EMI – TEST REPORT

- FCC Part 15.407, RSS-247 -

Type / Model Name : System master basic

Product Description : WLAN module

Applicant : BSH Hausgeräte GmbH

Address : Im Gewerbepark B10

93059 REGENSBURG, GERMANY

Manufacturer : BSH Hausgeräte GmbH

Address : Im Gewerbepark B10

93059 REGENSBURG, GERMANY

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

Test Report No. : T44223-02-05HS	11. December 2019 Date of issue

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

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.

FCC ID: 2AHES-SMB **IC: 21152-SMB**

Contents

1 TEST STANDARDS 3

2 EQUIPMENT UNDER TEST 4

3 TEST RESULT SUMMARY 7

4 TEST ENVIRONMENT 8

4.1 Address of the test laboratory 8
4.2 Environmental conditions 8
4.3 Statement of the measurement uncertainty 8
4.1 Measurement protocol for FCC and IC 9

5 TEST CONDITIONS AND RESULTS 10

5.1 Conducted emissions 10
5.2 Maximum conducted output power 14
5.4 Undesirable emissions 17
5.5 Antenna application 42

6 USED TEST EQUIPMENT AND ACCESSORIES 43

ATTACHMENT A 44

1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15, Subpart A - General (September, 2019)

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 (September, 2019)

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 (December, 2019)

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
ETSI TR 100 028 V1.3.1: 2001-03	Electromagnetic Compatibility and Radio Spectrum Matters (ERM); Uncertainties in the Measurement of Mobile Radio Equipment Characteristics—Part 1 and Part 2
KDB 789033 D02 v02r01	Guidelines for compliance testing of UNII-Devices – Part 15, Subpart E, December 14, 2017.

2 EQUIPMENT UNDER TEST

2.1 Photo documentation of the EUT – Detailed photos see ATTACHMENT A

2.2 General remarks

The EUT is a communication module consist of a fully tested and approved WLAN-Module according the FCC 15.407 with a manufacturer designed host and PCB antennas. This test report show the further compliance to the FCC 15.407 after integration. Therefore, the re-test is partly done to the following requirements, only.

- RF output power (radiated)
- Transmitter unwanted emissions, radiated

2.3 Equipment category

WLAN - Client

2.4 Short description of the equipment under test (EUT)

The EUT is a communication module for assembling into house hold devices.

Number of tested samples: 1
Serial number: Muster 286
Firmware version WLAN: 7.45.165

EUT configuration:
(The CDF filled by the applicant can be viewed at the test laboratory.)

2.5 Variants of the EUT

There are no variants.

2.6 Operation frequency and channel plan

The operating frequency is 5470 MHz to 5725 MHz.

Channel plan WLAN Standard 802.11a, n HT20, ac VT20:

Channel	Frequency (MHz)
100	5500
104	5520
108	5540
112	5560
116	5580
120	5600
124	5620
128	5640
132	5660
136	5680
140	5700
144	5720

Channel plan WLAN Standard 802.11n HT40, ac VT40:

Channel	Frequency (MHz)
102	5510
110	5550
118	5590
126	5630
134	5670
142	5710

Channel plan WLAN Standard 802.11ac VT80:

Channel	Frequency (MHz)
106	5510
122	5610
138	5690

Note: The marked frequencies are determined for final testing.

2.7 Transmit operating modes

The module use 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 (MCS = *megabits per second)*
- 802.11n HT40, MCS 0 – 7
- 802.11ac VT20, MCS 0 – 8
- 802.11ac VT40, MCS 0 – 9
- 802.11ac VT80, MCS 0 – 9

2.8 Antenna

The following antenna shall be used with the EUT:

Number	Characteristic	Model number	Connector	Frequency (GHz)	Gain 5GHz (dBi)	Cable loss (dB)	effective Gain 5 GHz (dBi)
1	Omni	PCB antenna (Ant0)	-	5	3.99	0	3.99
2	Omni	PCB antenna (Ant1)	-	5	3.14	0	3.14

2.9 Power supply system utilised

Power supply voltage, V_{nom} : 12 VDC

2.10 Peripheral devices and interface cables

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

- LAN cable Model : Common
- - Model : -
- Model :

2.11 Determination of worst case conditions for final measurement

FCC ID: 2AHES-SMB IC: 21152-SMB

Measurements have been made in all three orthogonal axes and the settings of the EUT were changed to locate at which position and at what setting of the EUT produce the maximum of the emissions. For the final measurement the EUT is set in X position.
Preliminary tests were performed to find the worst case mode from all possible combinations between available modulations, data rates. The maximum output power depends on used data rate.
Following channels and test modes were selected for the final test as listed below:

HT20 mode:

Technology	Available channels	Tested channels	Modulation	Modulation type	Data rate (Mbps)
802.11n	100 - 144	100, 116, 120, 140, 144	OFDM	BPSK	MCS=0 (BW=20 MHz)

VT40 mode:

Technology	Available channels	Tested channels	Modulation	Modulation type	Data rate (Mbps)
802.11ac	102 - 142	102, 110, 118, 134, 142	OFDM	BPSK	MCS=0 (BW=40 MHz)

VT80 mode:

Technology	Available channels	Tested channels	Modulation	Modulation type	Data rate (Mbps)
802.11ac	108 - 138	108, 122, 138	OFDM	BPSK	MCS=0 (BW=80 MHz)

- TX continuous mode, 802.11n
- TX continuous mode, 802.11ac

2.11.1 Test jig

No test jig is used.

2.11.2 Test software

The test software for the EUT provides free power setting, the special test mode TX continuous mode, modulated. The EUT was set with test modulation to transmit data during the tests with a maximum duty cycle (x) from an internal packet generator.

3 TEST RESULT SUMMARY

UNII device uses the operating band 5470 MHz - 5725 MHz:

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	Output power	passed
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	passed
15.407(a)	RSS-210, A9.2(2)	EBW26, OBW 99 %	Not tested

The mentioned RSS Rule Parts in the above table are related to:
RSS-Gen, Issue 5, March 2019
RSS-247, Issue 2, February 2017

3.1 Final assessment

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

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

Testing commenced on : 20 September 2019

Testing concluded on : 11 October 2019

Checked by:

Klaus Gegenfurtner
I confirm the correctness and integrity of this document
2019.12.11 14:10:02 +01'00'

Klaus Gegenfurtner
Teamleader Radio

Tested by:

I am the author of this document
2019.12.11 13:53:01 +01'00'

Hermann Smetana
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:	15-35 °C
Humidity:	30-60 %
Atmospheric pressure:	86-106 kPa

4.3 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. It is noted that the expanded measurement uncertainty corresponds to the measurement results from the standard measurement uncertainty multiplied by the coverage factor k = 2. The true value is located in the corresponding interval with a probability of 95 % The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16-4-2 / 11.2003 „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%	± 3.29 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%	± 2.71 dB
Field strength of the fundamental	1000 MHz to 7000 MHz	95%	± 2.71 dB
Power spectral density	2400 MHz to 3000 MHz	95%	± 0.62 dB
Spurious Emissions, conducted	9 kHz to 10000 MHz	95%	± 2.15 dB
Spurious Emissions, conducted	10000 MHz to 40000 MHz	95%	± 3.47 dB
Spurious Emissions, radiated	9 kHz to 30 MHz	95%	± 3.53 dB
Spurious Emissions, radiated	30 MHz to 1000 MHz	95%	± 4.44 dB
Spurious Emissions, radiated	1000 MHz to 30000 MHz	95%	± 2.34 dB
Spurious Emissions, radiated	30000 MHz to 40000 MHz	95%	± 5.13 dB

FCC ID: 2AHES-SMB **IC: 21152-SMB**

4.1 Measurement protocol for FCC and IC

4.1.1 General information

The Open Area test site is a listed Open Site under the Canadian Test-Sites File-No:

IC 3009A-1

The Anechoic chamber is a listed test site under the Canadian Test-Sites File-No:

IC 3009A-2

4.1.2 General Standard information

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

4.1.2.1 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.

5 TEST CONDITIONS AND RESULTS

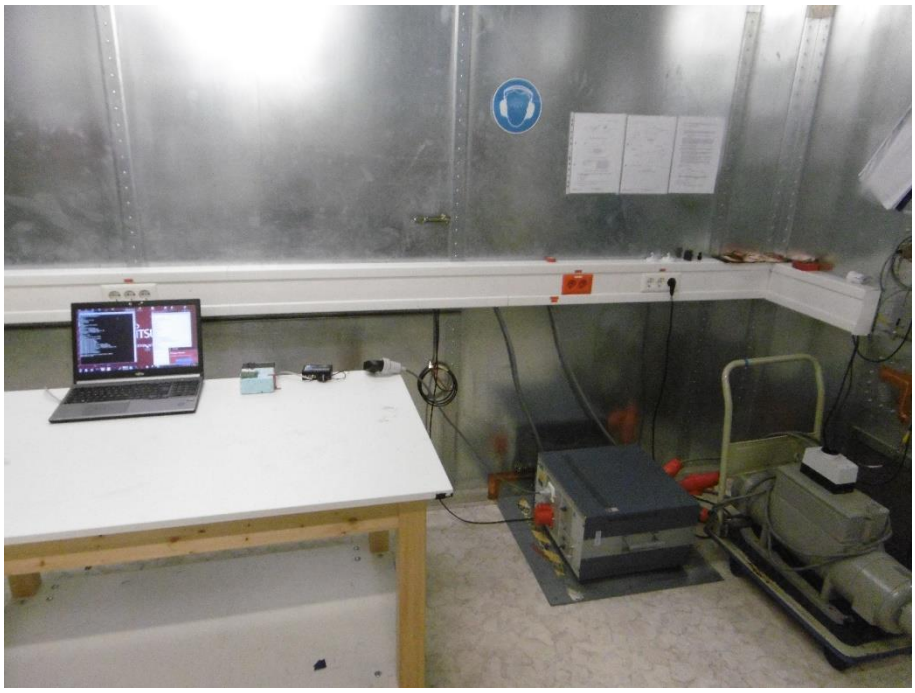
5.1 Conducted emissions

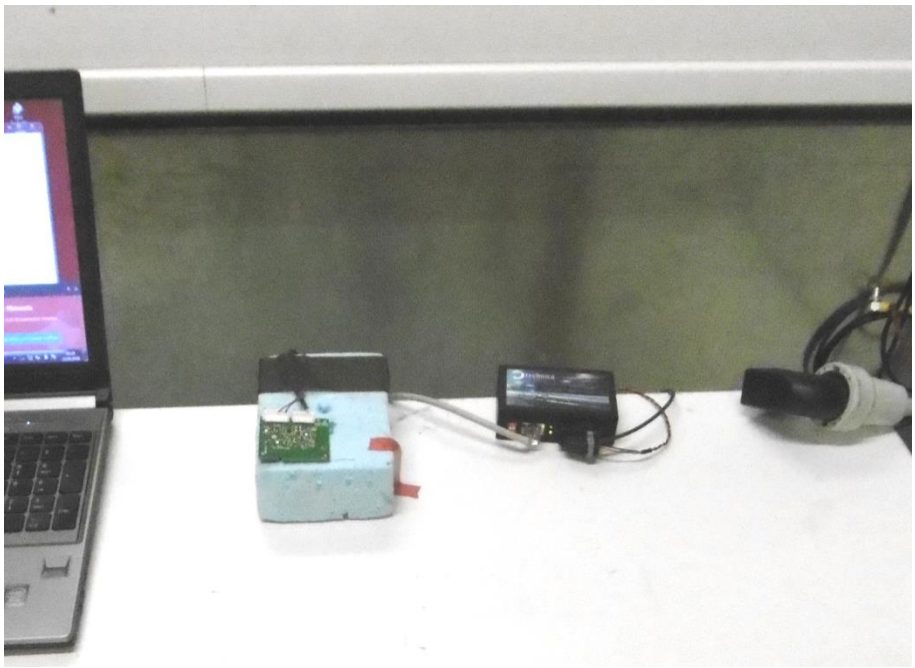
For test instruments and accessories used see section 6 Part **A 4**.

5.1.1 Description of the test location

Test location: Shielded Room S2

5.1.2 Photo documentation of the test set-up





FCC ID: 2AHES-SMB IC: 21152-SMB

5.1.3 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 under FCC 15.207(a).

5.1.4 Description of Measurement

The measurements are performed following the procedures set out in ANSI C63.10 described under item 4.4.3. 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 on the data sheets.

5.1.5 Test result

Frequency range: 0.15 MHz - 30 MHz

Min. limit margin 10.8 dB at 0.186 MHz

Limit according to FCC Part 15, Section 15.207(a):

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

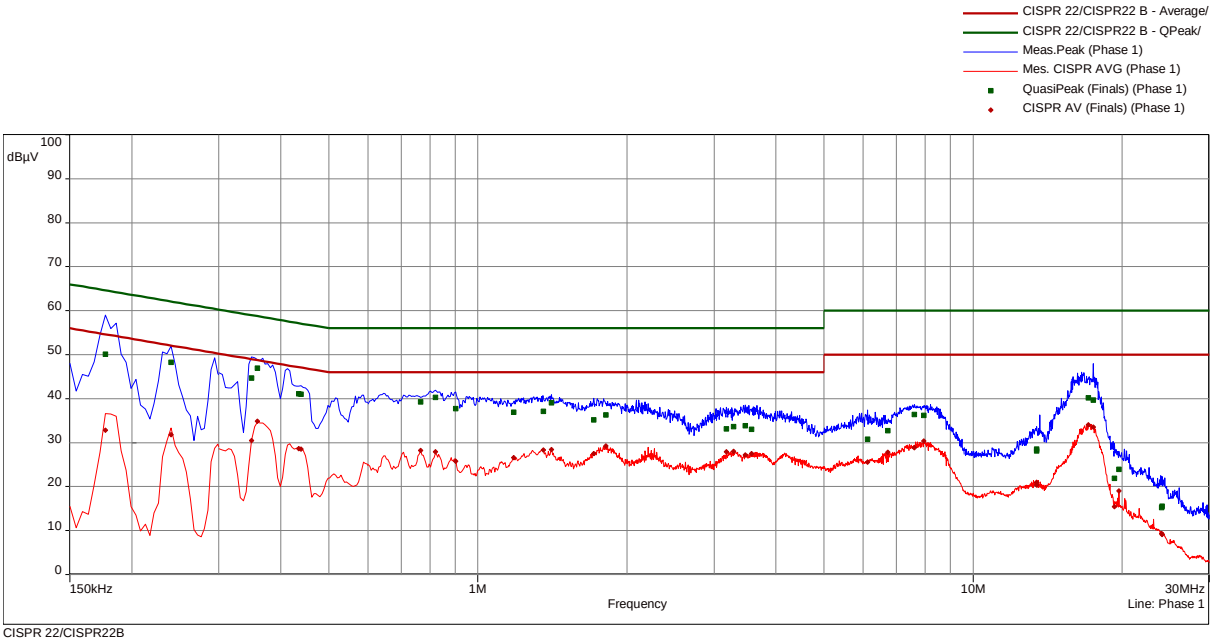
The requirements are **FULFILLED.**

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

FCC ID: 2AHES-SMB **IC: 21152-SMB**

5.1.6 Test protocol

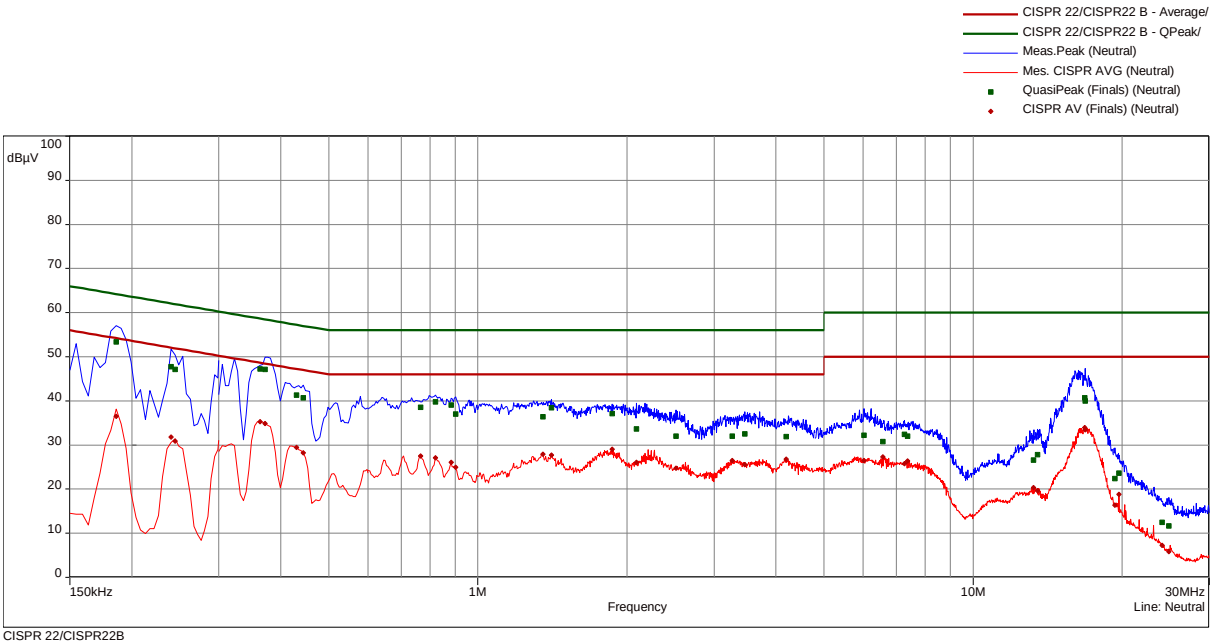
Test point L1 Result: passed
Operation mode: Transmission 5 GHz
Remarks:



freq	SR	QP	margin	limit	AV	margin	limit	line	corr
MHz		dB(µV)	dB	dB	dB(µV)	dB	dB		dB
0.177	1	50.1	-14.5	64.6	32.9	-21.8	54.6	Phase 1	10.1
0.240	1	48.3	-13.8	62.1	31.9	-20.3	52.1	Phase 1	10.1
0.350	2	44.7	-14.3	59.0	30.5	-18.5	49.0	Phase 1	10.1
0.359	2	47.0	-11.8	58.8	34.8	-13.9	48.8	Phase 1	10.1
0.435	2	41.1	-16.1	57.2	28.7	-18.5	47.2	Phase 1	10.1
0.440	2	41.0	-16.1	57.1	28.5	-18.6	47.1	Phase 1	10.1
0.767	3	39.2	-16.8	56.0	28.3	-17.7	46.0	Phase 1	10.2
0.821	3	40.3	-15.7	56.0	28.0	-18.0	46.0	Phase 1	10.2
0.902	3	37.7	-18.3	56.0	25.7	-20.3	46.0	Phase 1	10.2
1.181	3	37.0	-19.0	56.0	26.6	-19.4	46.0	Phase 1	10.2
1.358	4	37.1	-18.9	56.0	28.3	-17.7	46.0	Phase 1	10.2
1.407	4	39.1	-16.9	56.0	28.4	-17.6	46.0	Phase 1	10.2
1.713	4	35.2	-20.8	56.0	27.5	-18.5	46.0	Phase 1	10.3
1.812	4	36.3	-19.7	56.0	29.2	-16.8	46.0	Phase 1	10.3
3.179	5	33.1	-22.9	56.0	27.9	-18.1	46.0	Phase 1	10.4
3.282	5	33.6	-22.4	56.0	28.0	-18.0	46.0	Phase 1	10.4
3.467	5	33.8	-22.2	56.0	27.2	-18.8	46.0	Phase 1	10.4
3.570	5	33.0	-23.0	56.0	27.5	-18.5	46.0	Phase 1	10.4
6.128	6	30.8	-29.2	60.0	25.6	-24.4	50.0	Phase 1	10.6
6.731	6	32.8	-27.2	60.0	27.8	-22.2	50.0	Phase 1	10.6
7.617	6	36.5	-23.6	60.0	28.9	-21.2	50.0	Phase 1	10.6
7.946	6	36.2	-23.8	60.0	30.4	-19.6	50.0	Phase 1	10.7
13.439	7	28.5	-31.5	60.0	21.0	-29.0	50.0	Phase 1	11.1
13.443	7	28.2	-31.8	60.0	20.3	-29.7	50.0	Phase 1	11.1
17.084	7	40.2	-19.8	60.0	34.0	-16.0	50.0	Phase 1	11.3
17.475	7	39.7	-20.3	60.0	33.5	-16.5	50.0	Phase 1	11.3
19.299	8	21.9	-38.1	60.0	15.5	-34.5	50.0	Phase 1	11.4
19.709	8	23.9	-36.1	60.0	19.1	-30.9	50.0	Phase 1	11.4
24.051	8	15.3	-44.7	60.0	9.4	-40.7	50.0	Phase 1	11.6
24.096	8	15.6	-44.4	60.0	9.2	-40.9	50.0	Phase 1	11.7

