0.100	-10.4	18.3	-72.1	27.6	-99.7
0.700	4.4	18.2	-17.4	30.7	-48.1
5.000	6.0	17.5	-16.5	30.0	-46.5
20.000	5.4	19.0	-15.6	30.0	-45.6

Note: No emissions detected in the frequency range 9 kHz to 30 MHz. The recorded values are solely noise values of the OATS.

30 MHz < f < 1000 MHz:

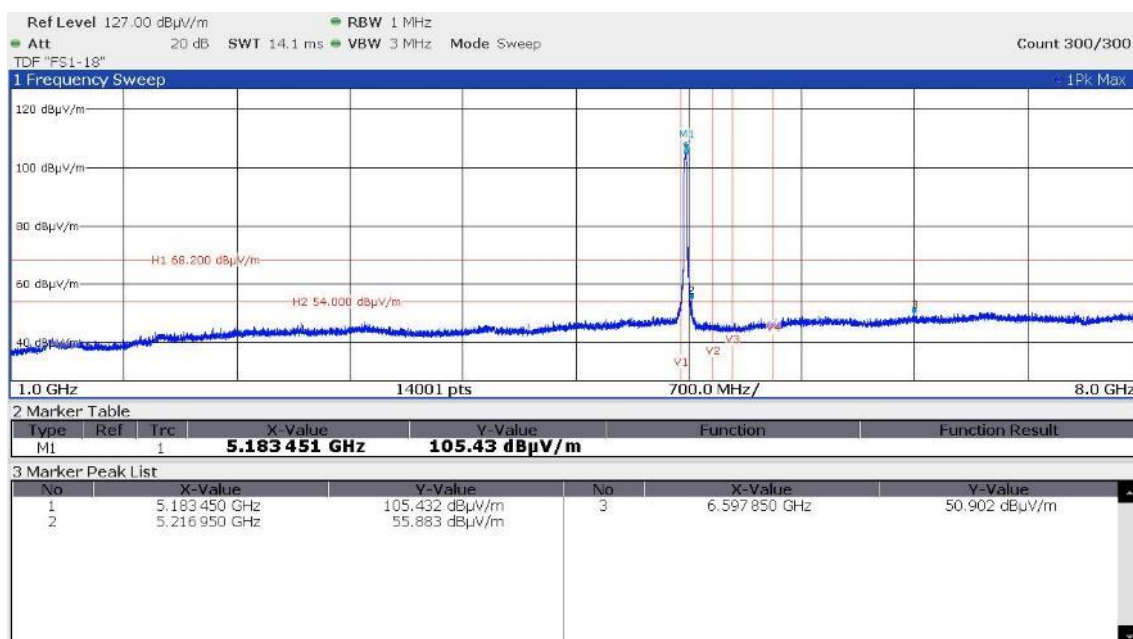
Frequency (MHz)	Reading Vert. (dBμV)	Reading Hor. (dBμV)	Correct. Vert. (dB)	Correct. Hor. (dB)	Level Vert. (dBμV/m)	Level Hor. (dBμV/m)	Limit (dBμV/m)	Dlimit (dB)
30.00	15.8	-3.6	15.6	17.1	31.4	13.5	40.0	-8.6
50.00	11.4	-2.6	17.6	18.8	29.0	16.2	40.0	-11.0
150.00	1.9	-2.6	19.5	18.9	21.4	16.3	43.5	-22.1
300.00	-1.7	4.7	20.2	20.8	18.5	25.5	46.0	-20.5
750.00	-3.2	-3.1	30.7	31.1	27.5	28.0	46.0	-18.0
980.00	-2.9	-3.0	33.8	34.2	30.9	31.2	54.0	-22.8



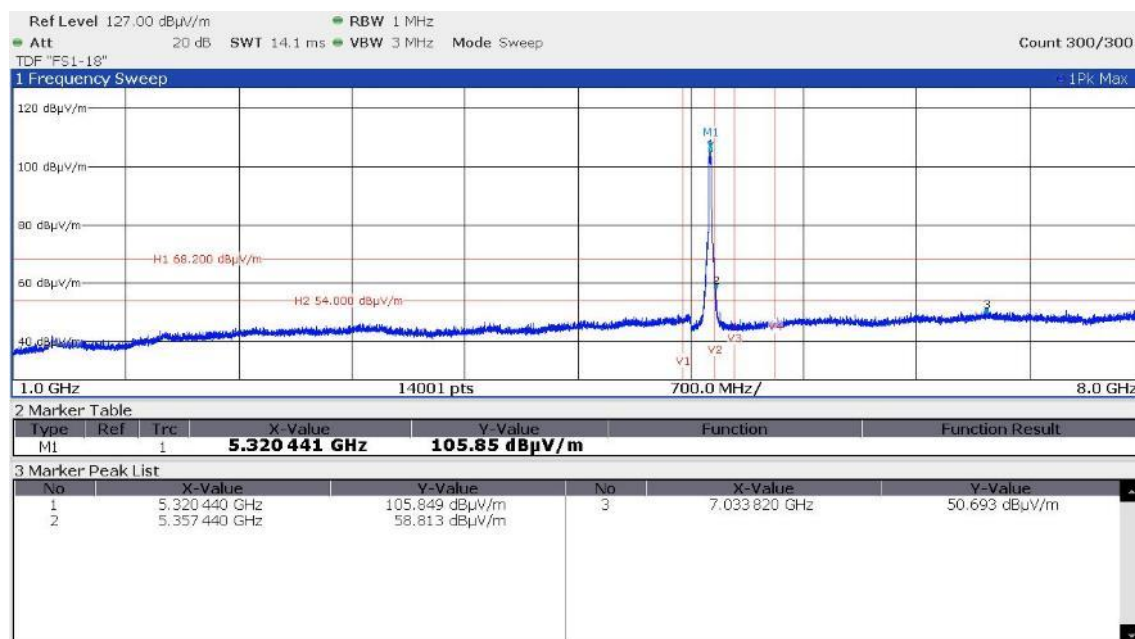
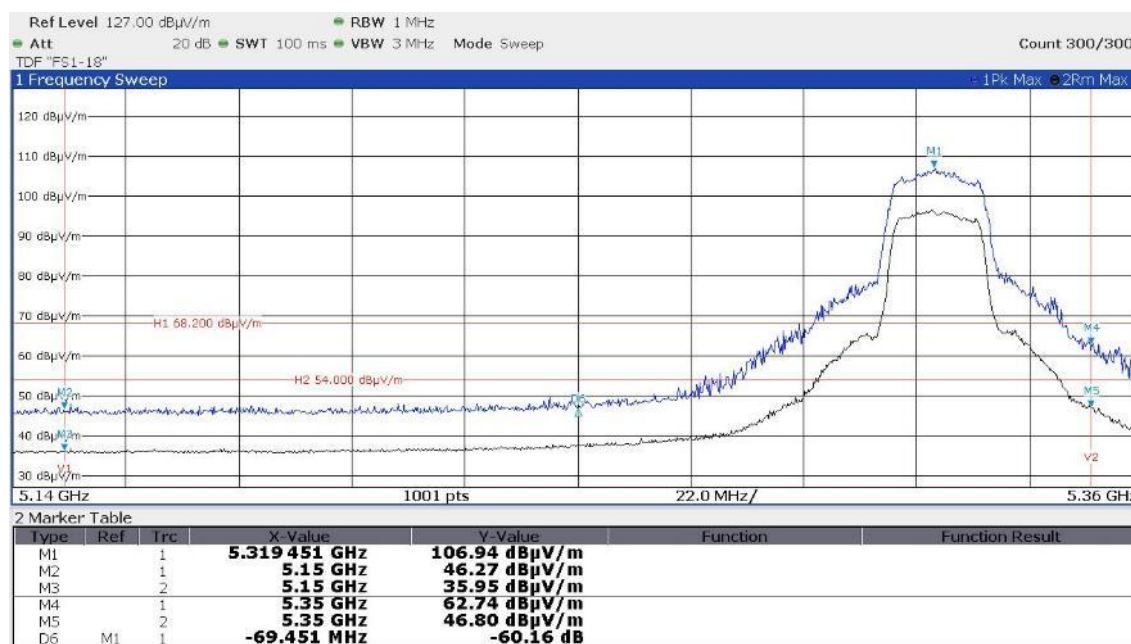
Note: No emissions detected in the frequency range 30 MHz to 1 GHz. The recorded values are solely noise values of the OATS.