FCC ID: 2AHES-SMB **IC: 21152-SMB**

Test point N Result: passed
Operation mode: Transmission 5 GHz
Remarks:



CISPR 22/CISPR22B

freq	SR	QP	margin	limit	AV	margin	limit	line	corr
MHz		dB(µV)	dB	dB	dB(µV)	dB	dB		dB
0.186	9	53.4	-10.8	64.2	36.5	-17.7	54.2	Neutral	10.1
0.240	9	47.8	-14.3	62.1	31.8	-20.3	52.1	Neutral	10.1
0.245	9	47.2	-14.8	61.9	30.9	-21.0	51.9	Neutral	10.1
0.363	10	47.2	-11.4	58.7	35.3	-13.4	48.7	Neutral	10.1
0.372	10	47.2	-11.3	58.5	34.9	-13.6	48.5	Neutral	10.1
0.431	10	41.4	-15.9	57.2	29.4	-17.8	47.2	Neutral	10.1
0.444	10	40.7	-16.3	57.0	28.3	-18.7	47.0	Neutral	10.1
0.767	11	38.5	-17.5	56.0	27.5	-18.5	46.0	Neutral	10.2
0.821	11	39.7	-16.3	56.0	27.1	-18.9	46.0	Neutral	10.2
0.884	11	39.1	-16.9	56.0	26.1	-19.9	46.0	Neutral	10.2
0.902	11	37.1	-19.0	56.0	25.0	-21.0	46.0	Neutral	10.2
1.353	12	36.4	-19.6	56.0	27.9	-18.1	46.0	Neutral	10.2
1.407	12	38.4	-17.6	56.0	27.8	-18.3	46.0	Neutral	10.2
1.866	12	37.2	-18.8	56.0	29.0	-17.0	46.0	Neutral	10.3
2.091	12	33.6	-22.4	56.0	26.1	-19.9	46.0	Neutral	10.3
2.513	13	32.0	-24.0	56.0	24.7	-21.3	46.0	Neutral	10.3
3.264	13	32.1	-23.9	56.0	26.5	-19.5	46.0	Neutral	10.4
3.462	13	32.6	-23.4	56.0	25.6	-20.5	46.0	Neutral	10.4
4.191	13	31.9	-24.1	56.0	26.8	-19.2	46.0	Neutral	10.4
6.024	14	32.2	-27.8	60.0	26.5	-23.5	50.0	Neutral	10.5
6.578	14	30.8	-29.2	60.0	27.3	-22.7	50.0	Neutral	10.6
7.262	14	32.5	-27.5	60.0	25.8	-24.3	50.0	Neutral	10.6
7.374	14	32.1	-27.9	60.0	26.4	-23.6	50.0	Neutral	10.6
13.245	15	26.6	-33.4	60.0	20.3	-29.7	50.0	Neutral	10.9
13.502	15	27.8	-32.2	60.0	19.6	-30.4	50.0	Neutral	10.9
16.827	15	40.7	-19.3	60.0	33.9	-16.1	50.0	Neutral	11.1
16.832	15	40.0	-20.0	60.0	33.4	-16.6	50.0	Neutral	11.1
19.358	16	22.4	-37.6	60.0	16.3	-33.7	50.0	Neutral	11.2
19.709	16	23.6	-36.4	60.0	18.8	-31.2	50.0	Neutral	11.2
24.105	16	12.5	-47.5	60.0	7.3	-42.7	50.0	Neutral	11.3
24.866	16	11.7	-48.3	60.0	5.9	-44.1	50.0	Neutral	11.3

FCC ID: 2AHES-SMB **IC: 21152-SMB**

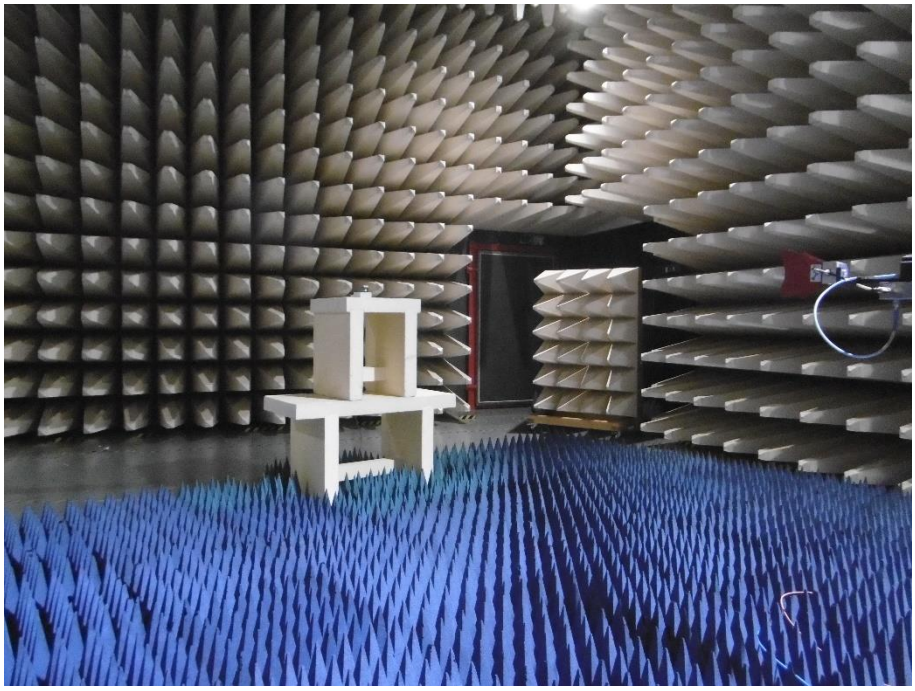
5.2 Maximum conducted output power

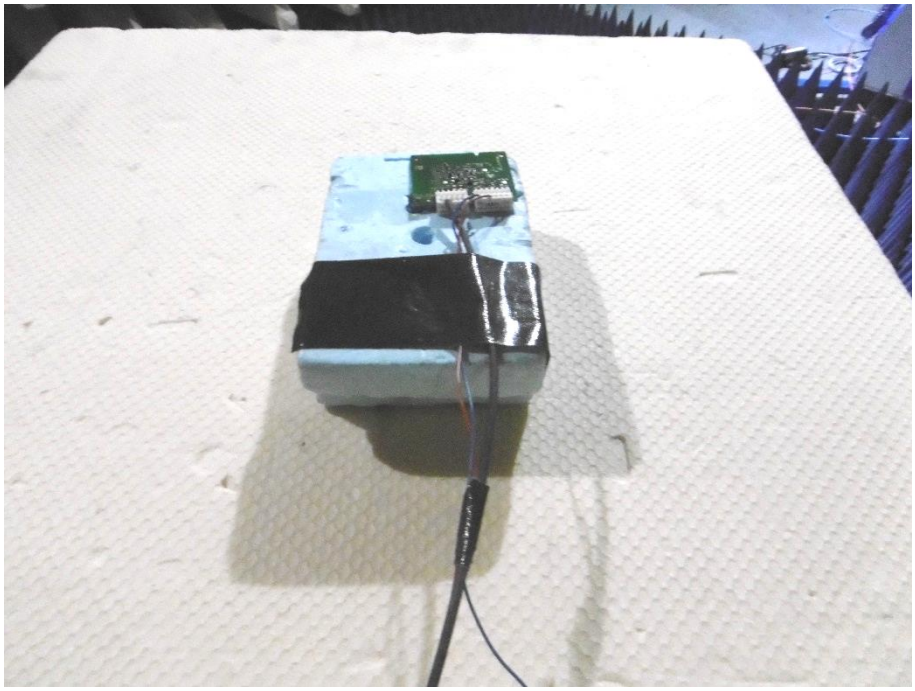
For test instruments and accessories used see section 6 Part **CPR 3**.

5.2.1 Description of the test location

Test location: Anechoic chamber 1
Test distance: 3 m

5.2.2 Photo documentation of the test set-up





5.2.3 Applicable standard

According to FCC Part 15E, Section 15.407(a):
For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5.2.4 Description of Measurement

The output power is measured conducted using a spectrum analyser. The EUT has no constant duty cycle and may be smaller than 98% therefore the procedure according the KDB 789033; item E 2b) Method SA-1 is followed. The EUT is set while measuring in TX continuous mode with a maximum duty cycle. The insertion loss of the measurement cable is taken into account with amplitude offset while measuring. The output power is integrated across the OBW 99 alternatively.

Spectrum analyser settings:
Channel power measurement function, TX channel bandwidth equal to OBW;
RBW: 1 MHz, VBW: 3 MHz, Sweep time: auto, Detector: rms, Trace: power averaging over 100 sweeps;

5.2.5 Test result

802.11n HT20, MCS0, P17, Ant0 Duty cycle: 99%		**Test results radiated**		Test results conducted calculated		
Channel	Power set	P [EIRP] (dBm)	G (dBi)	A [Pmax] (dBm)	Limit (dBm)	Margin (dB)
CH100	*P15*	15.8	3.99	11.8	22.5	-10.7
CH116	*P15*	16.2	3.99	12.2	22.5	-10.3
CH120	*P15*	16.6	3.99	12.6	22.5	-9.9
CH140	*P15*	15.9	3.99	11.9	22.5	-10.6
CH144	*P15*	15.7	3.99	11.7	22.5	-10.8

802.11ac VT40, MCS0, P13, Ant0 Duty cycle: 99%		**Test results radiated**		Test results conducted calculated		
Channel		P [EIRP] (dBm)	G (dBi)	A [Pmax] (dBm)	Limit (dBm)	Margin (dB)
CH102	*P13*	11.5	3.99	7.5	24.0	-16.5
CH110	*P13*	12.0	3.99	8.0	24.0	-16.0
CH118	*P13*	12.2	3.99	8.2	24.0	-15.8
CH134	*P13*	11.9	3.99	7.9	24.0	-16.1
CH142	*P13*	11.6	3.99	7.6	24.0	-16.4

802.11ac VT80, MCS0, Ant0 Duty cycle: 99%		**Test results radiated**		Test results conducted calculated		
Channel	Power set	P [EIRP] (dBm)	G (dBi)	A [Pmax] (dBm)	Limit (dBm)	Margin (dB)
CH106	*P6*	4.9	3.99	0.9	24.0	-23.1
CH122	*P13*	11.0	3.99	7.0	24.0	-17.0
CH138	*P16*	13.2	3.99	9.2	24.0	-14.8

FCC ID: 2AHES-SMB **IC: 21152-SMB**

802.11n HT20, MCS0, P17, Ant1 Duty cycle: 99%		Test results radiated		Test results conducted calculated		
Channel	Power set	P [EIRP] (dBm)	G (dBi)	A [Pmax] (dBm)	Limit (dBm)	Margin (dB)
CH100	*P13*	14.9	3.14	11.8	22.5	-10.7
CH116	*P13*	15.0	3.14	11.9	22.5	-10.6
CH120	*P13*	14.8	3.14	11.7	22.5	-10.8
CH140	*P13*	14.7	3.14	11.6	22.5	-10.9
CH144	*P13*	13.9	3.14	10.8	22.5	-11.7

802.11ac VT40, MCS0, P13, Ant1 Duty cycle: 99%		Test results radiated		Test results conducted calculated		
Channel		P [EIRP] (dBm)	G (dBi)	A [Pmax] (dBm)	Limit (dBm)	Margin (dB)
CH102	*P11*	10.7	3.14	7.6	24.0	-16.4
CH110	*P11*	10.8	3.14	7.7	24.0	-16.3
CH118	*P11*	10.5	3.14	7.4	24.0	-16.6
CH134	*P11*	10.4	3.14	7.3	24.0	-16.7
CH142	*P11*	10.2	3.14	7.1	24.0	-16.9

802.11ac VT80, MCS0, Ant1 Duty cycle: 99%		Test results radiated		Test results conducted calculated		
Channel	Power set	P [EIRP] (dBm)	G (dBi)	A [Pmax] (dBm)	Limit (dBm)	Margin (dB)
CH106	*P5*	4.6	3.14	1.5	24.0	-22.5
CH122	*P12*	10.2	3.14	7.1	24.0	-16.9
CH138	*P15*	12.9	3.14	9.8	24.0	-14.2

Peak power limit according to FCC Part 15E, Section 15.407(a)(1)(ii):

(2) For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Determination of the limit:
20 MHz bandwidth:
OBW99 = 17.920 MHz
Limit = 11 dBm + 10logB = 11 + 10log17.9 = 10 + 12.5 = 22.5 dBm; Applicable limit 22.5 dBm
40 MHz bandwidth:
OBW99 = 36.243 MHz
Limit = 11 dBm + 10logB = 11 + 10log36.2 = 10 + 15.6 = 25.6 dBm; Applicable limit 24 dBm
80 MHz bandwidth:
OBW99 = 75.697 MHz
Limit = 11 dBm + 10logB = 11 + 10log75.7 = 10 + 18.8 = 25.6 dBm; Applicable limit 24 dBm

The requirements are **FULFILLED.**

Remarks:

FCC ID: 2AHES-SMB **IC: 21152-SMB**

5.4 Undesirable emissions

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

5.4.1 Description of the test location

Test location: OATS 1
Test location: Anechoic chamber 1

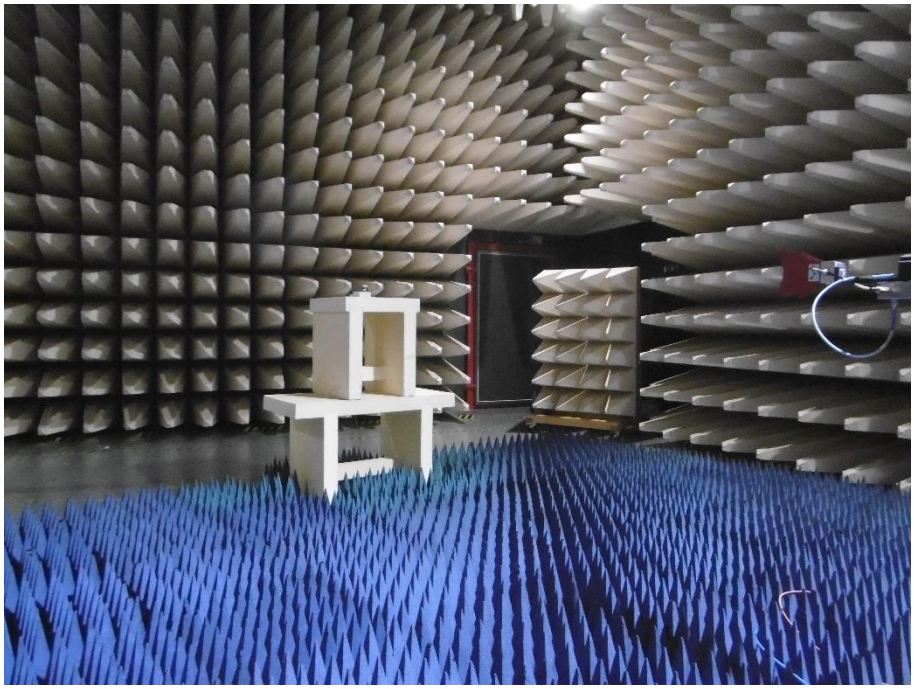
Test distance: 3 m

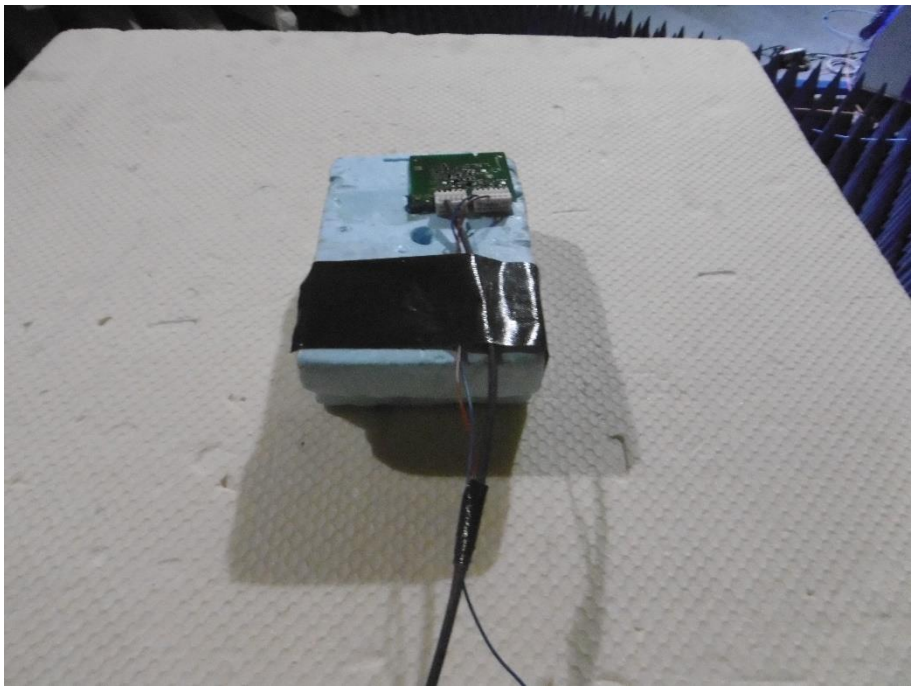
5.4.2 Photo documentation of the test set-up