5.2.4.1 Emission 1 GHz – 8 GHz

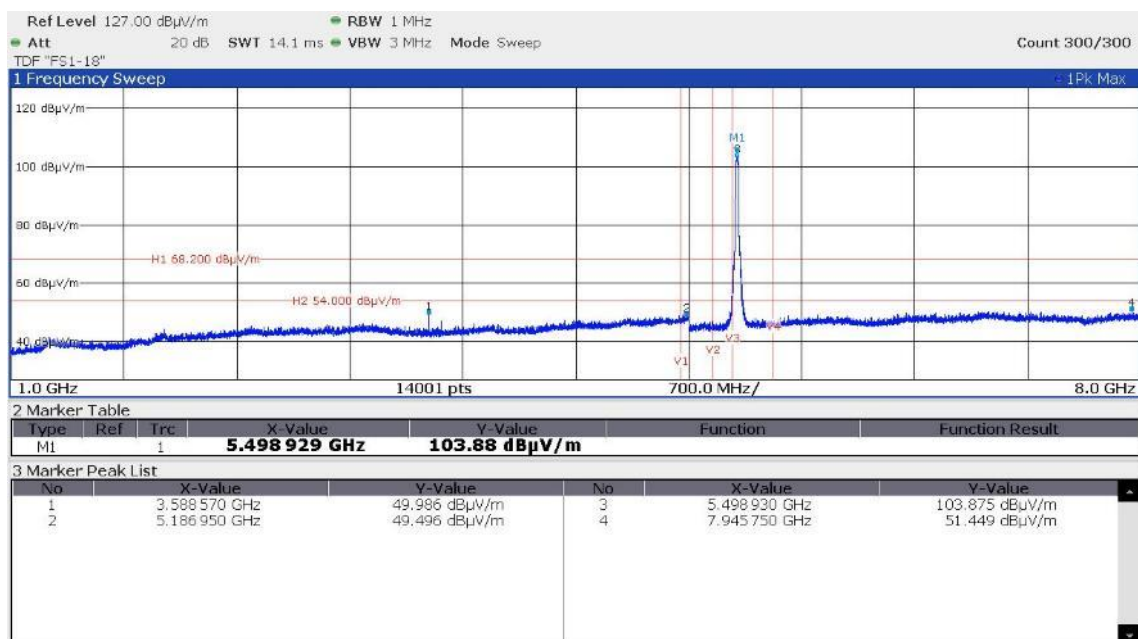
5.2.4.1.1 WLAN Standard 802.11n HT20 CH36



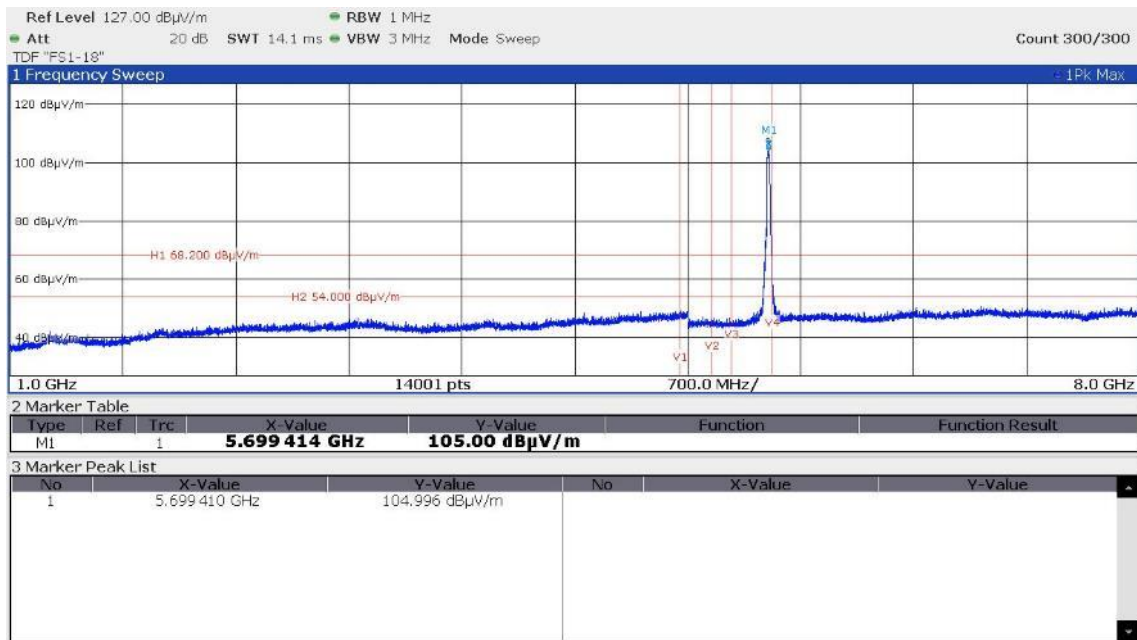
CH64



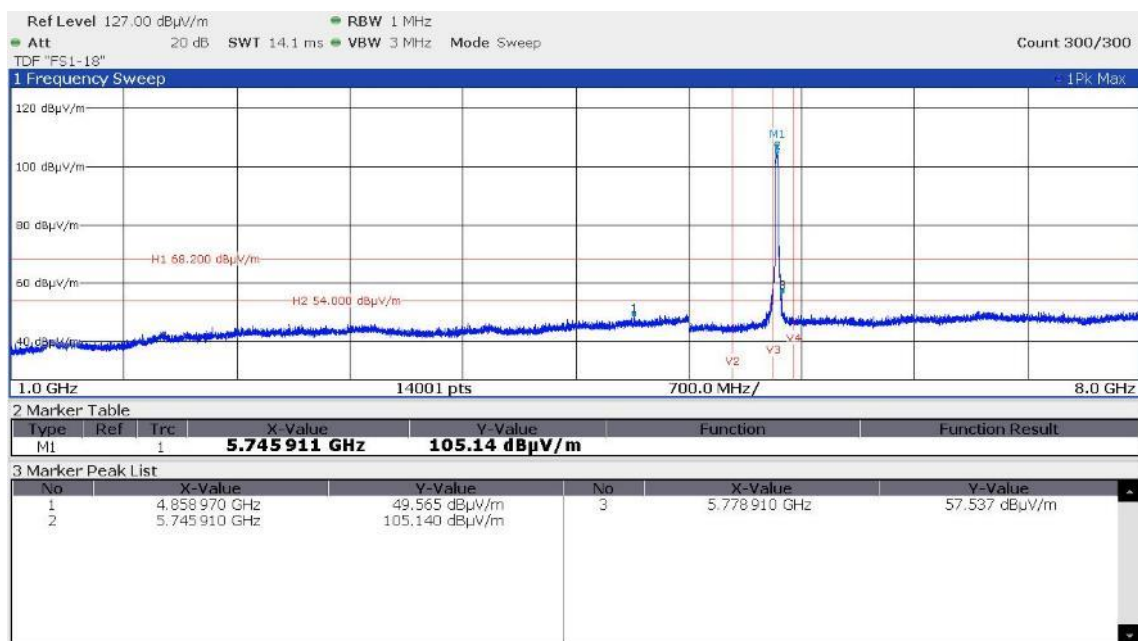
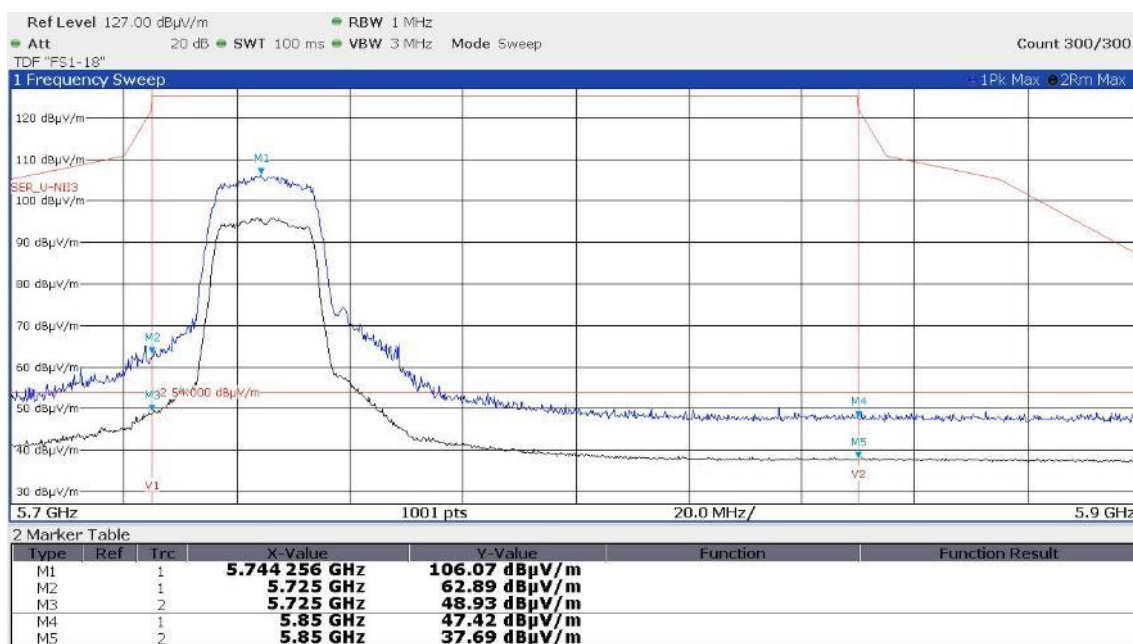
CH100