Open area test site

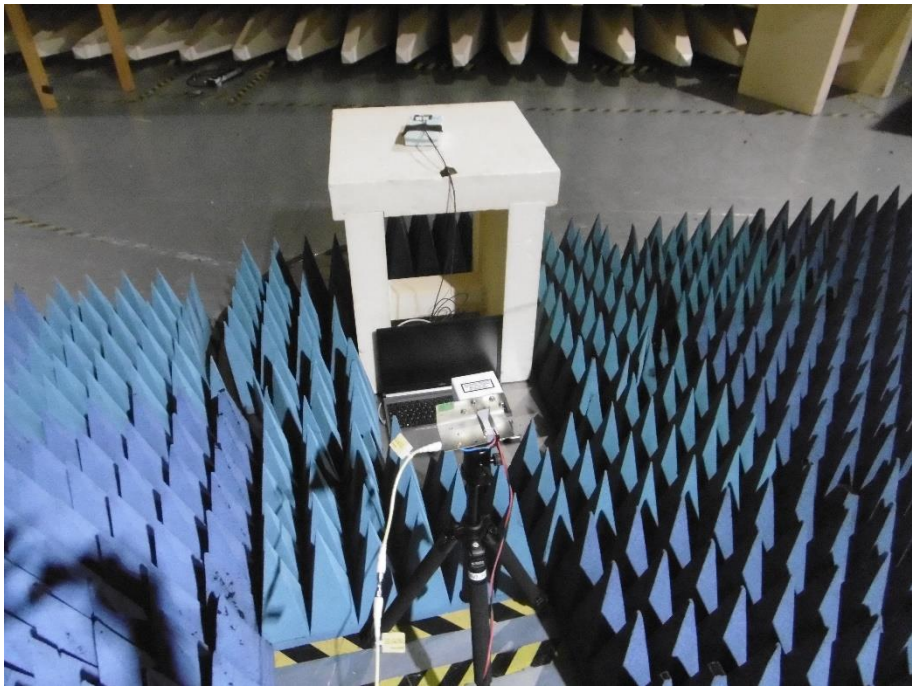
FCC ID: 2AHES-SMB **IC: 21152-SMB**

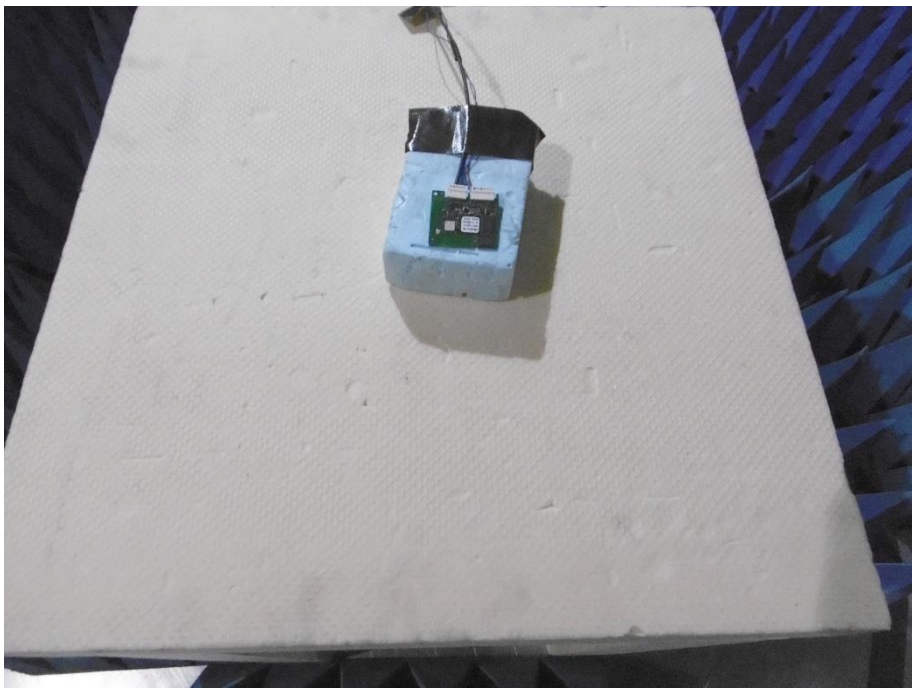
Anechoic chamber





FCC ID: 2AHES-SMB **IC: 21152-SMB**





5.4.3 Applicable standard

According to FCC Part 15E, Section 15.407(b)(3):
For transmitters operating in the 5.47-5.725 GHz band: All emissions outside of the 5.47-5.725 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.
In addition, radiated emissions which fall in the restricted bands, as defined in Section15.205(a), must also comply with the radiated emission limit specified in Section15.209(a) (see Section15.205(c)).

5.4.4 Description of Measurement

Undesirable emissions are measured using a spectrum analyser and following the procedures according the KDB 789033, item H. If the emission level of the EUT in peak mode complies with the average limit 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. Up from 8 GHz a HP filter is used.

Spectrum analyser settings for peak values:
RBW: 1 MHz, VBW: 3 MHz, Sweep: Auto, Trace mode: max hold;
Spectrum analyser settings for average values:
RBW: 1 MHz VBW: 10 Hz Sweep: Auto, Trace mode: max hold;

5.4.5 Test result

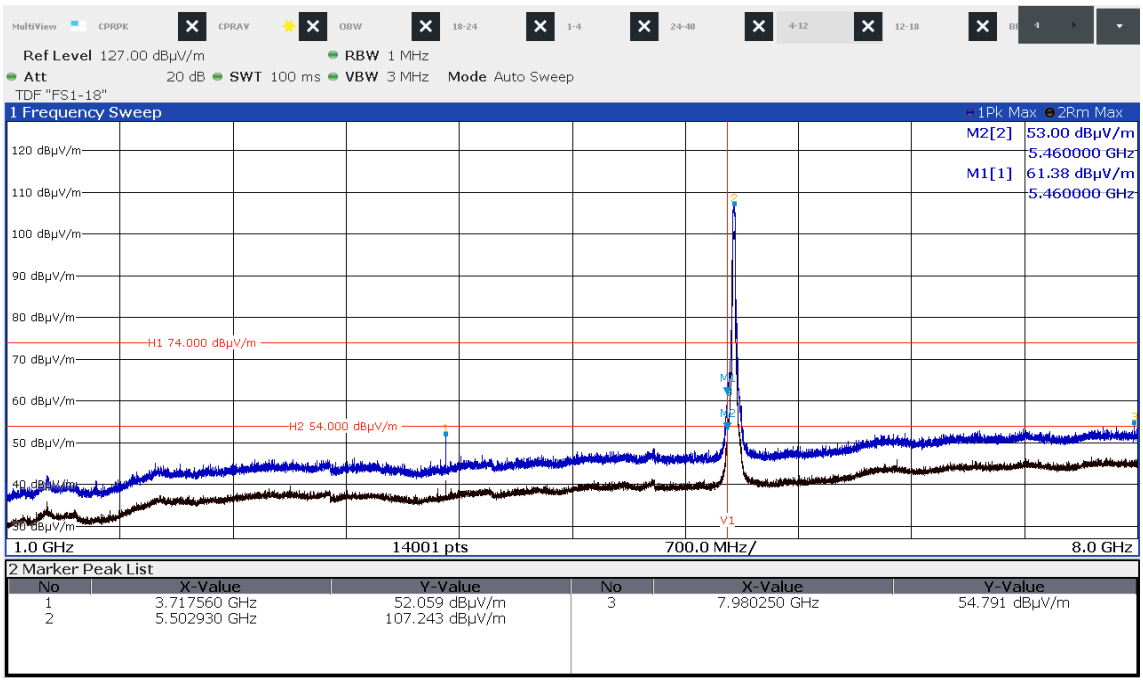
f < 1000 MHz

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)
54.00	9.2	3.3	14.1	13.1	23.3	16.4	40.0	-16.7
125.00	20.7	27.0	12.0	12.5	32.7	39.5	43.5	-4.0
250.00	11.6	20.0	12.9	13.1	24.5	33.1	46.0	-12.9
500.00	10.6	20.7	21.4	21.1	32.0	41.8	46.0	-4.2
875.00	1.4	8.8	28.7	28.2	30.1	37.0	46.0	-9.0

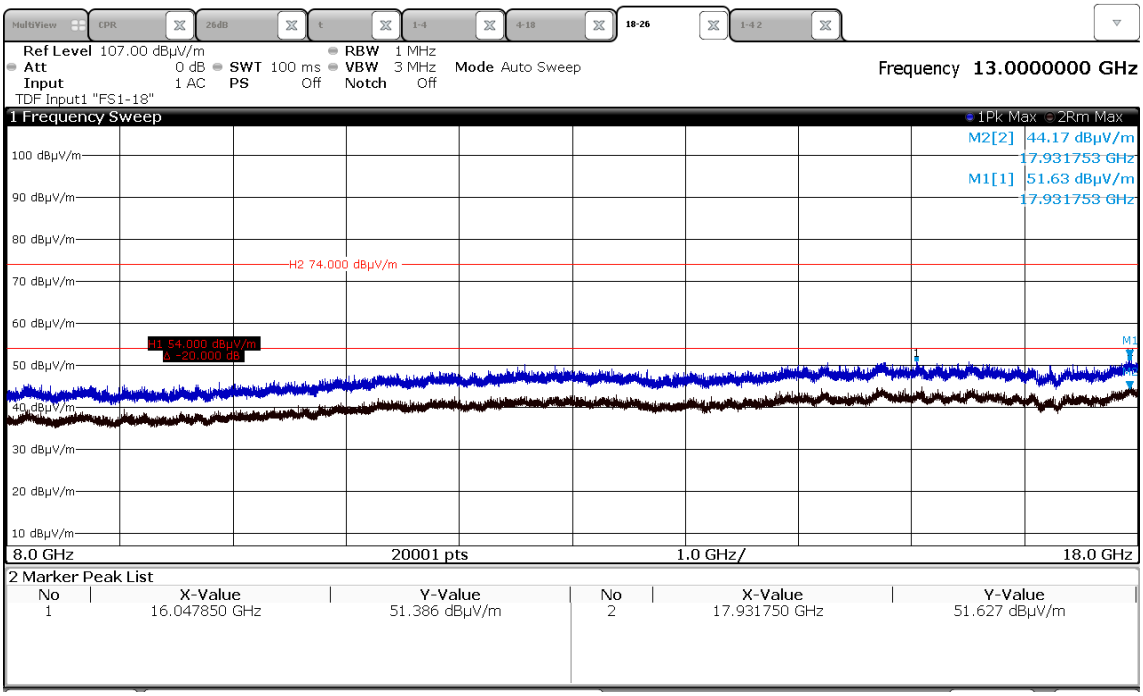
f > 1000 MHz

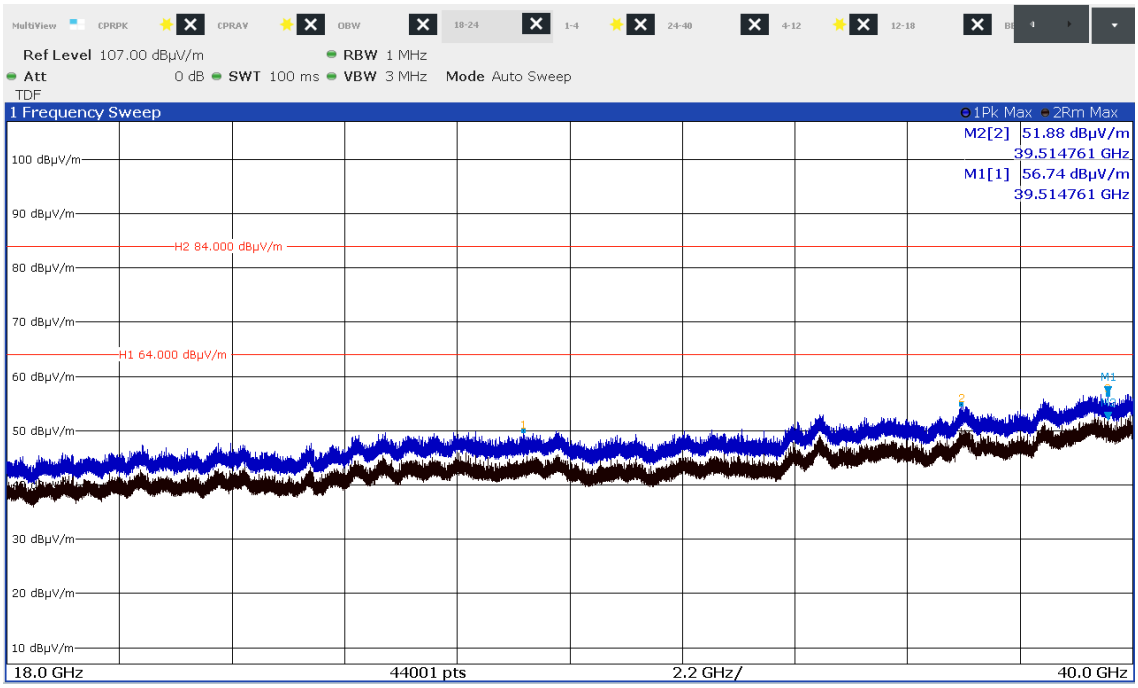
The spurious emission at Ant0 is measured only because of the highest gain.

5.4.5.1 CHn100 HT20, Ant0, P15



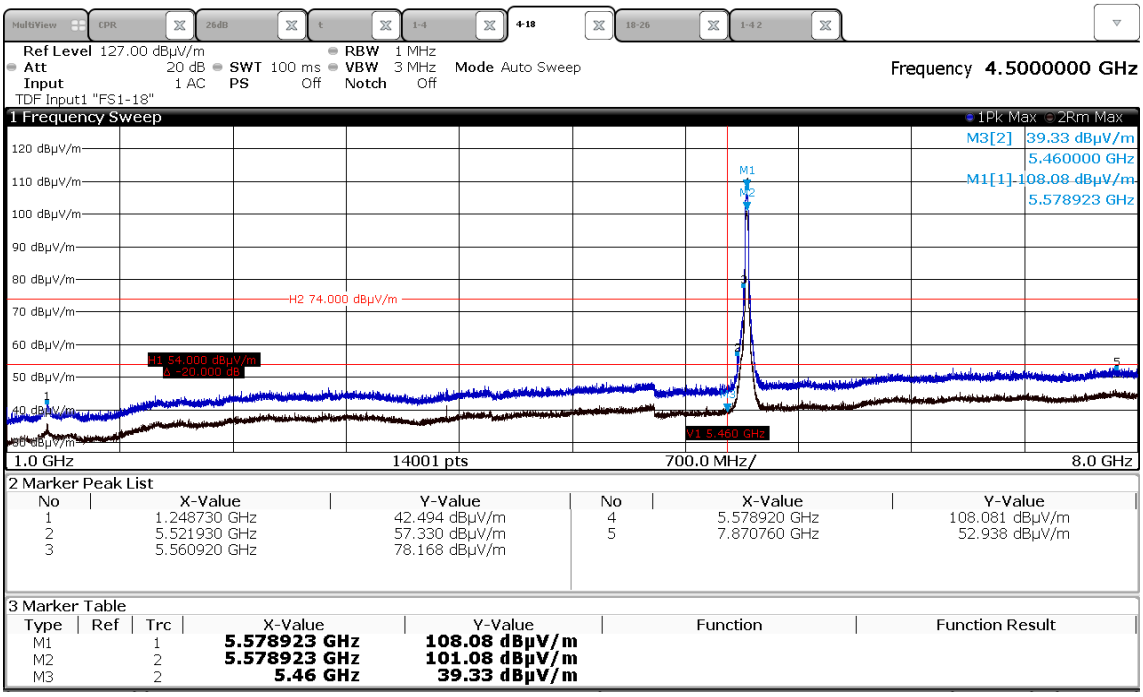
FCC ID: 2AHES-SMB **IC: 21152-SMB**

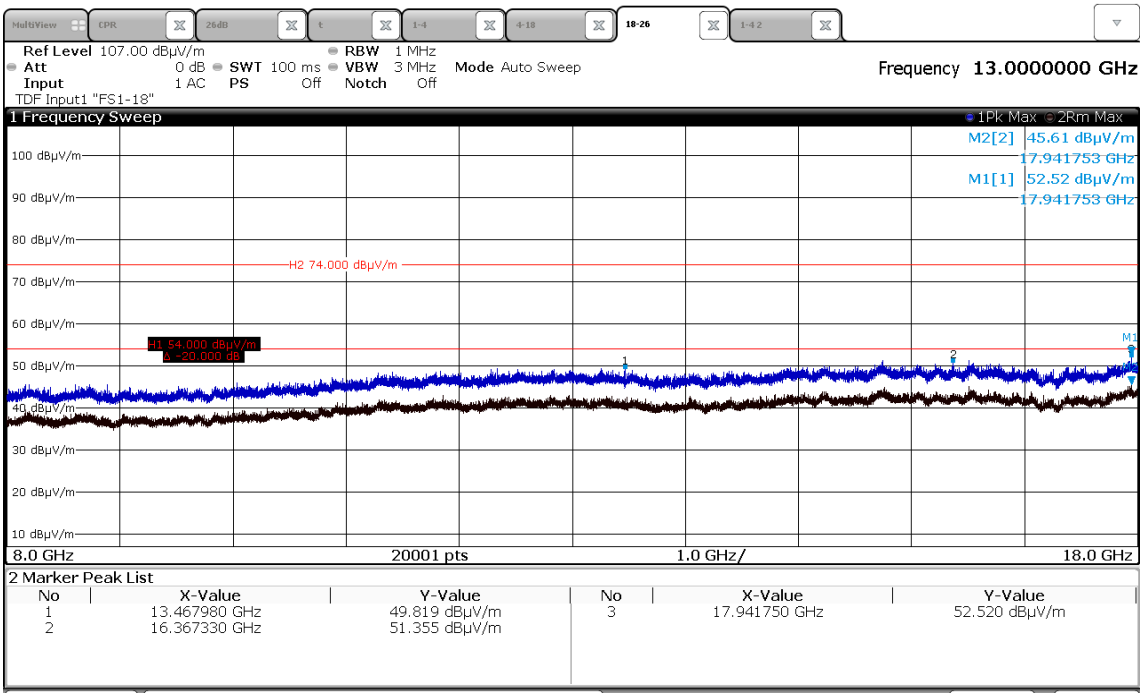




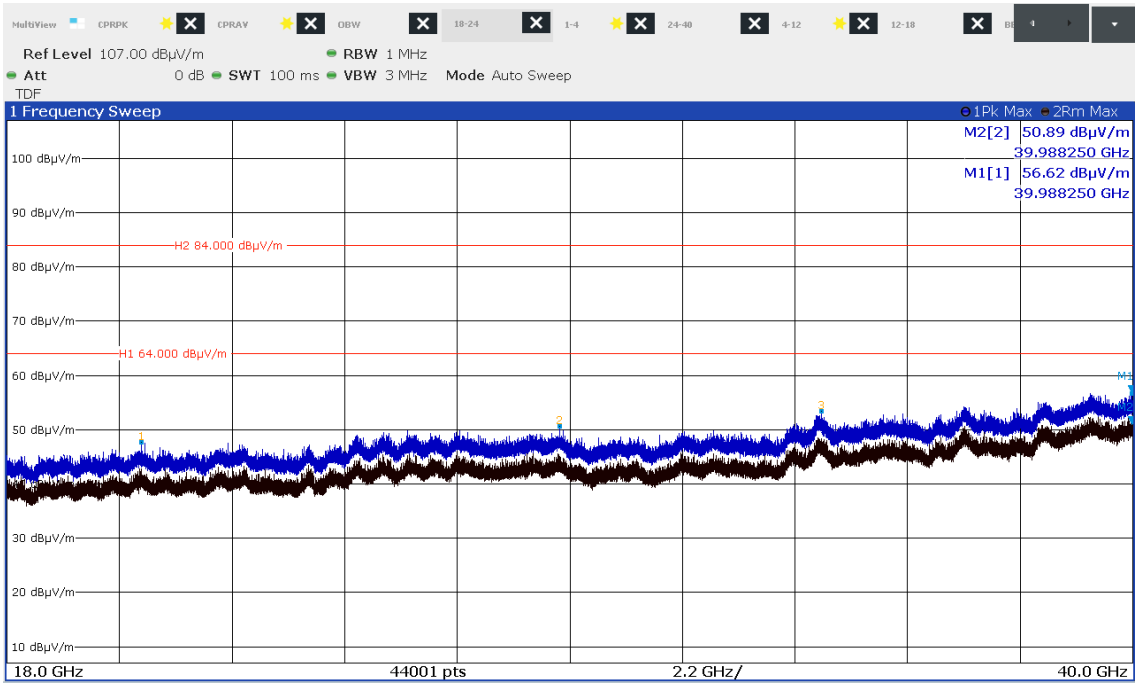
FCC ID: 2AHES-SMB **IC: 21152-SMB**

5.4.5.2 CH116n HT20, Ant0

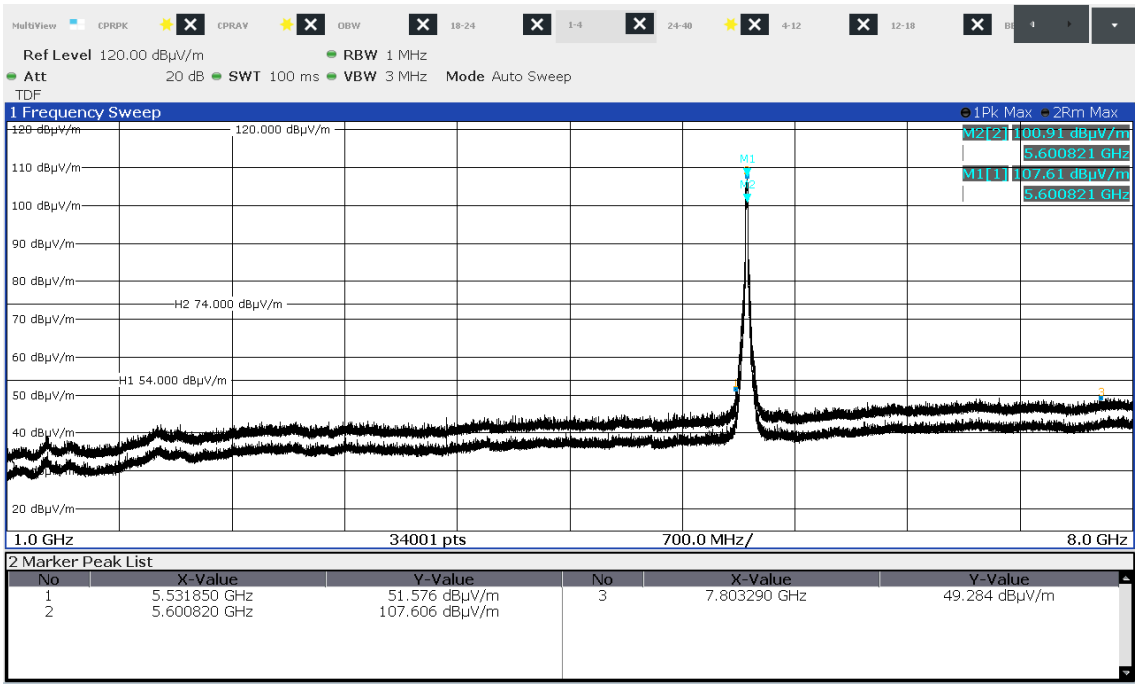




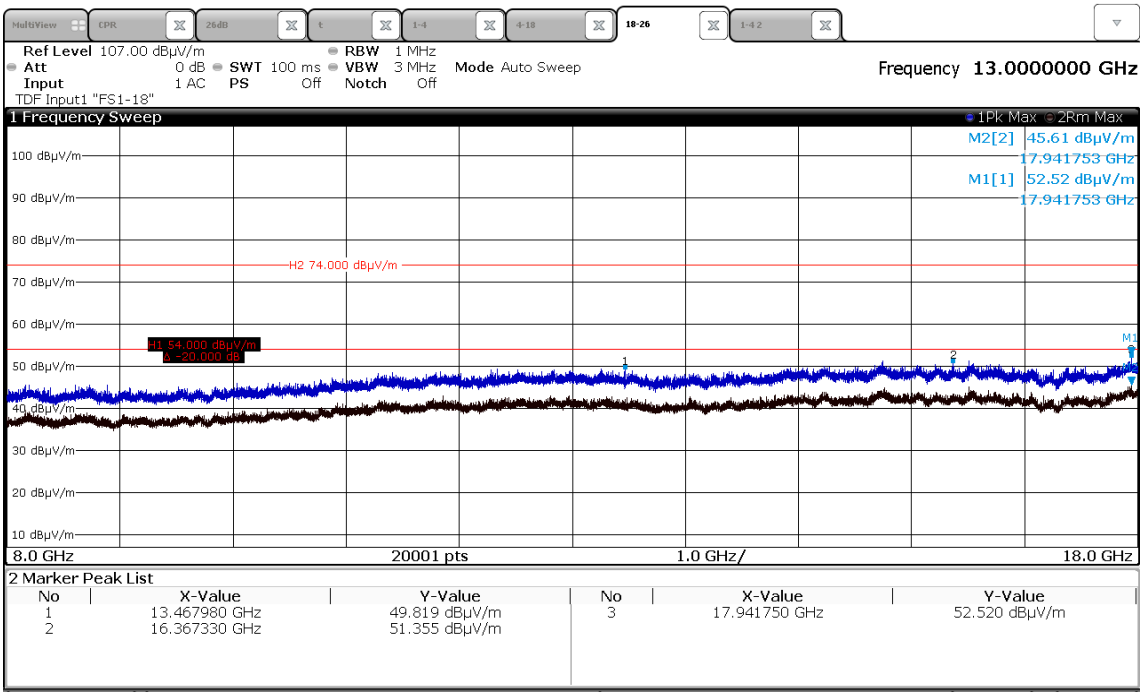
FCC ID: 2AHES-SMB **IC: 21152-SMB**

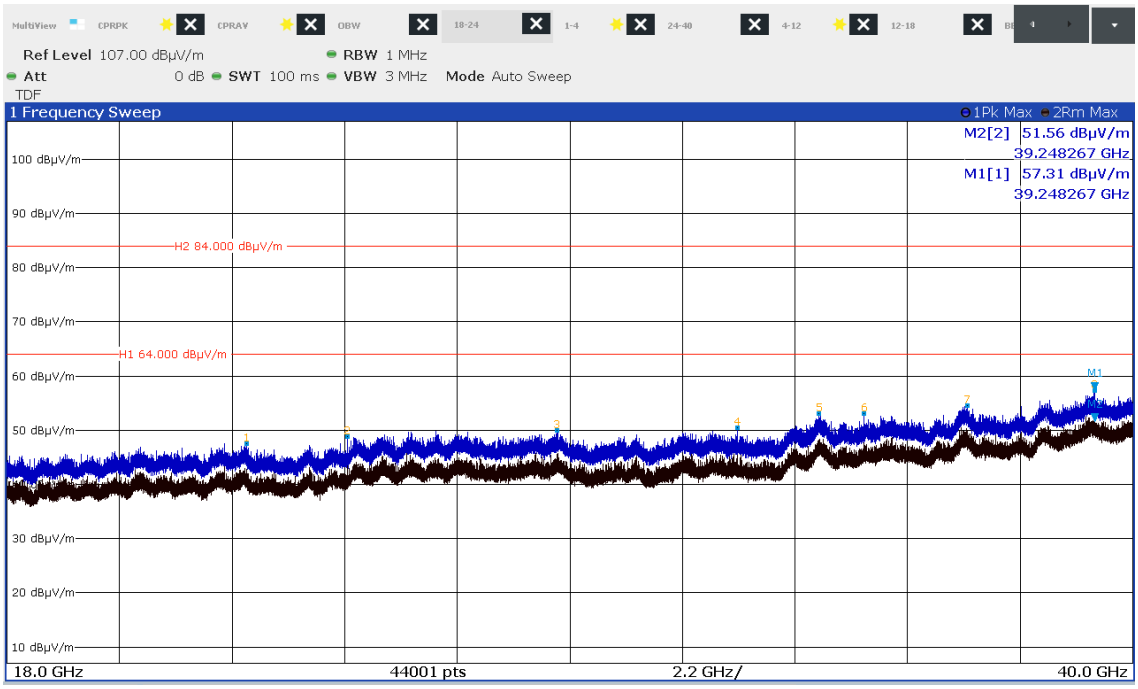


5.4.5.3 CH120n HT20, Ant0



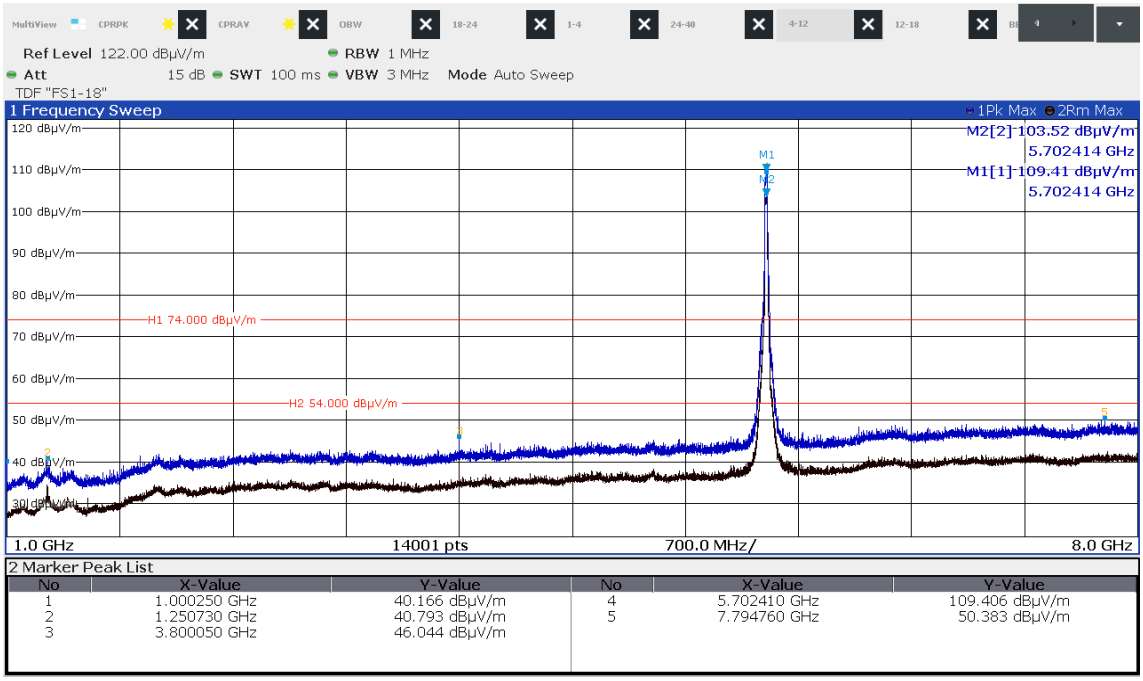
FCC ID: 2AHES-SMB **IC: 21152-SMB**

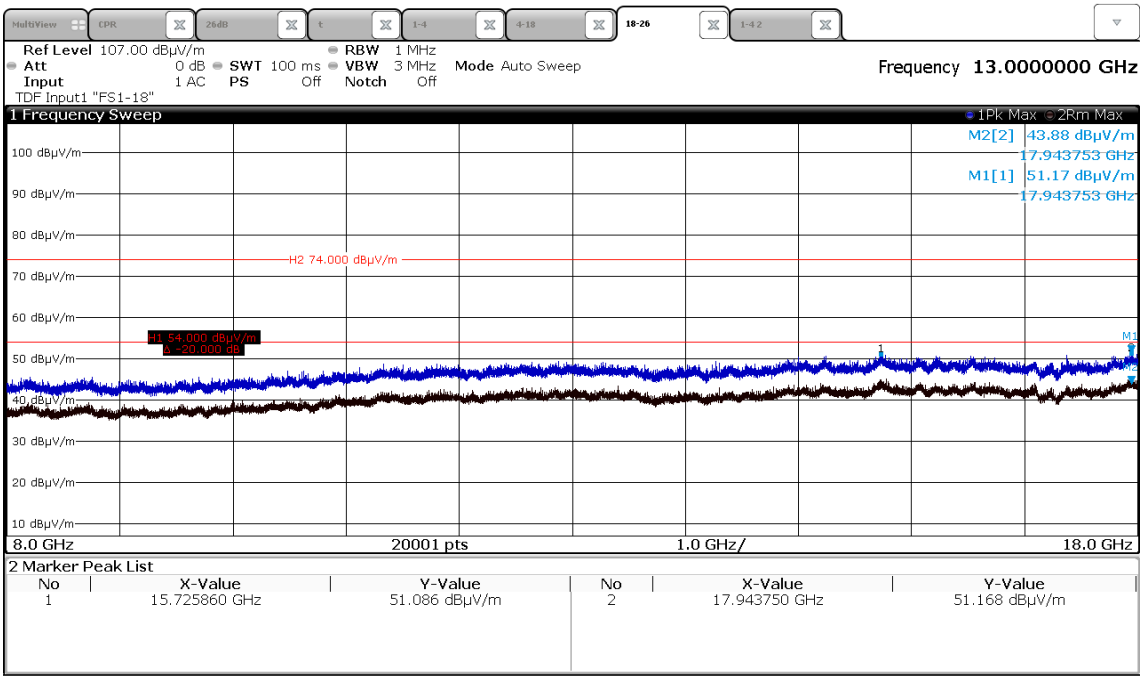




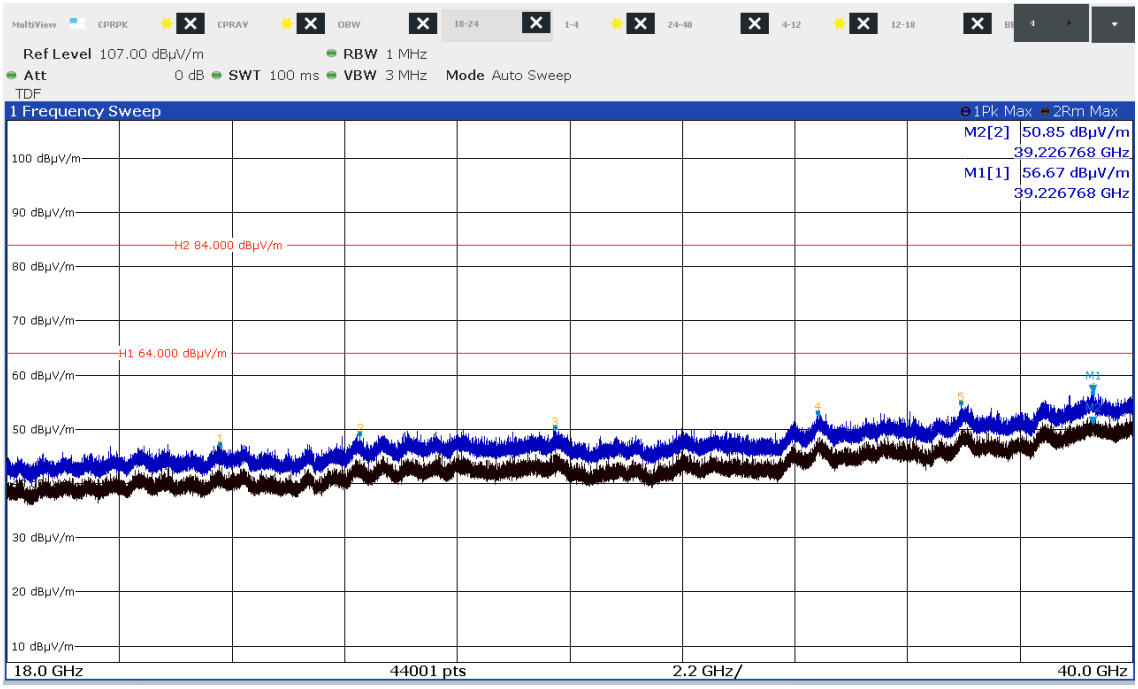
FCC ID: 2AHES-SMB **IC: 21152-SMB**

5.4.5.4 CH140n HT20, Ant0