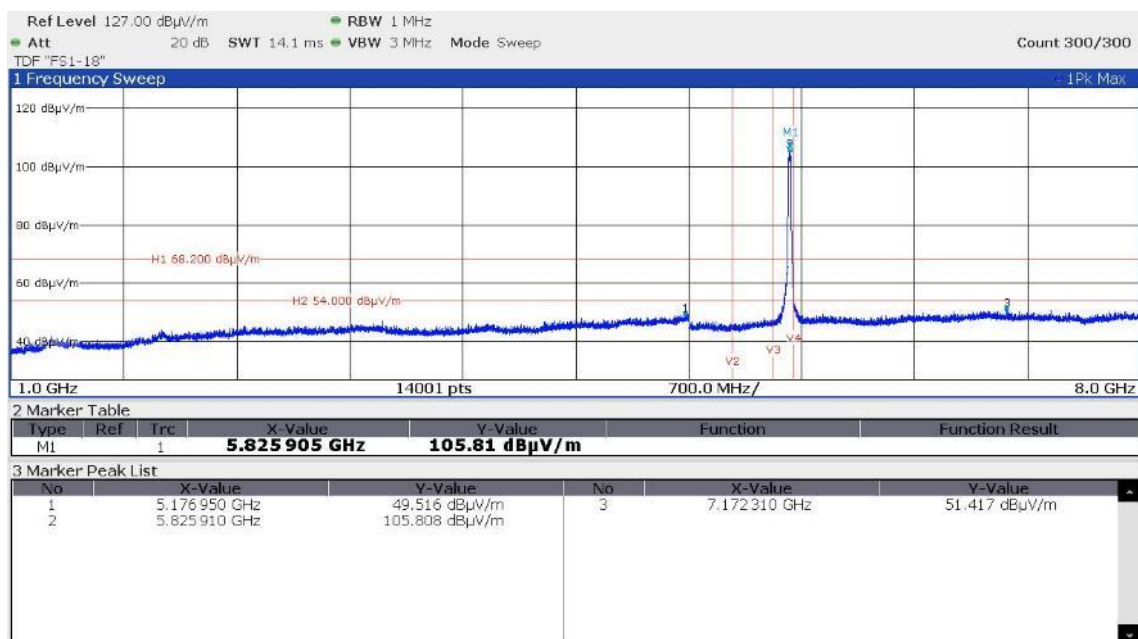
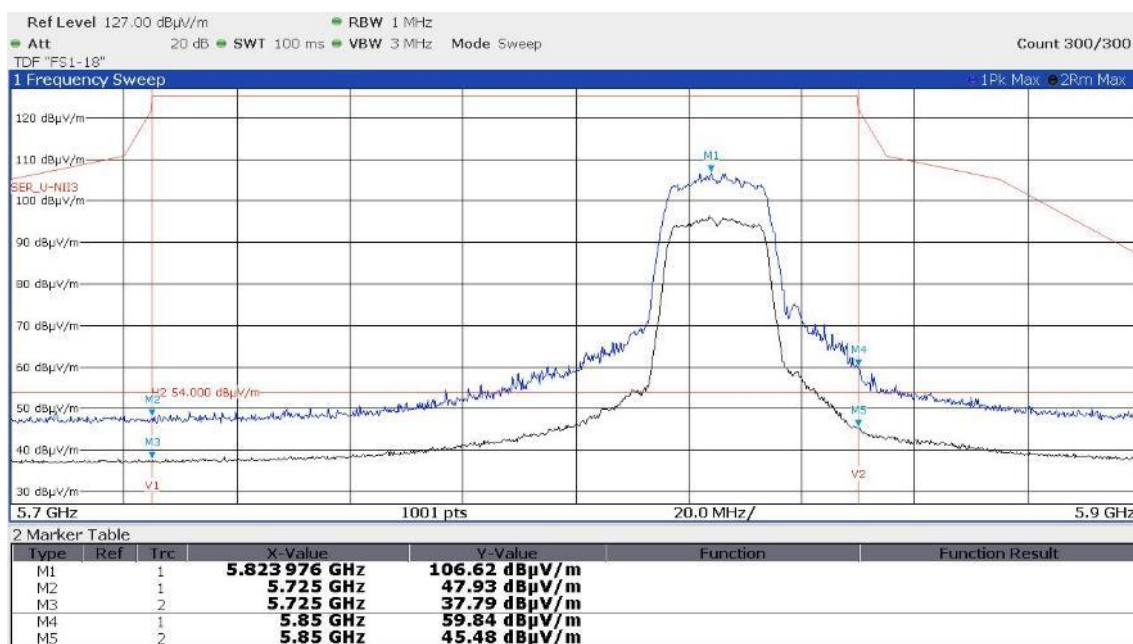
CH140



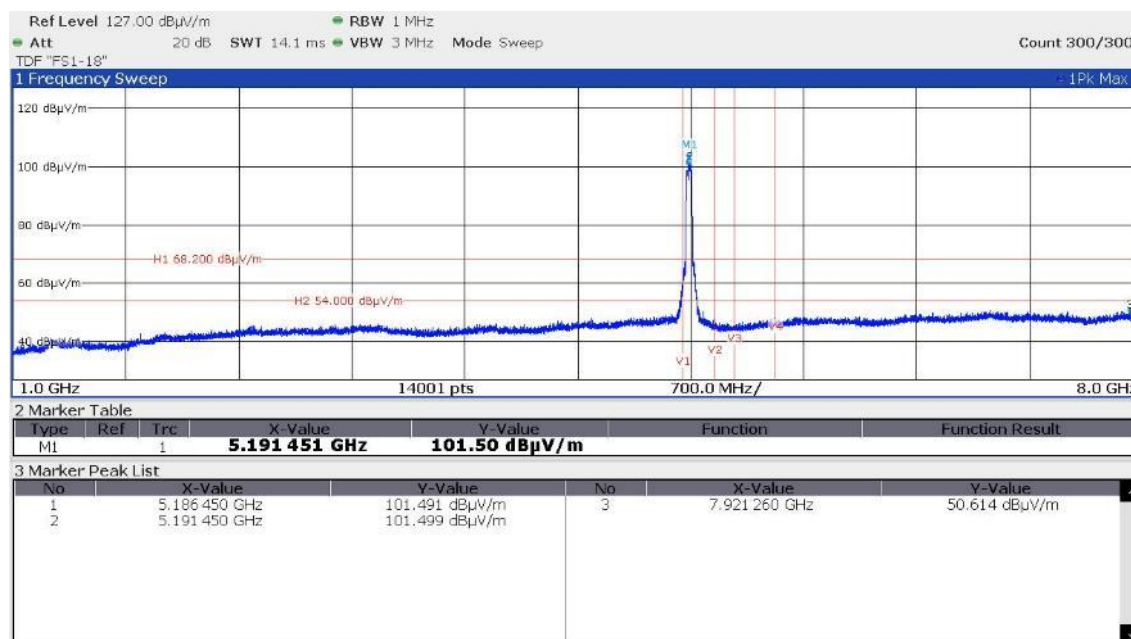
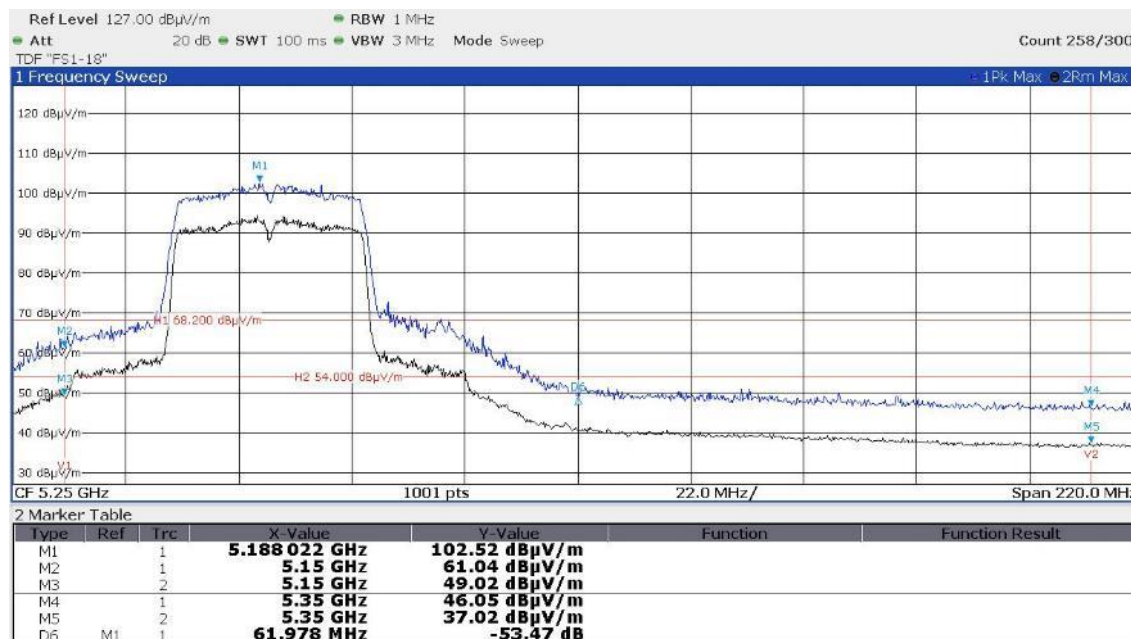
CH149



CH165

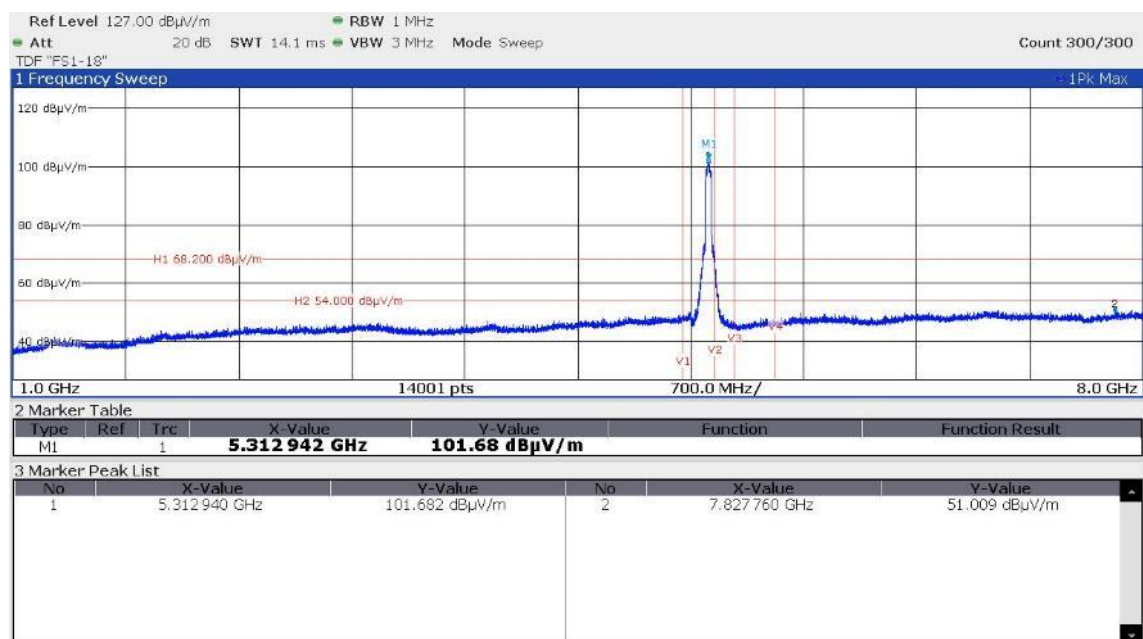
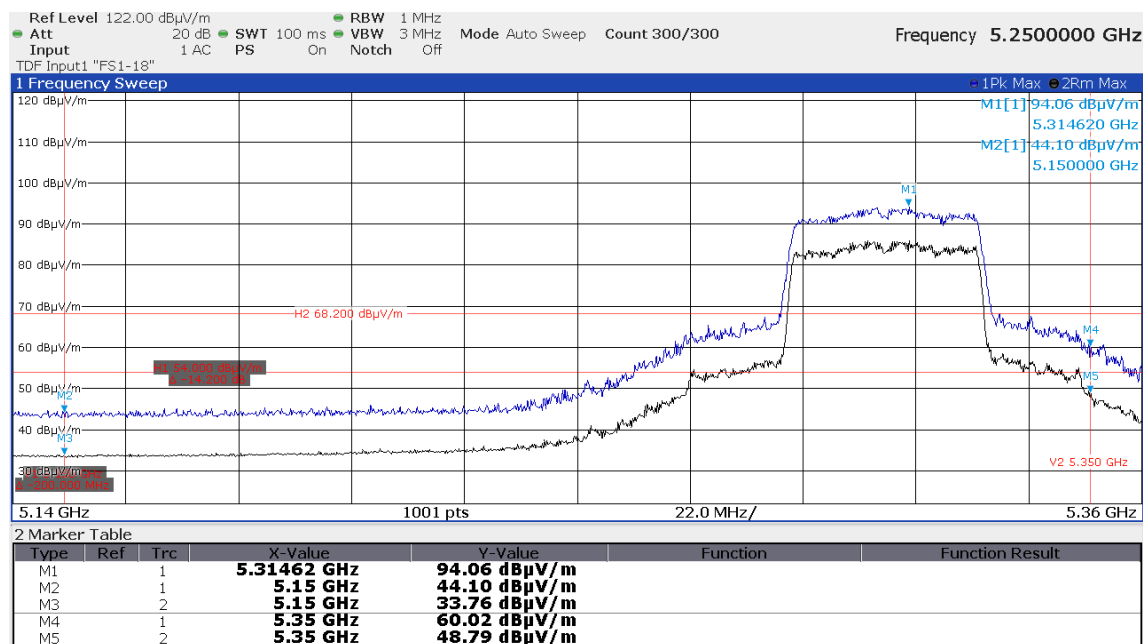


5.2.4.1.2 WLAN Standard 802.11n HT40 CH38

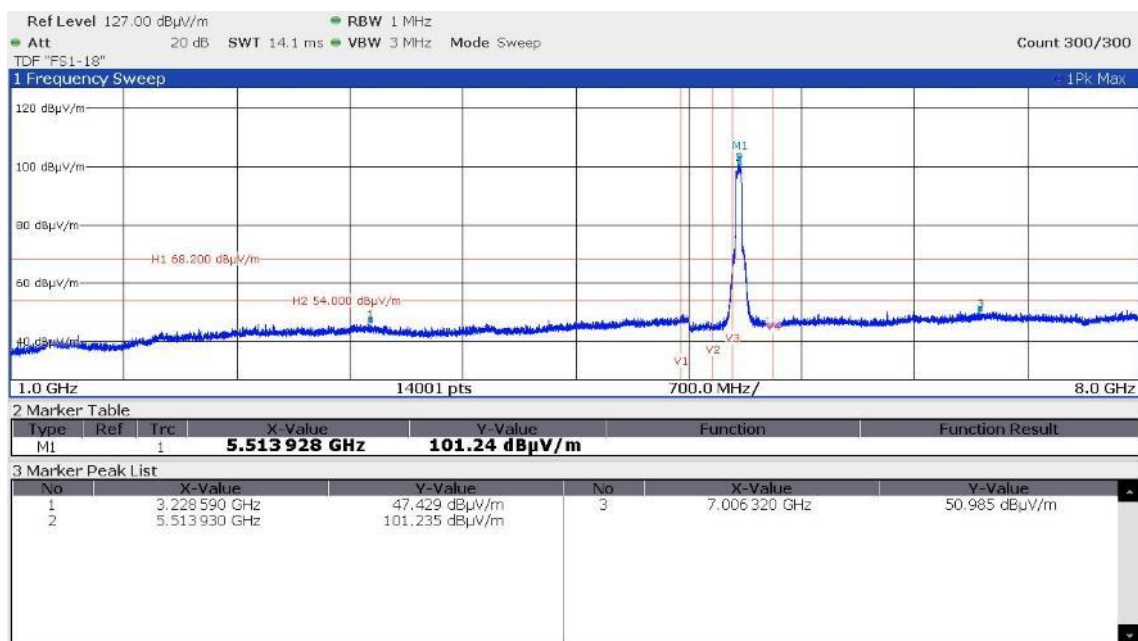
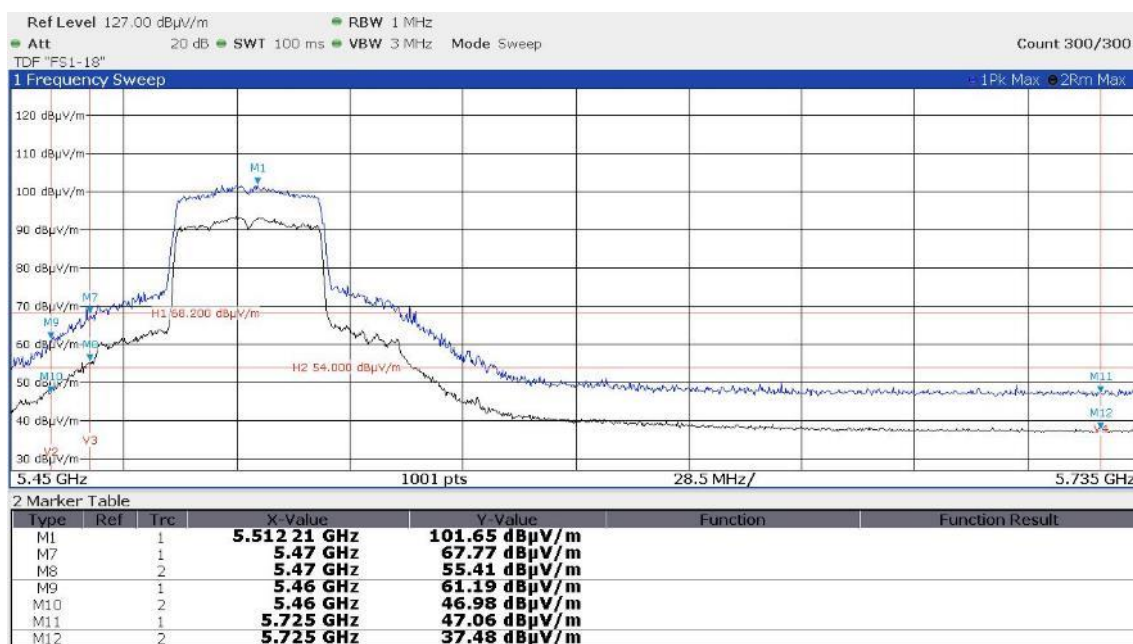