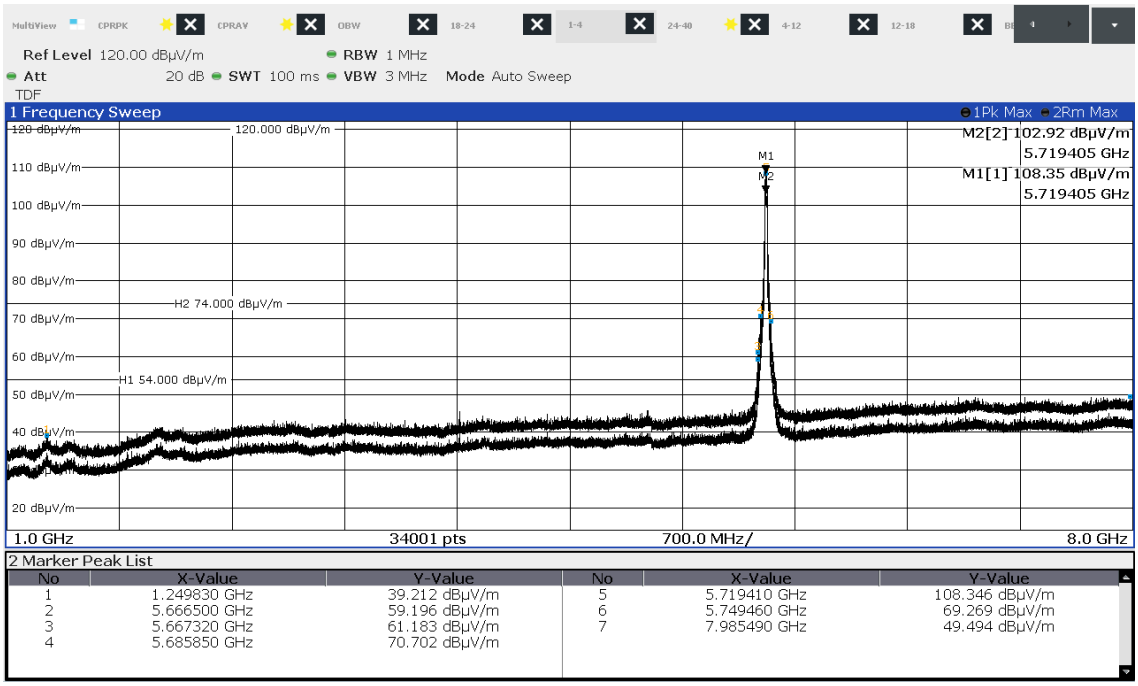




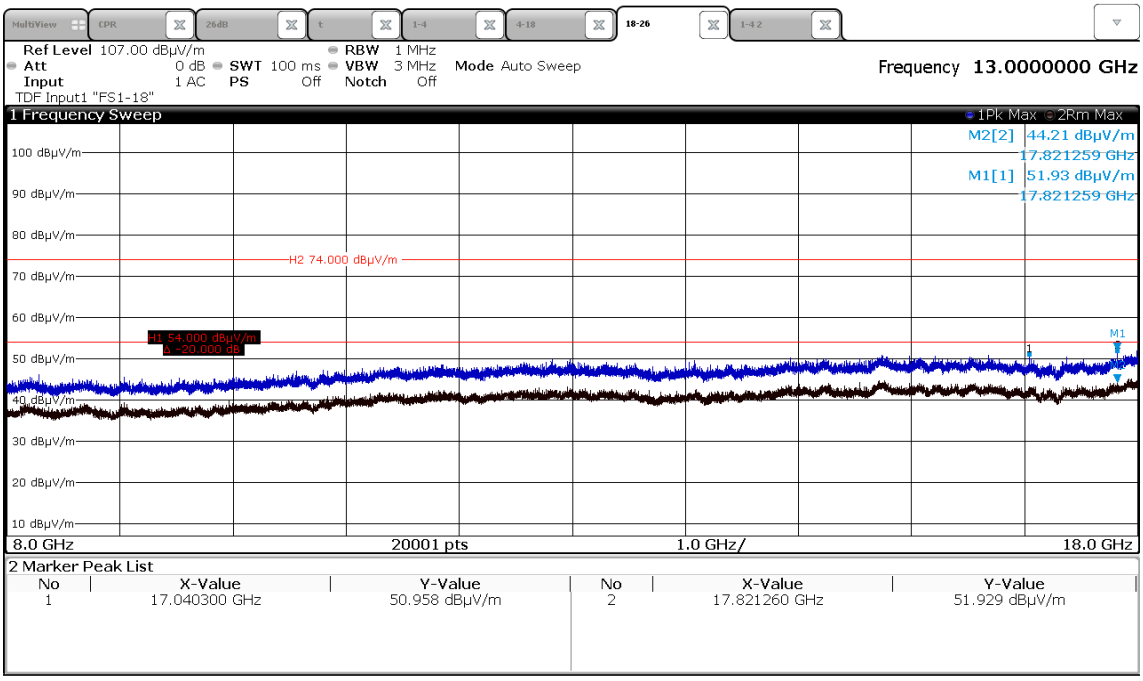
FCC ID: 2AHES-SMB **IC: 21152-SMB**

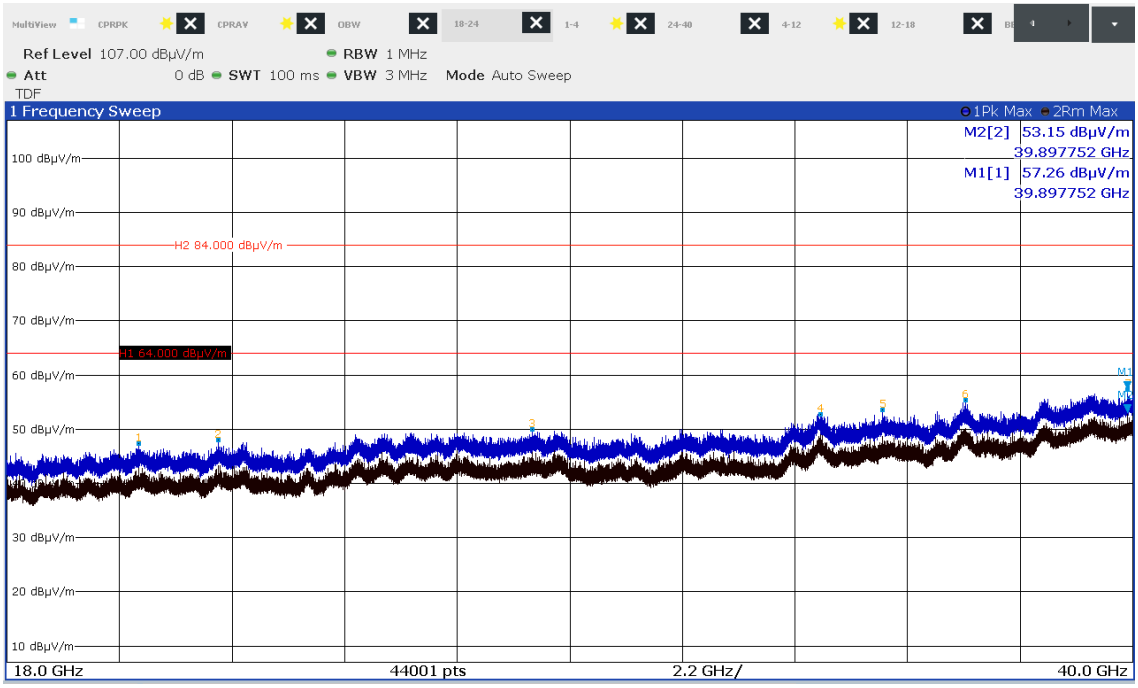


5.4.5.5 CH144n HT20, Ant0



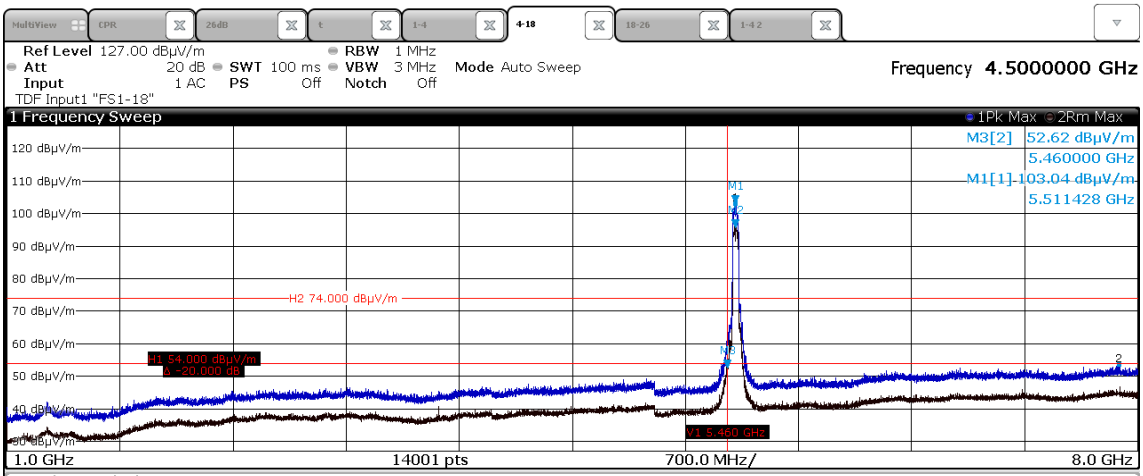
FCC ID: 2AHES-SMB **IC: 21152-SMB**

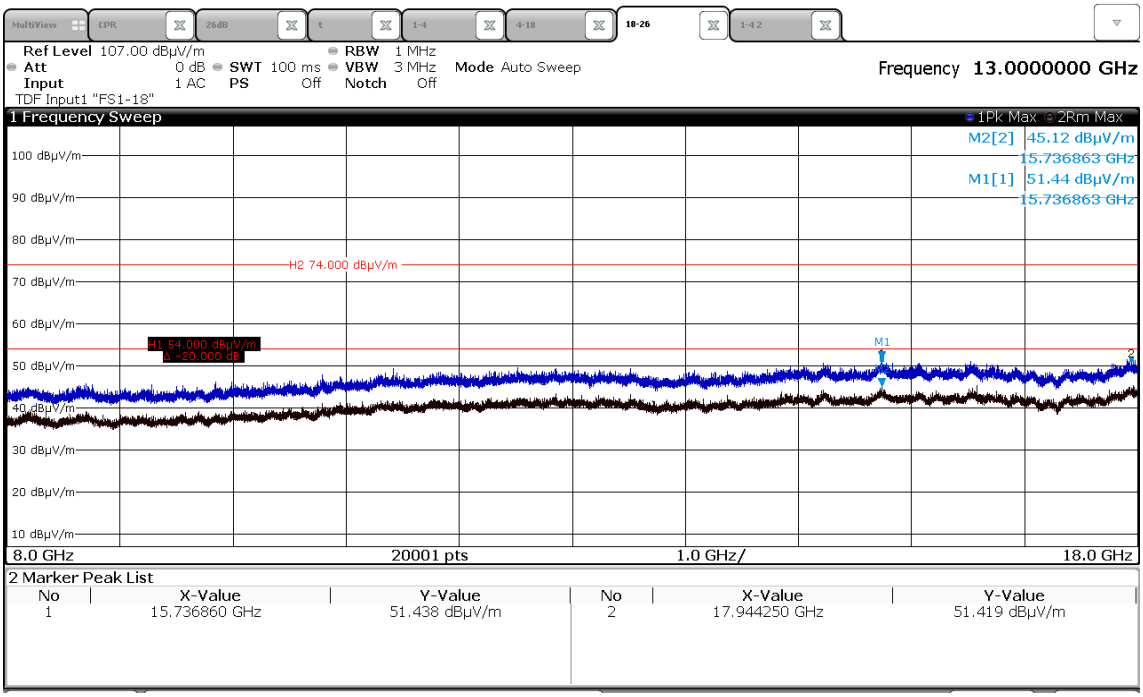




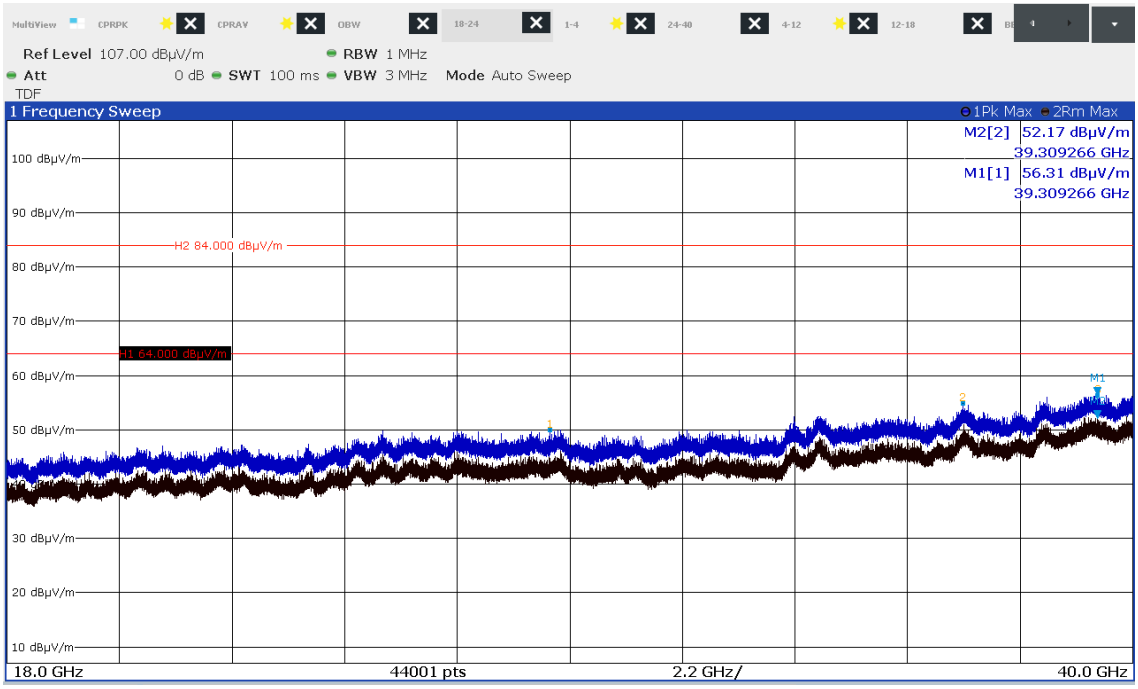
FCC ID: 2AHES-SMB **IC: 21152-SMB**

5.4.5.6 CH102ac VT40, Ant0, P13

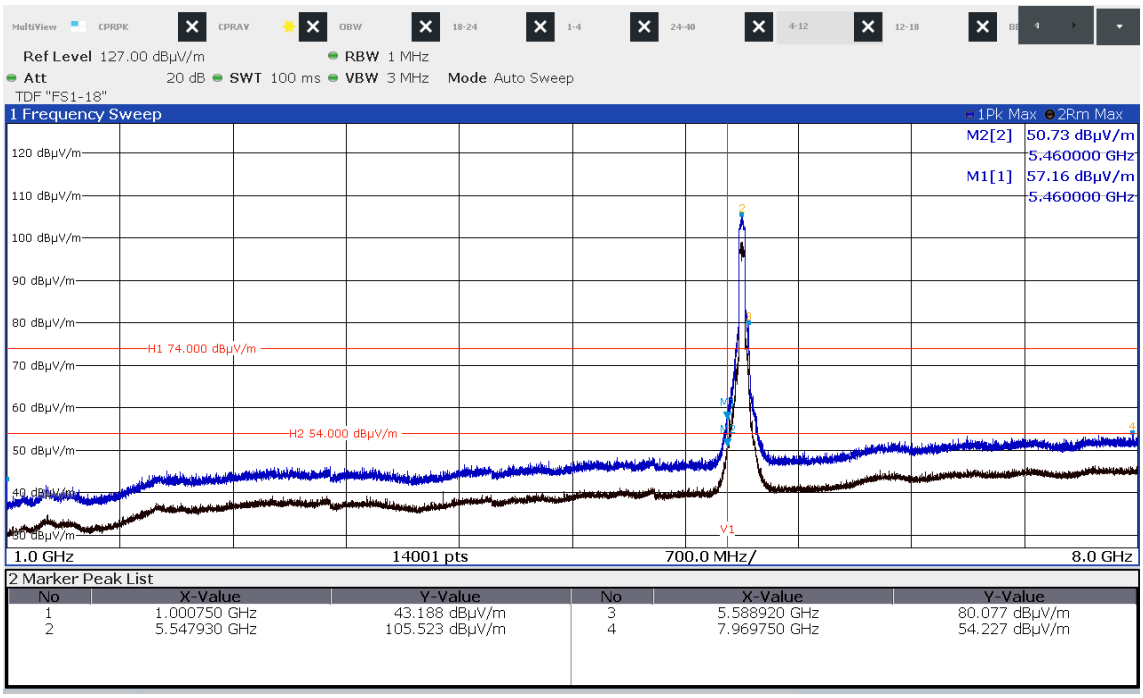




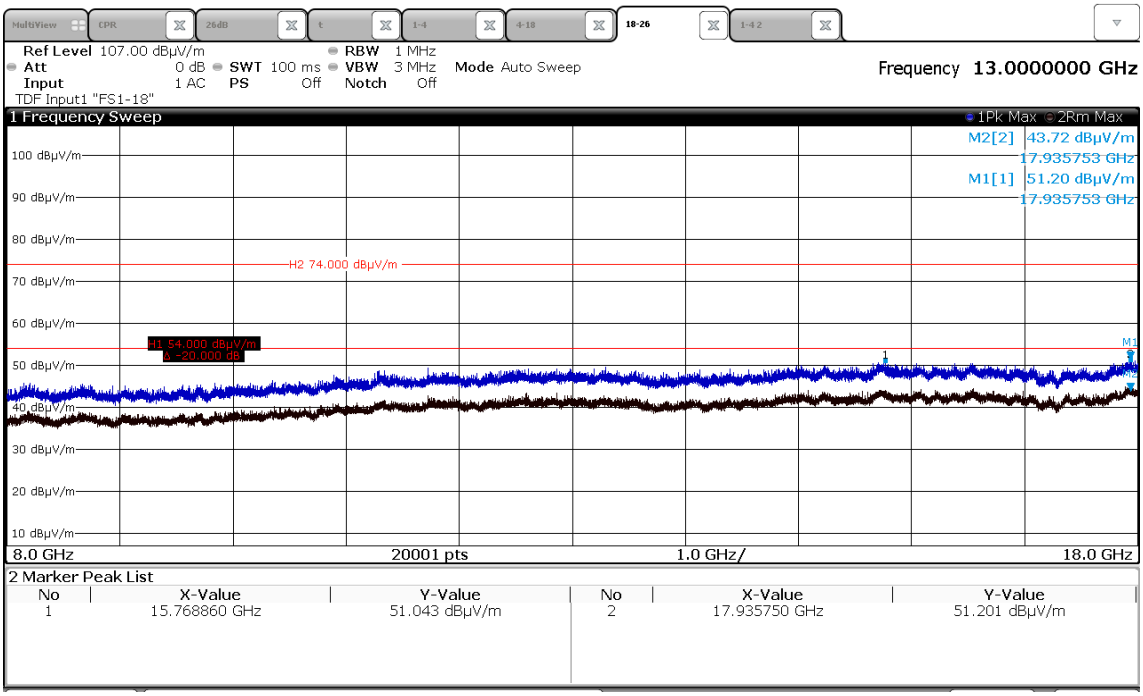
FCC ID: 2AHES-SMB **IC: 21152-SMB**

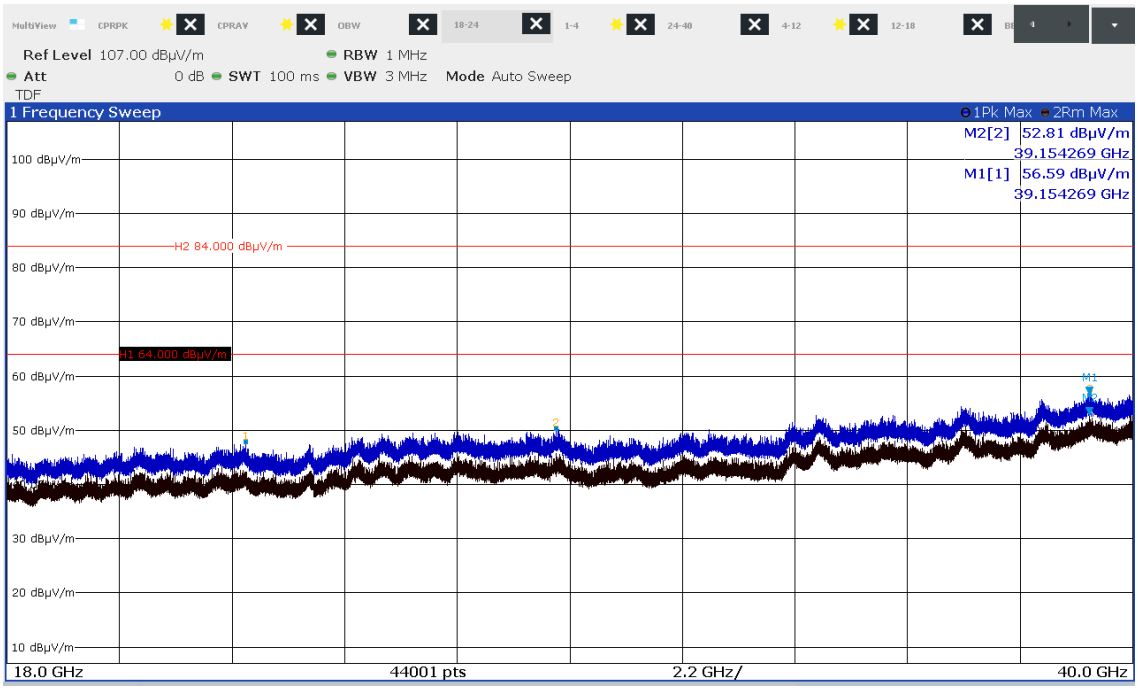


5.4.5.7 CH110ac VT40, Ant0



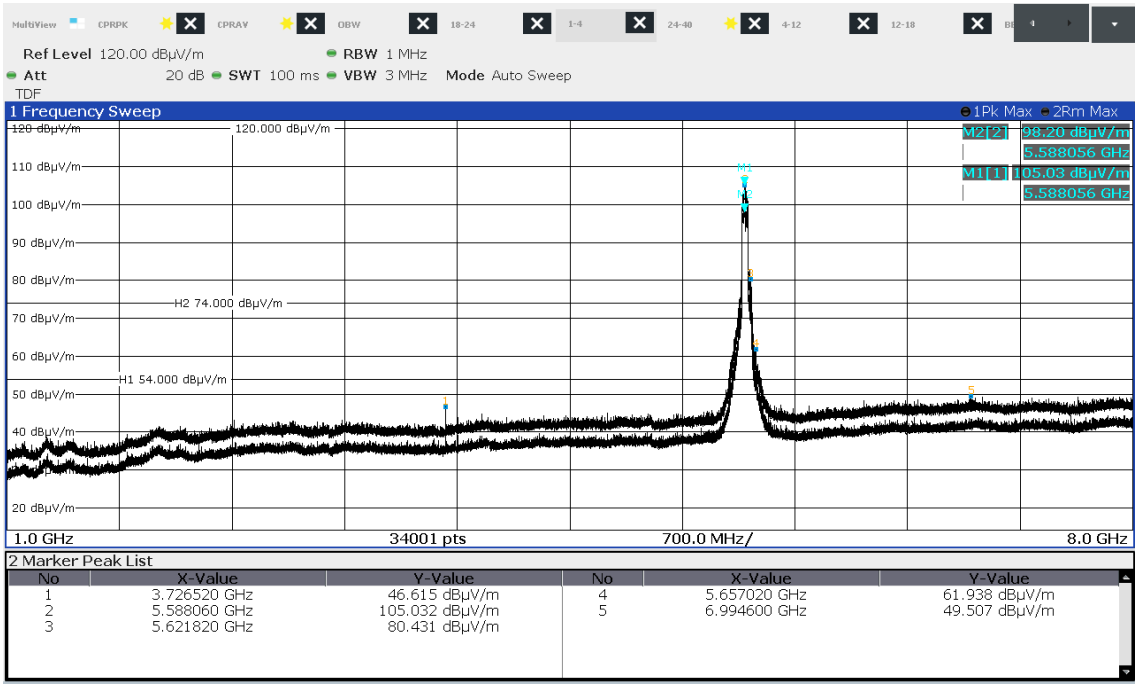
FCC ID: 2AHES-SMB **IC: 21152-SMB**

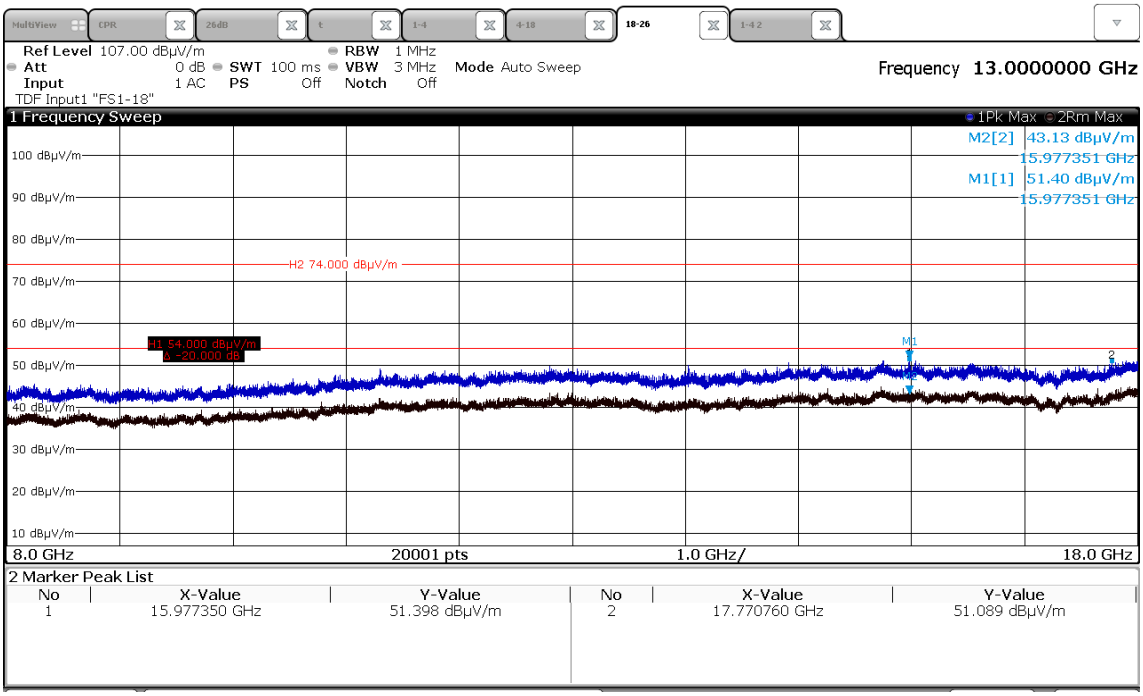




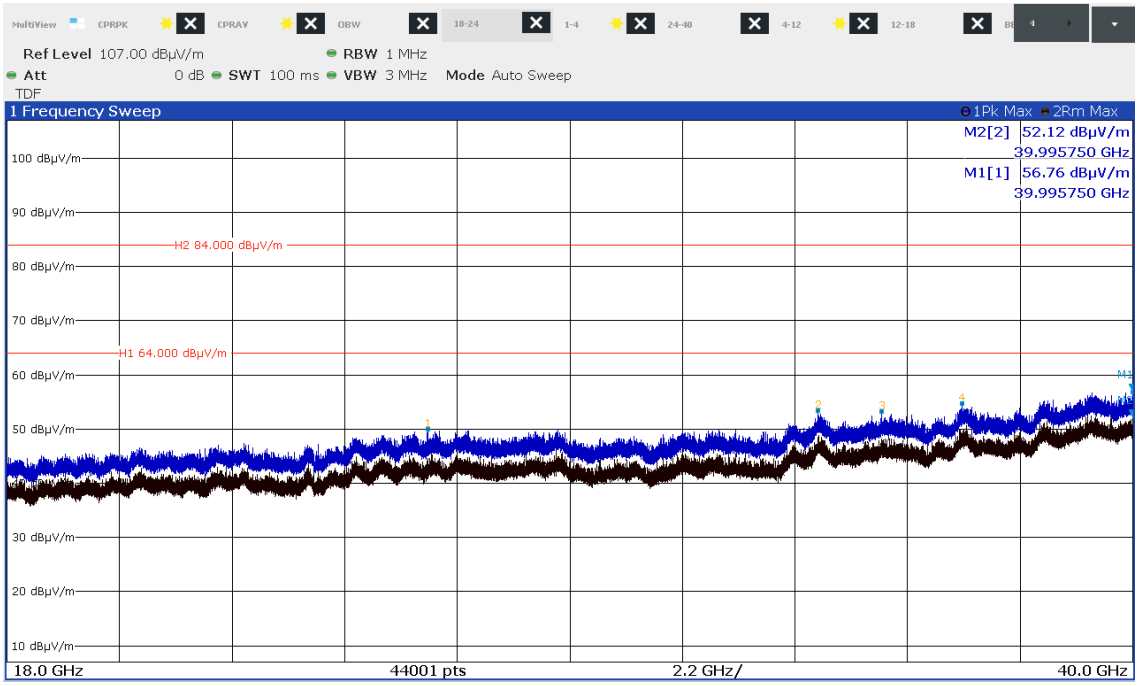
FCC ID: 2AHES-SMB **IC: 21152-SMB**

5.4.5.8 CH118ac VT40, Ant0

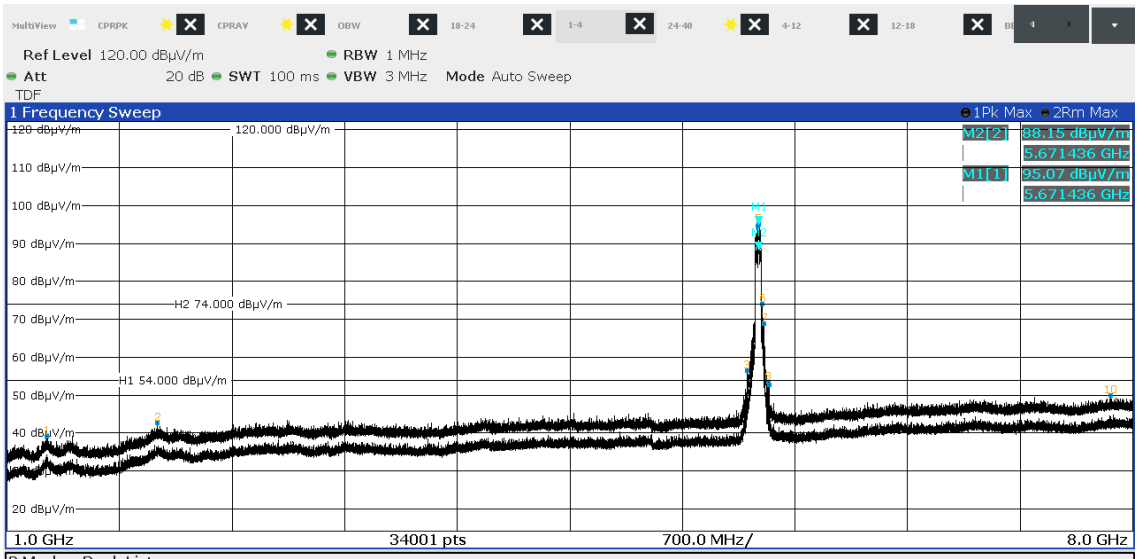




FCC ID: 2AHES-SMB **IC: 21152-SMB**



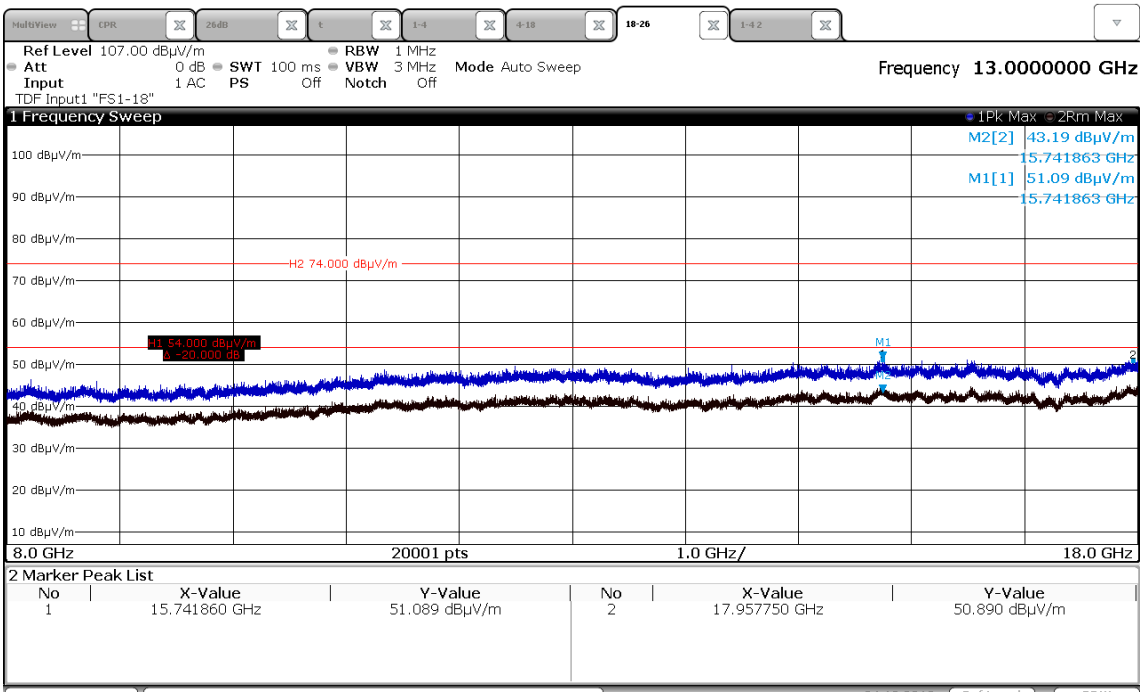
5.4.5.9 CH134ac VT40, Ant0

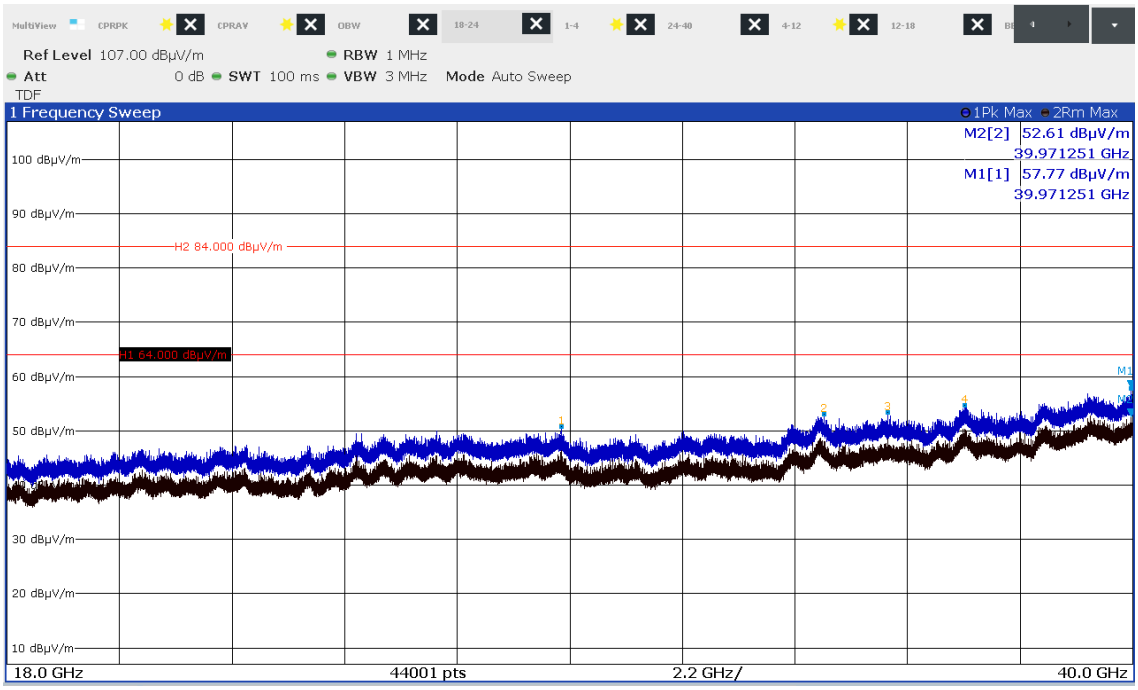


2 Marker Peak List

No	X-Value	Y-Value	No	X-Value	Y-Value
1	1.250040 GHz	39.266 dBµV/m	6	5.696140 GHz	73.947 dBµV/m
2	1.936430 GHz	42.658 dBµV/m	7	5.707460 GHz	68.956 dBµV/m
3	5.601850 GHz	56.402 dBµV/m	8	5.732580 GHz	53.486 dBµV/m
4	5.666290 GHz	94.674 dBµV/m	9	5.737320 GHz	52.728 dBµV/m
5	5.671440 GHz	95.067 dBµV/m	10	7.861750 GHz	49.955 dBµV/m