The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

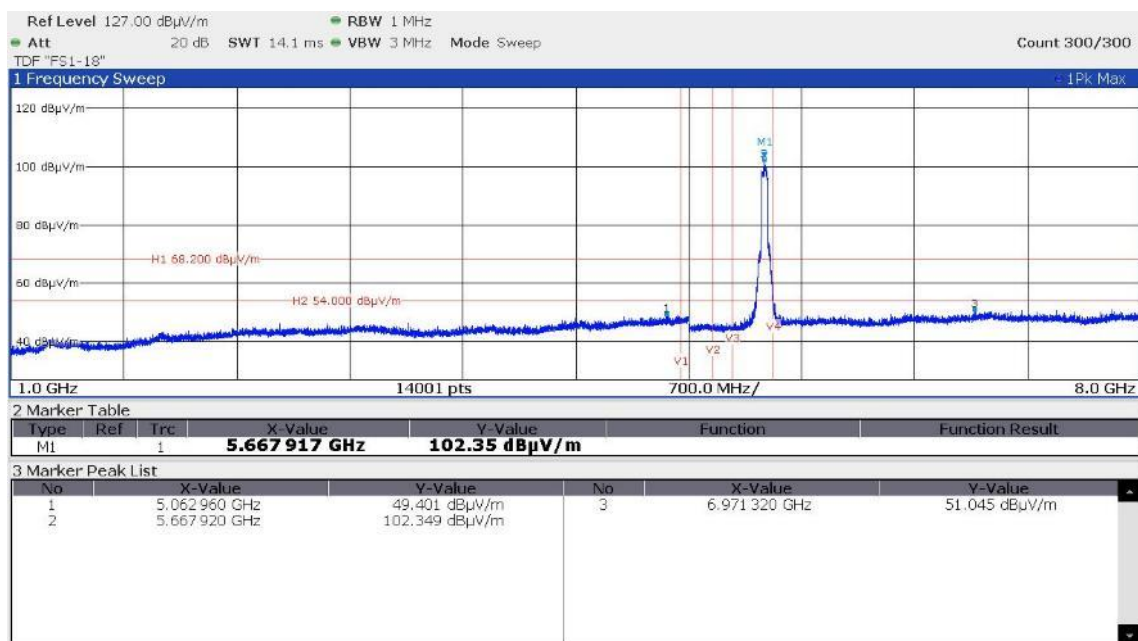
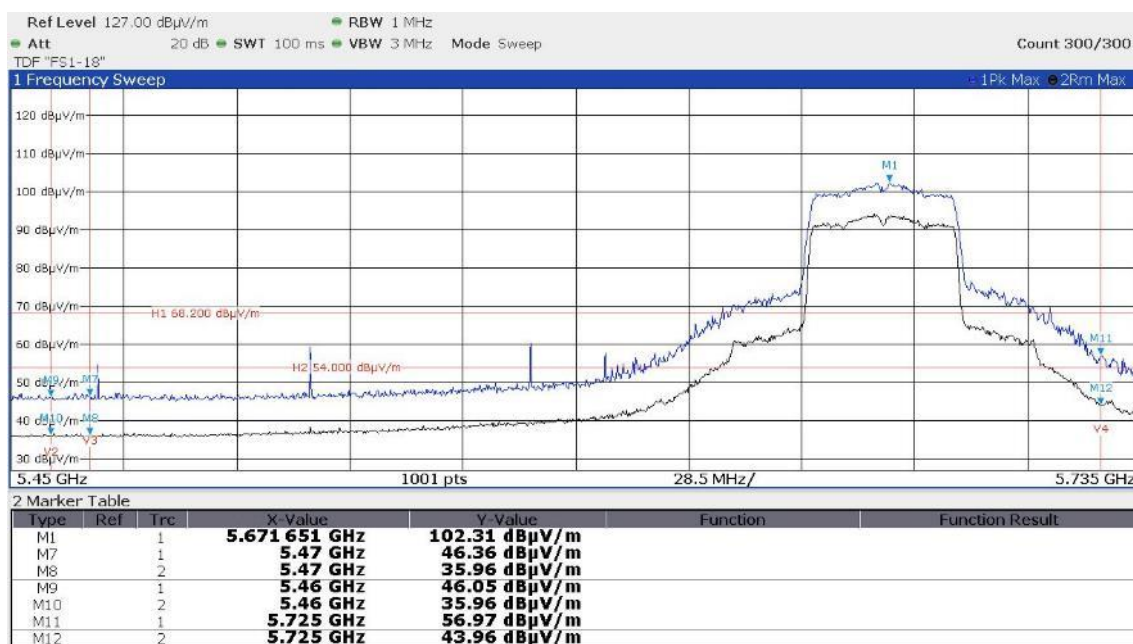
CH62



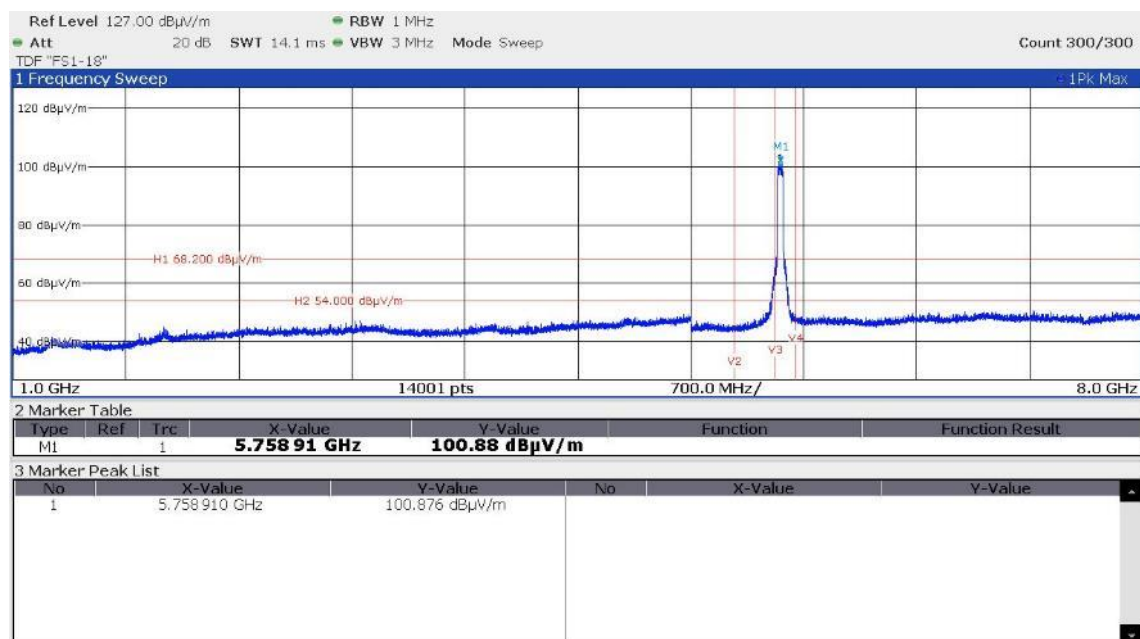
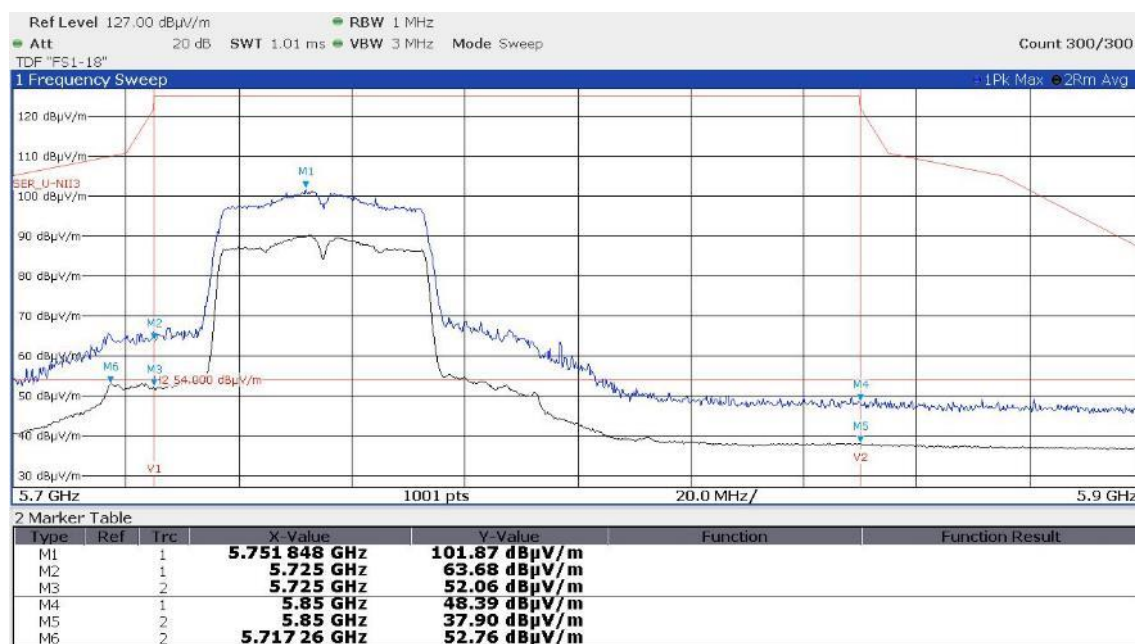
CH102



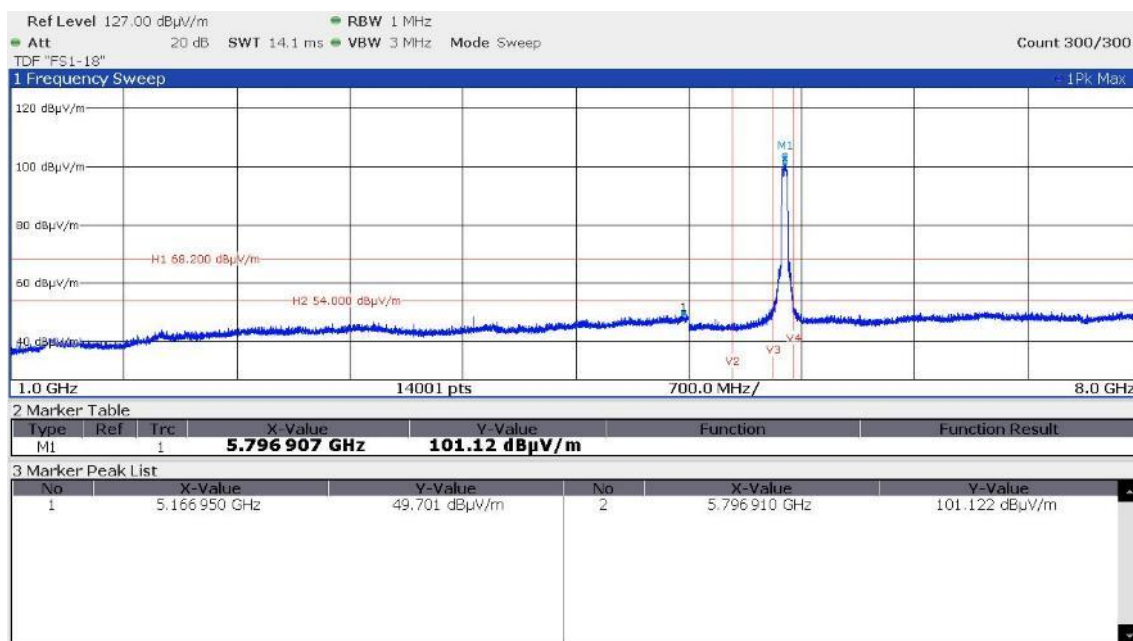
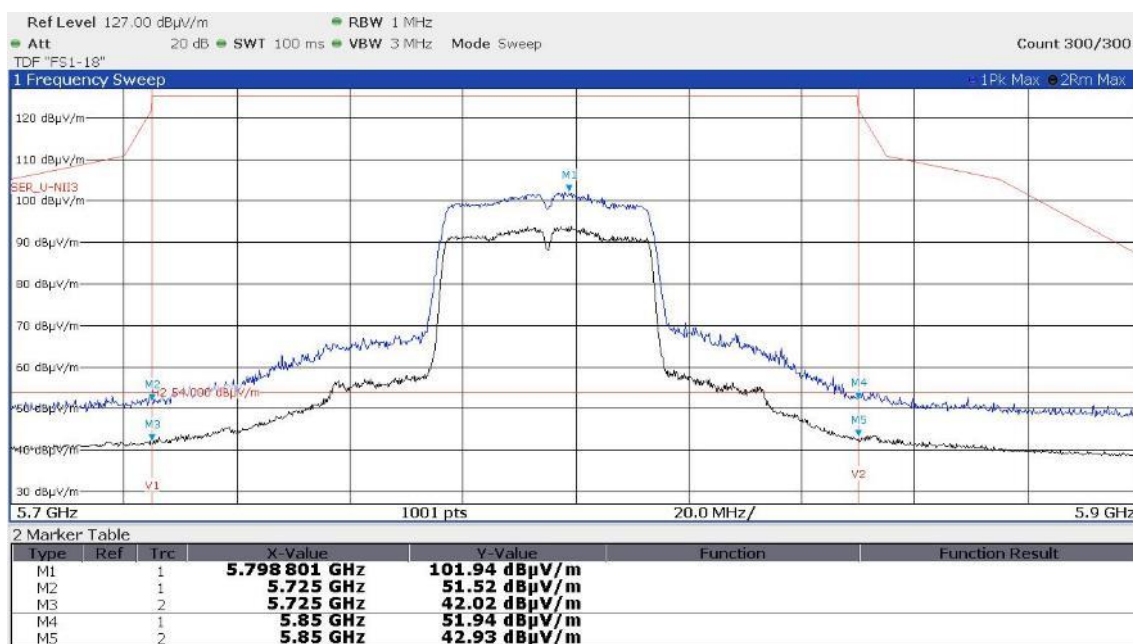
CH134



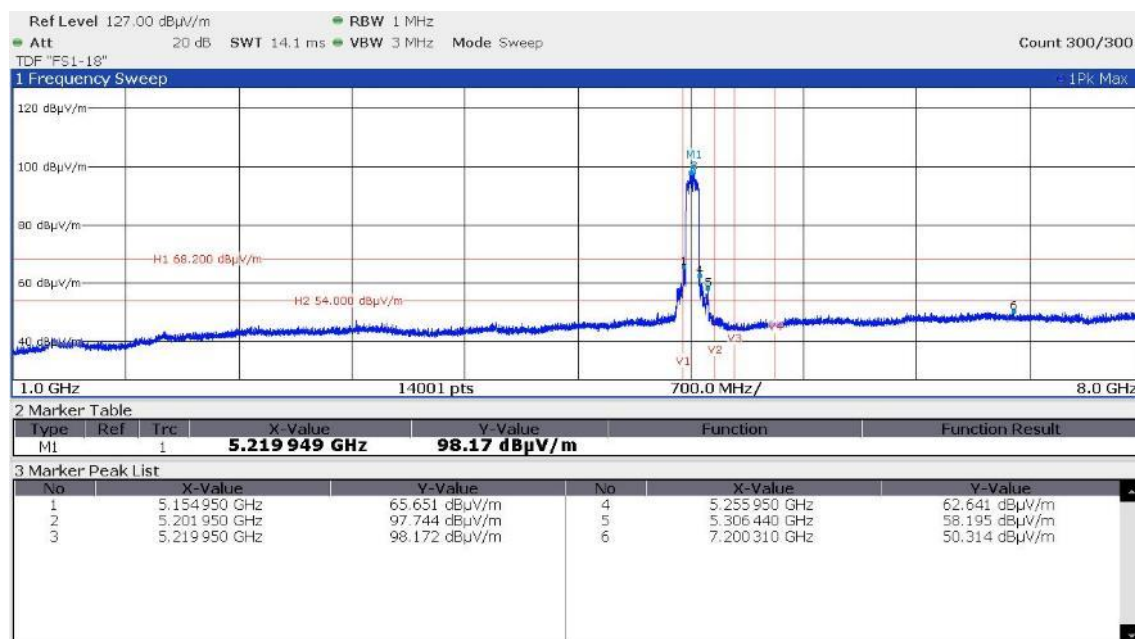
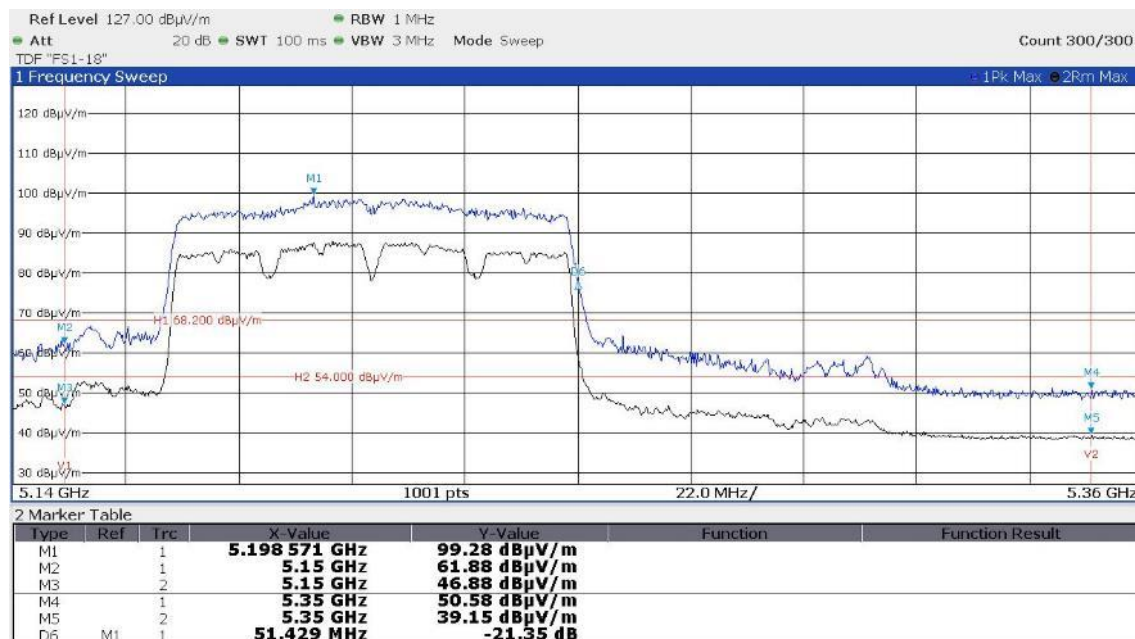
CH151