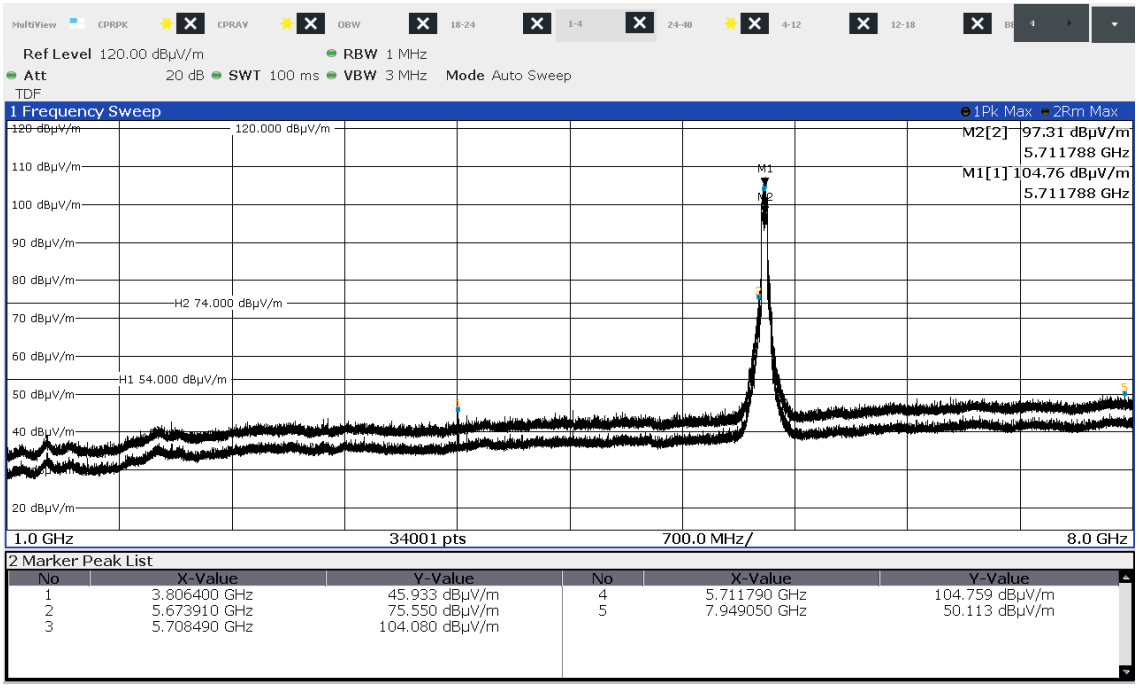
FCC ID: 2AHES-SMB **IC: 21152-SMB**

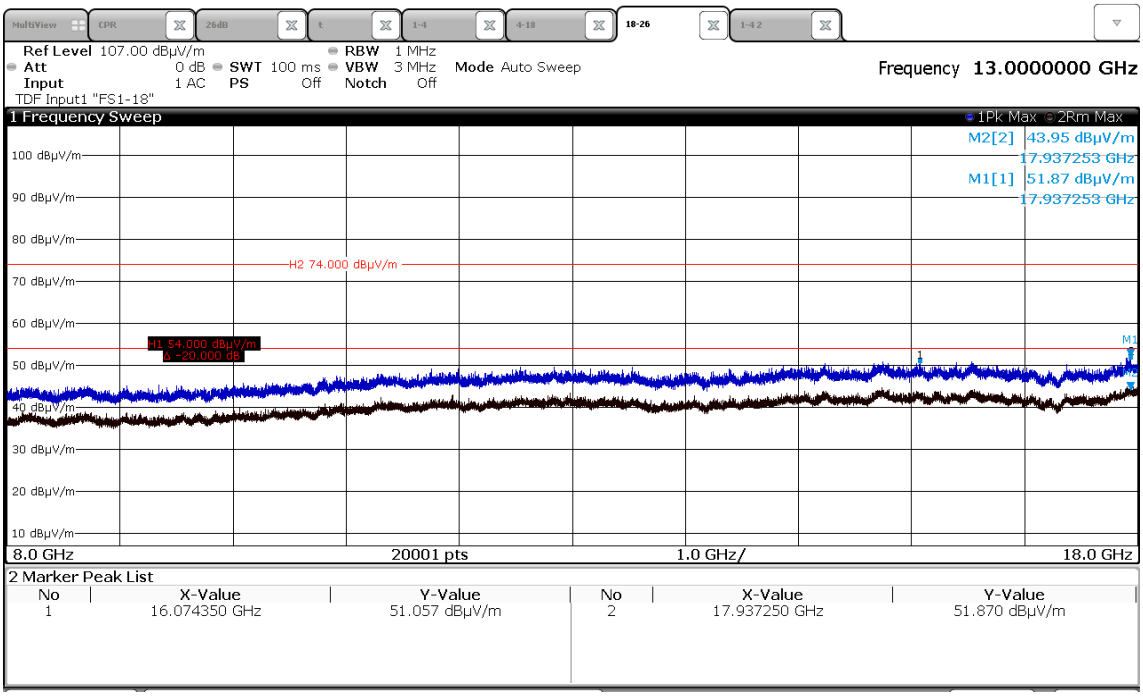




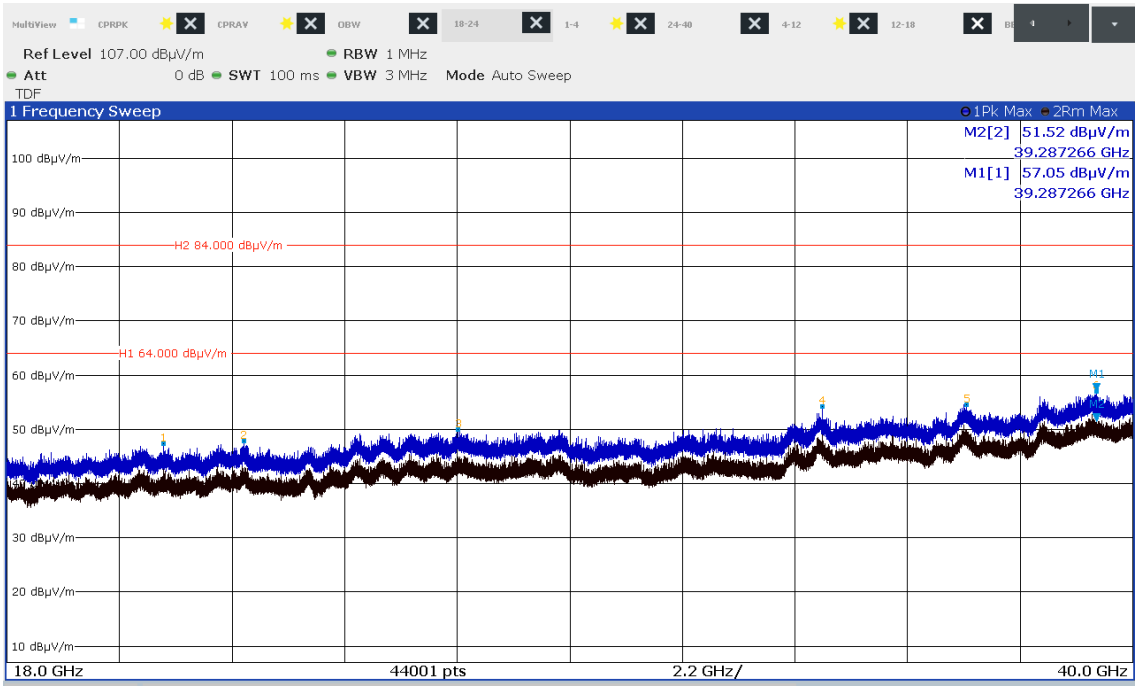
FCC ID: 2AHES-SMB **IC: 21152-SMB**

5.4.5.10 CH142ac VT40, Ant0



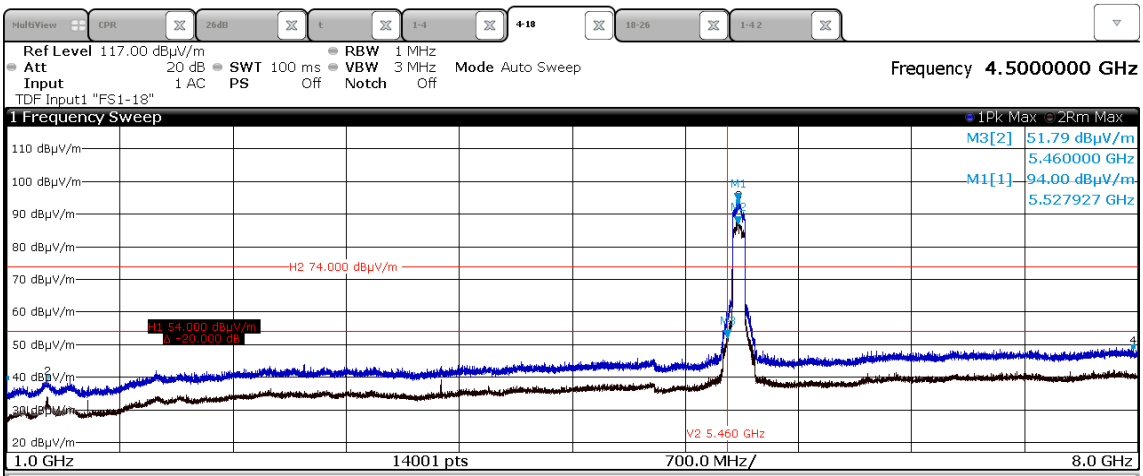


FCC ID: 2AHES-SMB **IC: 21152-SMB**



FCC ID: 2AHES-SMB **IC: 21152-SMB**

5.4.5.11 CH108ac VT80, Ant0, P6

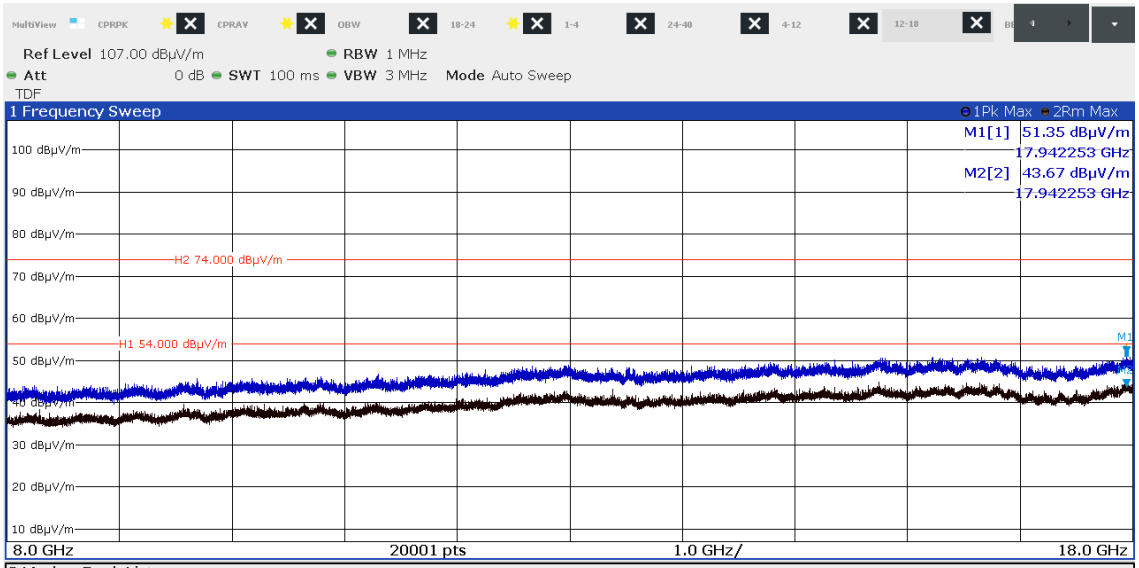


2 Marker Peak List

No	X-Value	Y-Value	No	X-Value	Y-Value
1	1.000250 GHz	39.797 dBµV/m	3	5.527930 GHz	94.000 dBµV/m
2	1.250230 GHz	40.148 dBµV/m	4	7.973750 GHz	49.339 dBµV/m

3 Marker Table

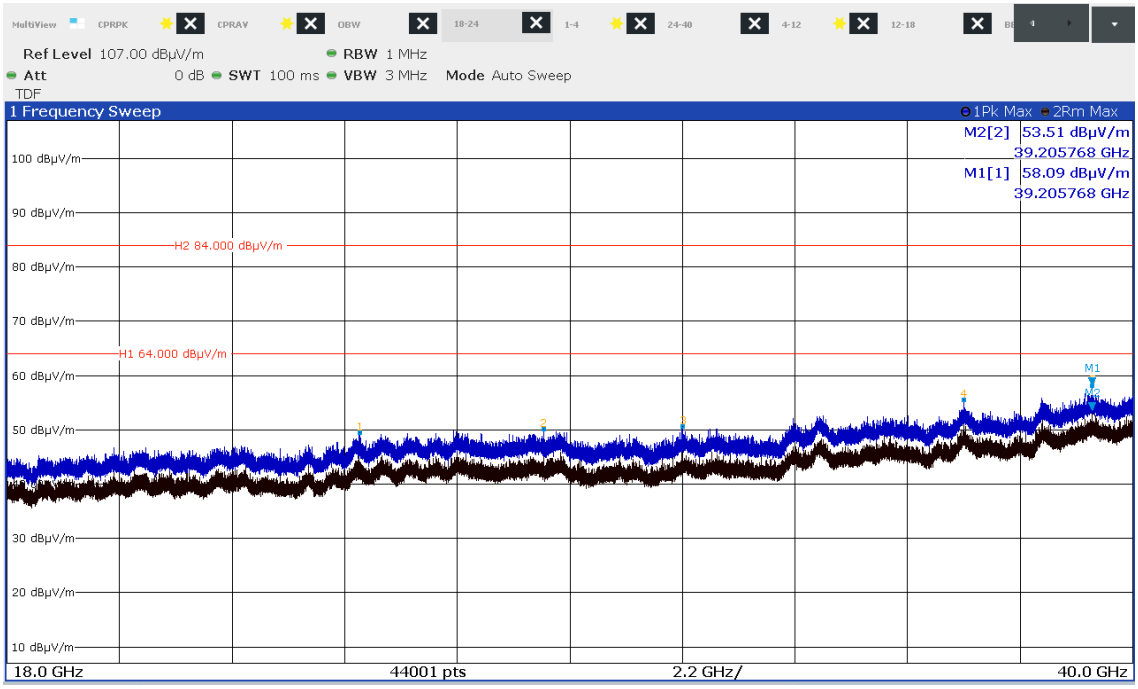
Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**5.527927 GHz**	**94.00 dBµV/m**		
M2		2	**5.527927 GHz**	**86.81 dBµV/m**		
M3		2	**5.46 GHz**	**51.79 dBµV/m**		