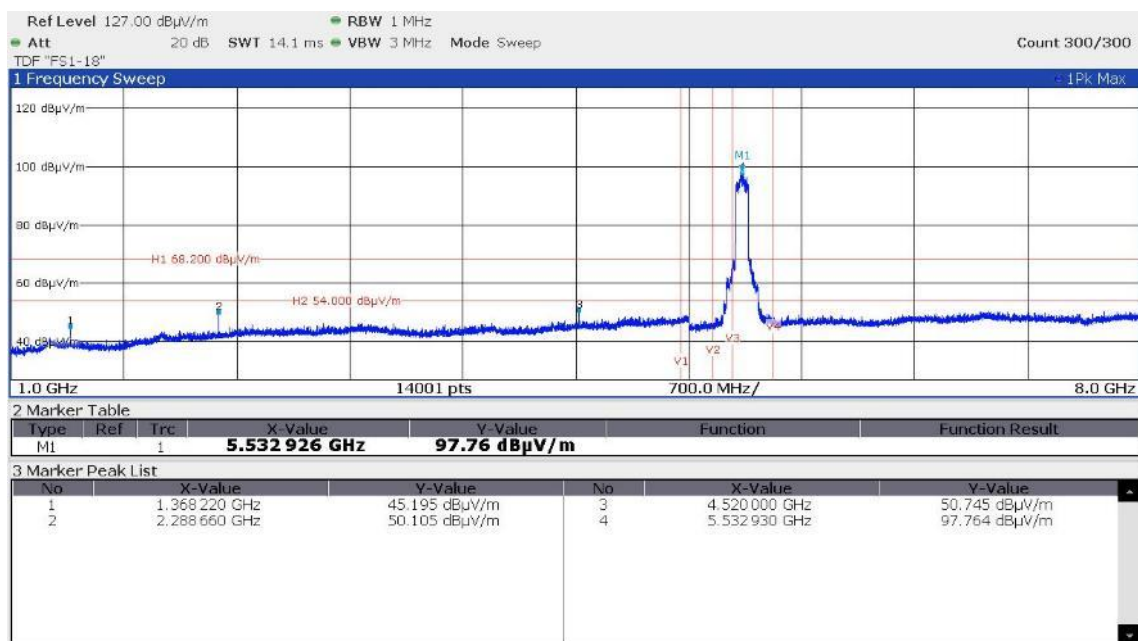
CH159



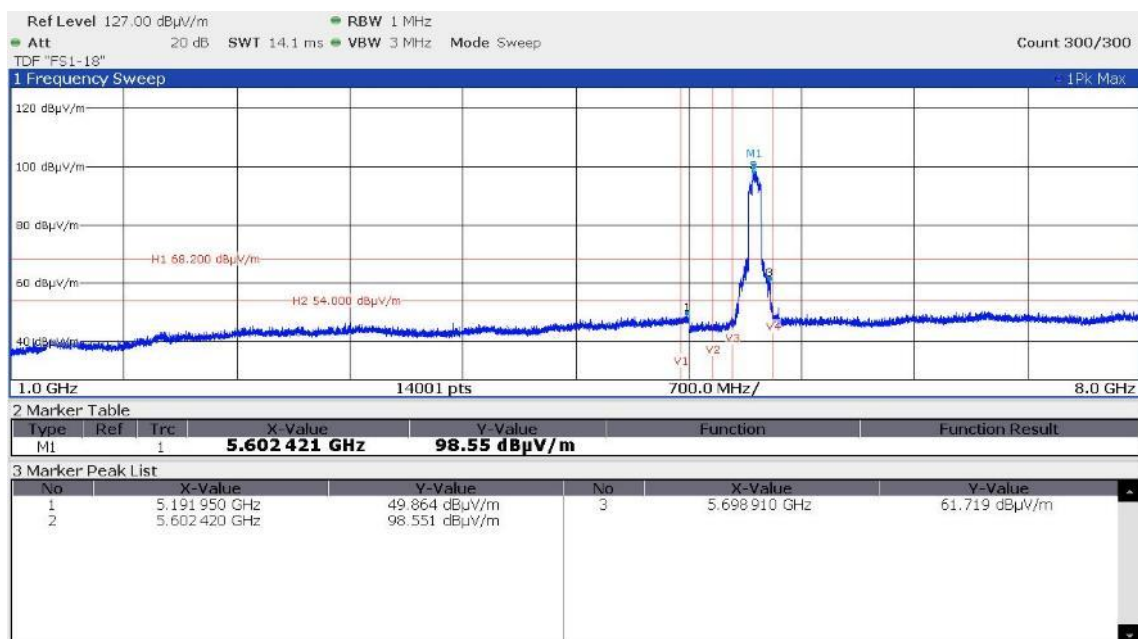
5.2.4.1.3 WLAN Standard 802.11ac VHT80 CH42



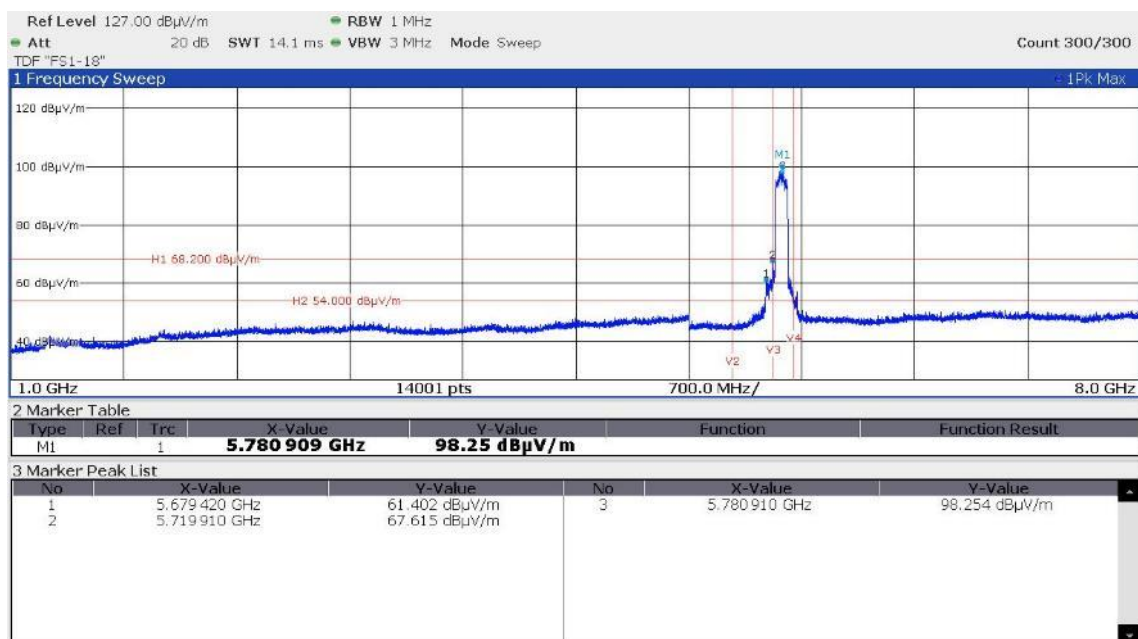
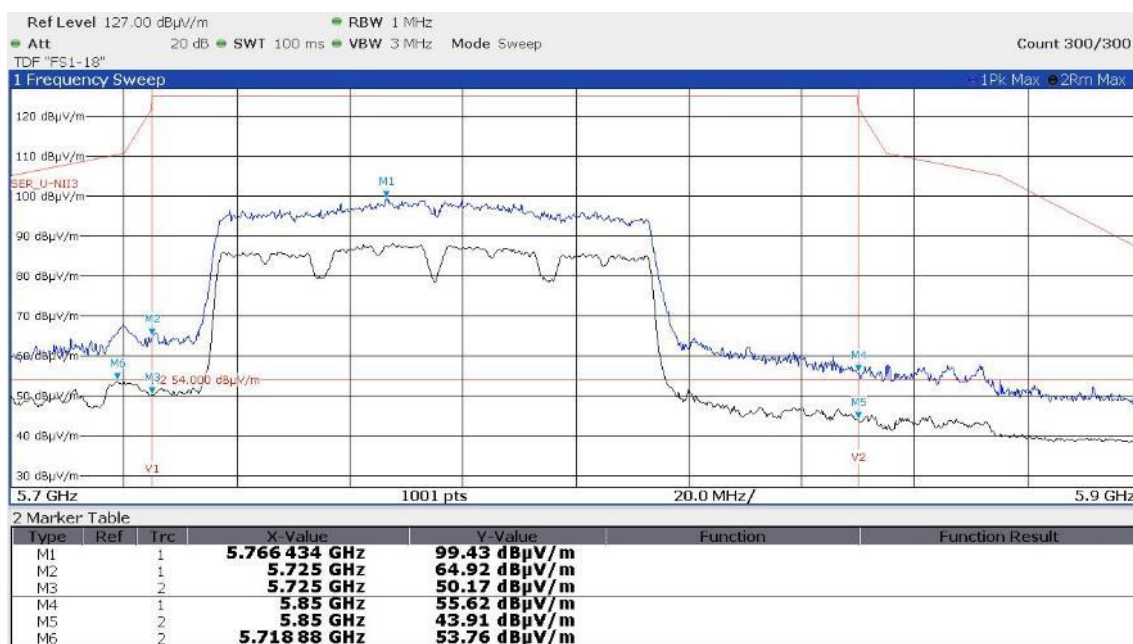
CH106



CH122



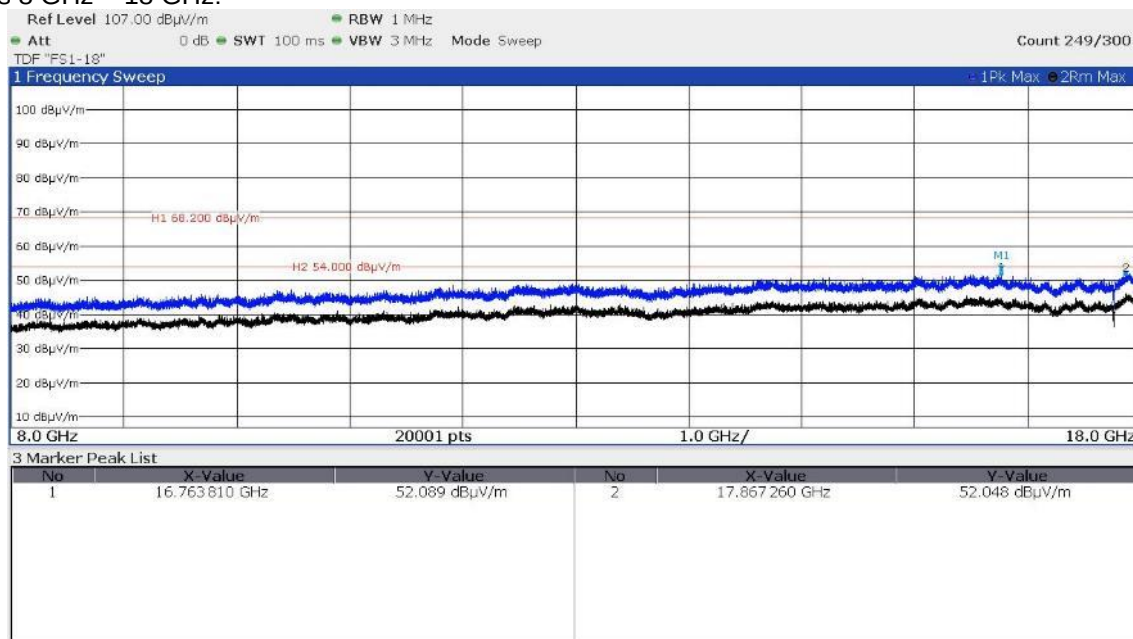
CH155



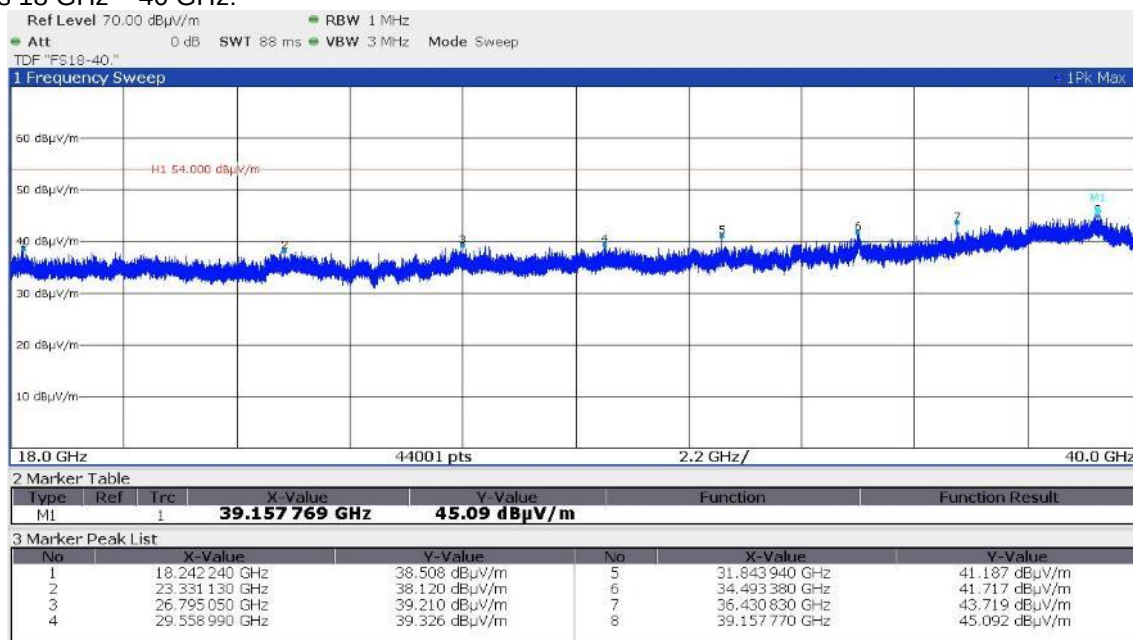
5.2.4.2 Emission 8 GHz – 40 GHz

No emission in the frequency span of 8 GHz to 40 GHz are identified on any channel and operation mode.

Emissions 8 GHz – 18 GHz:



Emissions 18 GHz – 40 GHz:



Limit according to FCC Part 15E, Section 15.407(b) for undesirable emissions (peak):

Operating Frequency range	Undesirable emission limit, EIRP	Undesirable emission limit, EIRP
MHz	dBm/MHz	dB(μV/m)/MHz
5150 - 5250	-27.0	68.2
5250 - 5350	-27.0	68.2
5470 - 5725	-27.0	68.2
57250 - 5850	See 15.407(b)(4)	

Radiated limits according to FCC Part 15C, Section 15.209(a) (RMS):

Frequency	Field strength of spurious emissions		Measurement distance
(MHz)	(μV/m)	dB(μV/m)	(metres)
0.009-0.490	2400/F (kHz)		300
0.490-1.705	24000/F (kHz)		30
1.705-30	30	29.5	30
30-88	100	40	3
88-216	150	43.5	3
216-960	200	46	3
Above 960	500	54	3

FCC Part 15C, Section 15.205, restricted bands of operation:

MHz	MHz	MHz	GHz
0.090 – 0.110	16.42 – 16.423	399.9 – 410	4.5 – 5.15
0.495 – 0.505	16.69475 – 16.69525	608 – 614	5.35 – 5.46
2.1735 – 2.1905	16.80425 – 16.80475	960 – 1240	7.25 – 7.75
4.125 – 4.128	25.5 – 25.67	1300 – 1427	8.025 – 8.5
4.17725 – 4.17775	37.5 – 38.25	1435 – 1626.5	9.0 – 9.2
4.20725 – 4.20775	73 – 74.6	1645.5 – 1646.5	9.3 – 9.5
6.215 – 6.218	74.8 – 75.2	1660 – 1710	10.6 – 12.7
6.26775 – 6.26825	108 – 121.94	1718.8 – 1722.2	13.25 – 13.4
6.31175 – 6.31225	123 – 138	2200 – 2300	14.47 – 14.5
8.291 – 8.294	149.9 – 150.05	2310 – 2390	15.35 – 16.2
8.362 – 8.366	156.52475 – 156.52525	2483.5 – 2500	17.7 – 21.4
8.37625 – 8.38675	156.7 – 156.9	2690 – 2900	22.01 – 23.12
8.41425 – 8.41475	162.0125 – 167.17	3260 – 3267	23.6 – 24.0
12.29 – 12.293	167.72 – 173.2	3332 – 3339	31.2 – 31.8
12.51975 – 12.52025	240 – 285	3345.8 – 3358	36.43 – 36.5
12.57675 – 12.57725	322 – 335.4	3600 – 4400	Above 38.6

RSS-Gen, Table 6 – Restricted Frequency Bands

MHz	MHz	MHz	GHz
0.090 - 0.110	12.57675 - 12.57725	399.9 - 410	7.250 - 7.750
0.495 - 0.505	13.36 - 13.41	608 - 614	8.025 – 8.500
2.1735 - 2.1905	16.42 - 16.423	960 - 1427	9.0 - 9.2
3.020 - 3.026	16.69475 - 16.69525	1435 - 1626.5	9.3 - 9.5
4.125 - 4.128	16.80425 - 16.80475	1645.5 - 1646.5	10.6 - 12.7
4.17725 - 4.17775	25.5 - 25.67	1660 - 1710	13.25 - 13.4
4.20725 - 4.20775	37.5 - 38.25	1718.8 - 1722.2	14.47 - 14.5
5.677 - 5.683	73 - 74.6	2200 - 2300	15.35 - 16.2
6.215 - 6.218	74.8 - 75.2	2310 - 2390	17.7 - 21.4
6.26775 - 6.26825	108 – 138	2483.5 - 2500	22.01 - 23.12
6.31175 - 6.31225	149.9 - 150.05	2655 - 2900	23.6 - 24.0
8.291 - 8.294	156.52475 - 156.52525	3260 – 3267	31.2 - 31.8
8.362 - 8.366	156.7 - 156.9	3332 - 3339	36.43 - 36.5
8.37625 - 8.38675	162.0125 - 167.17	3345.8 - 3358	Above 38.6
8.41425 - 8.41475	167.72 - 173.2	3500 - 4400	
12.29 - 12.293	240 – 285	4500 - 5150	
12.51975 - 12.52025	322 - 335.4	5350 - 5460	

The requirements are **FULFILLED**.

Remarks: The measurement was performed up to 40 GHz.

Only the worst case plots are listed.

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

6 USED TEST EQUIPMENT AND ACCESSORIES

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

Test ID	Model Type	Equipment No.	Next Calib.	Last Calib.	Next Verif.	Last Verif.
A 4	BAT-EMC 2022.0.32.0	01-02/68-13-001				
	ESCI	02-02/03-15-001	03/07/2024	03/07/2023		
	ESH 2 - Z 5	02-02/20-05-004	13/10/2025	13/10/2022	17/04/2024	17/04/2023
	N-4000-BNC	02-02/50-05-138				
	ESH 3 - Z 2	02-02/50-05-155	09/11/2025	09/11/2022	25/01/2024	25/07/2023
	SP 103 /3.5-60	02-02/50-05-182				
	HM 8143	02-02/50-10-016				
SER 1	ESW26	02-02/03-17-002	08/03/2024	08/03/2023		
	HFH 2 - Z 2	02-02/24-05-020	01/06/2025	01/06/2022	05/09/2024	05/09/2023
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
	EA-PS2012-10	02-02/50-15-035				
SER 2	ESVS 30	02-02/03-05-006	27/07/2024	27/07/2023		
	VULB 9168	02-02/24-05-005	20/04/2024	20/04/2023	03/05/2024	03/05/2023
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
	EA-PS2012-10	02-02/50-15-035				
	50F-003 N 3 dB	02-02/50-21-010				
SER 3	FSW43	02-02/11-21-001	22/05/2024	22/05/2023		
	AMF-6D-01002000-22-10P	02-02/17-15-004				
	LNA-40-18004000-33-5P	02-02/17-20-002				
	3117	02-02/24-05-009	12/07/2024	12/07/2023		
	BBHA 9170	02-02/24-05-013	21/03/2026	21/03/2023	21/03/2024	21/03/2023
	VLP-1602 PRO	02-02/50-10-015				
	EA-PS2012-10	02-02/50-15-035				
	BAM 4.5-P	02-02/50-17-024				
	NCD	02-02/50-17-025				
	KK-SF106-2X11N-6,5M	02-02/50-18-016				
	KMS116-GL140SE-KMS116-	02-02/50-20-026				
	BAT-EMC 2022.0.32.0	02-02/68-13-001				
	ESW44	09-16/03-24-001	21/11/2024	21/11/2023		

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