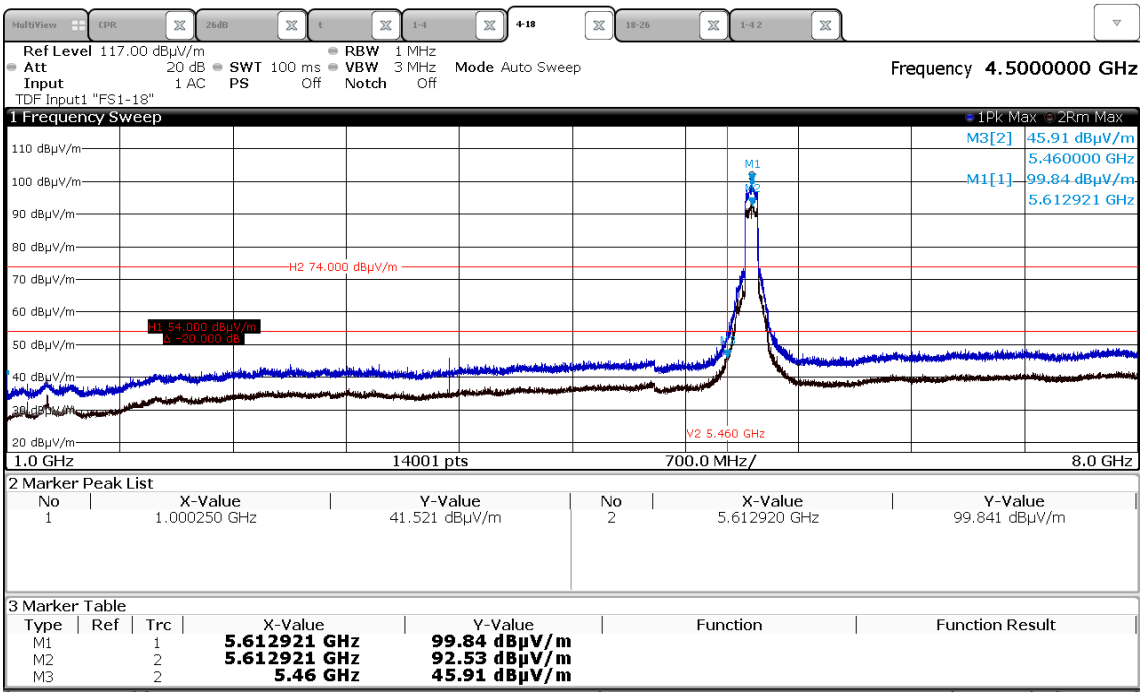
2 Marker Peak List

No	X-Value	Y-Value	No	X-Value	Y-Value
1	17.942250 GHz	51.346 dBµV/m			

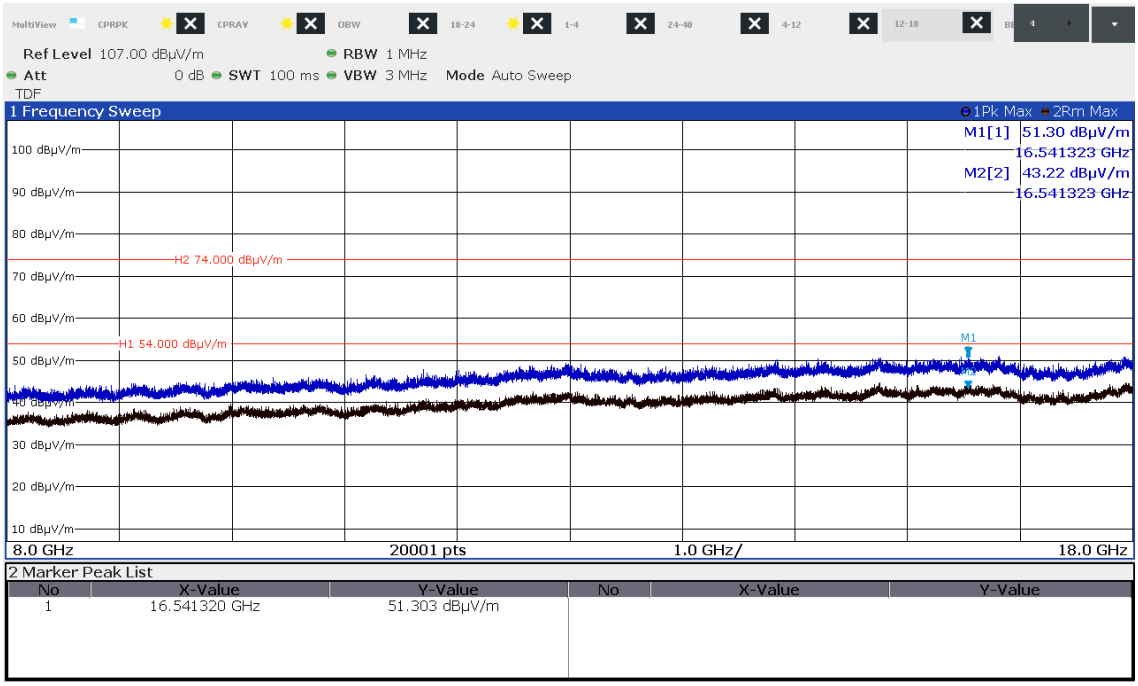
FCC ID: 2AHES-SMB **IC: 21152-SMB**

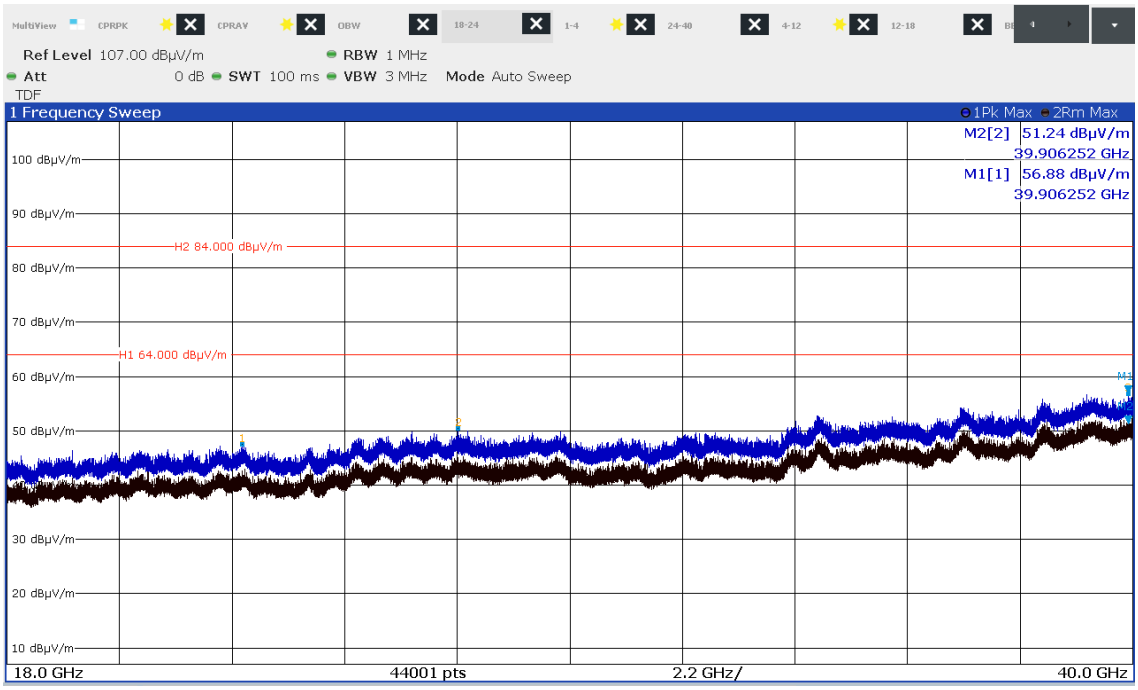


5.4.5.12 CH122ac VT80, Ant0, P13



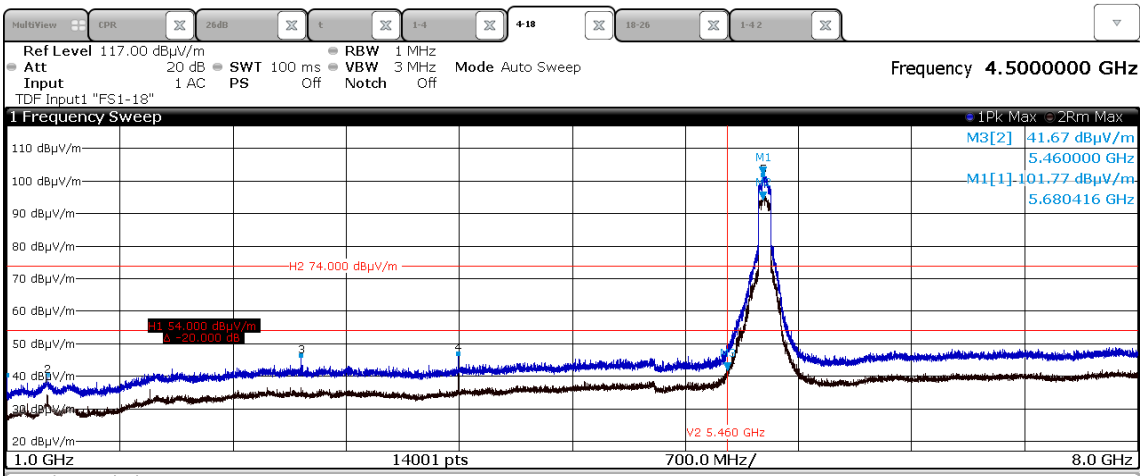
FCC ID: 2AHES-SMB **IC: 21152-SMB**





FCC ID: 2AHES-SMB **IC: 21152-SMB**

5.4.5.13 CH138ac VT80, Ant0

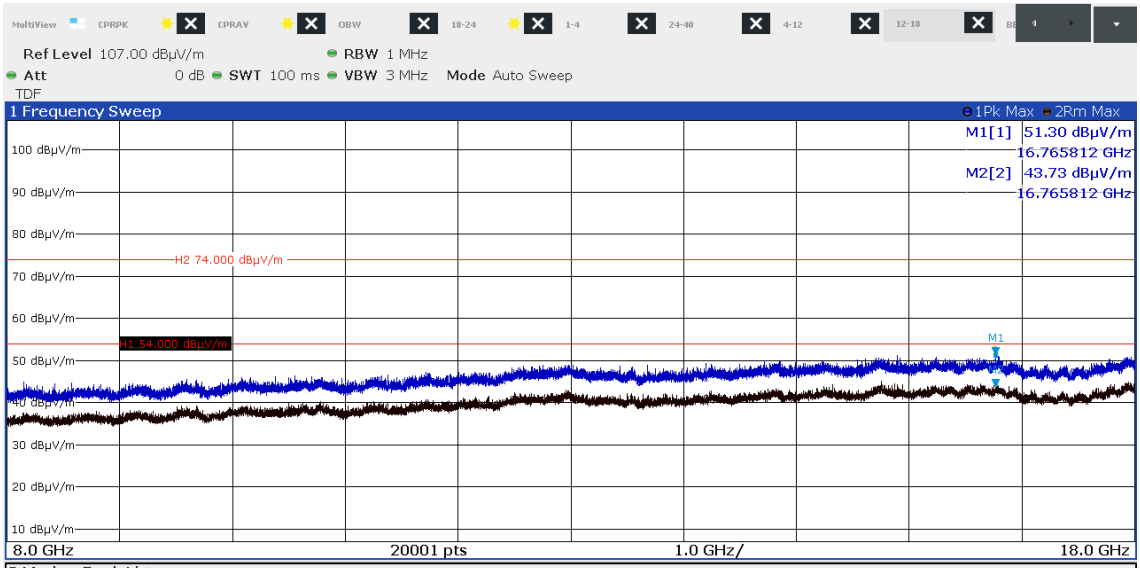


2 Marker Peak List

No	X-Value	Y-Value	No	X-Value	Y-Value
1	1.000750 GHz	40.333 dBµV/m	4	3.793050 GHz	46.850 dBµV/m
2	1.250230 GHz	40.246 dBµV/m	5	5.680420 GHz	101.773 dBµV/m
3	2.822620 GHz	46.344 dBµV/m			

3 Marker Table

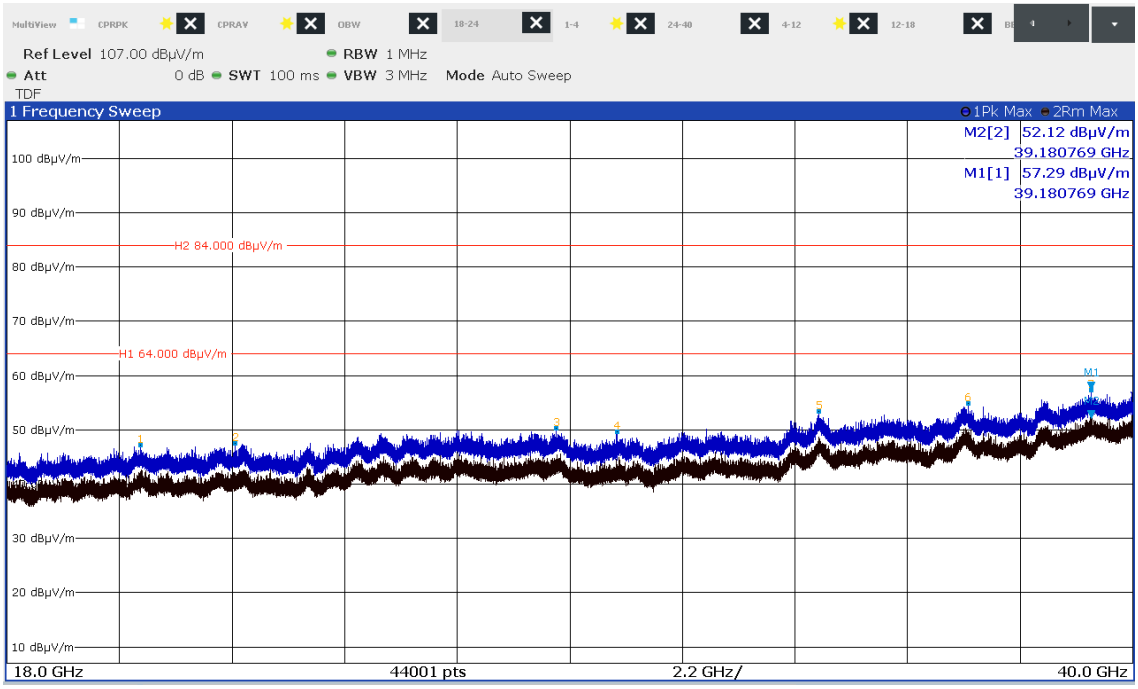
Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**5.680416 GHz**	**101.77 dBµV/m**		
M2		2	**5.680416 GHz**	**94.12 dBµV/m**		
M3		2	**5.46 GHz**	**41.67 dBµV/m**		



2 Marker Peak List

No	X-Value	Y-Value	No	X-Value	Y-Value
1	16.765810 GHz	51.297 dBµV/m			

FCC ID: 2AHES-SMB **IC: 21152-SMB**



Limit according to FCC Part 15E, Section 15.407(b)(3) for undesirable emissions:

Operating Frequency range	Undesirable emission limit, EIRP
(MHz)	(dBm/MHz)
5470 – 5725	-27.0

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

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 ID: 2AHES-SMB **IC: 21152-SMB**

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 from 30 MHz up to 40 GHz.

5.5 Antenna application

5.5.1 Applicable standard

According to FCC Part 15C, Section 15.203:
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit that broken antennas can be replaced by the user, but the use of a standard antenna jack is prohibited.

The EUT use the listed antennas for SISO technique. The equipment connector is subject to the end product.

5.5.2 Antenna requirements

According to FCC Part 15E, Section 15.407(a):
The conducted output power limit specified in paragraph (a) of 15.407 is based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from intentional radiator shall be reduced below the stated values in paragraph (a)(1), (a)(2) and (a)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds the effective value.

5.5.3 Defacto EIRP-Limit:

For the output power reduction of the used antennas see the following table. The limit is calculated as using following formula, Pout = 30 – (Gx – 6);

The used integrated PCB antennas has a gain smaller than 6 dBi, therefore no “defacto limit” results.

Remarks: No power reduction results using the listed antennas in combination with the mentioned power settings.

FCC ID: 2AHES-SMB **IC: 21152-SMB**

6 USED TEST EQUIPMENT AND ACCESSORIES

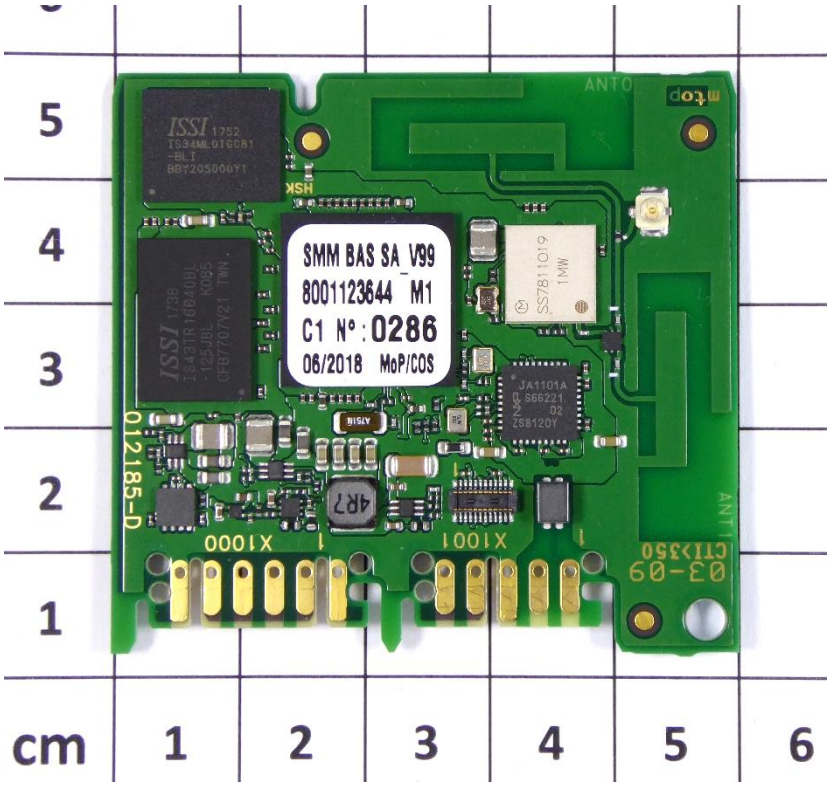
All test instruments used are calibrated and verified regularly. The calibration history is available on request.

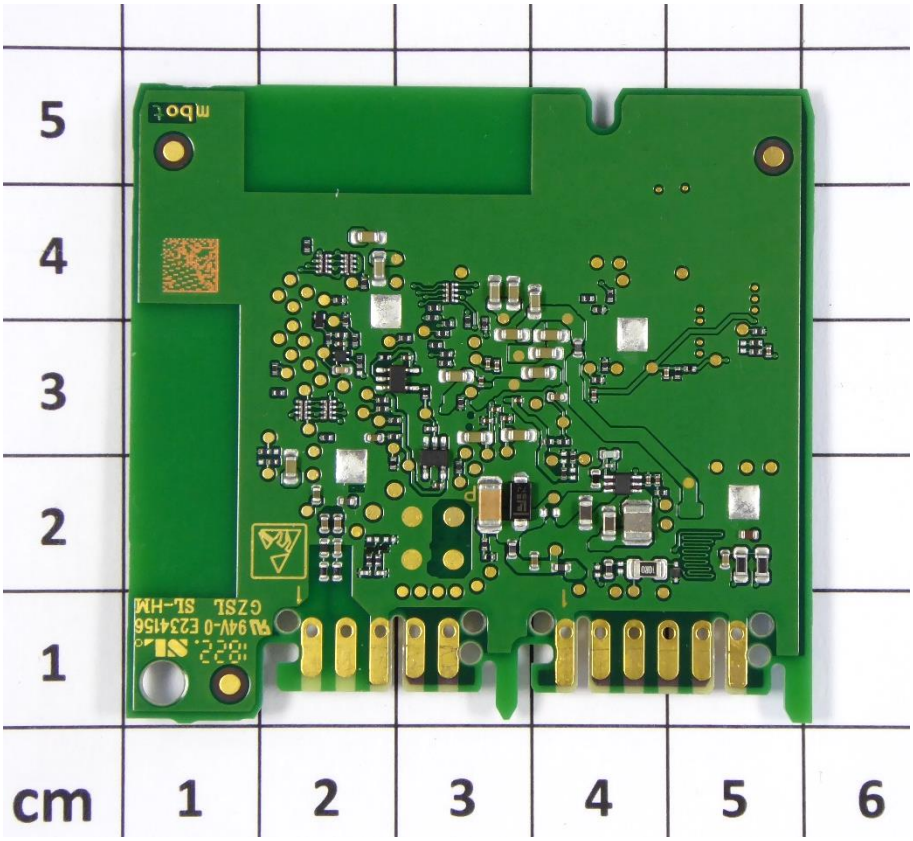
Test ID	Model Type	Equipment No.	Next Calib.	Last Calib.	Next Verif.	Last Verif.
A 4	BAT-EMC 3.18.0.26	01-02/68-13-001				
	ESCI	02-02/03-15-001	02/07/2020	02/07/2019		
	ESH 2 - Z 5	02-02/20-05-004	25/10/2019	25/10/2017	30/10/2019	30/04/2019
	EMV D 30000/PAS	02-02/30-05-006	21/02/2020	21/02/2017	25/02/2020	25/02/2019
	N-4000-BNC	02-02/50-05-138				
	N-1500-N	02-02/50-05-140				
	ESH 3 - Z 2	02-02/50-05-155	18/11/2019	18/11/2016	13/11/2019	13/05/2019
	EA-PS 3032-20B	02-02/50-11-013				
CPR 3	FSW43	02-02/11-15-001	08/04/2020	08/04/2019		
	AFS4-01000400-10-10P-4	02-02/17-13-002				
	AMF-4F-04001200-15-10P	02-02/17-13-003				
	BBHA 9120 E 251	02-02/24-05-006	15/07/2020	15/07/2019	02/03/2020	02/09/2019
	WBH2-18NHG	02-02/24-08-002	15/07/2020	15/07/2019	02/03/2020	02/09/2019
	Sucoflex N-2000-SMA	02-02/50-05-075				
	SF104/11SMA/11N/2000MM	02-02/50-15-003				
	SF104/11SMA/11N/2000MM	02-02/50-15-004				
SER 2	ESVS 30	02-02/03-05-006	19/08/2020	19/08/2019		
	VULB 9168	02-02/24-05-005	19/07/2020	19/07/2019		
	NW-2000-NB	02-02/50-05-113				
	EA-PS 3032-20B	02-02/50-11-013				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
SER 3	FSW43	02-02/11-15-001	08/04/2020	08/04/2019		
	JS4-18004000-30-5A	02-02/17-05-017				
	AMF-6D-01002000-22-10P	02-02/17-15-004				
	3117	02-02/24-05-009	06/06/2020	06/06/2019		
	BBHA 9170	02-02/24-05-014	12/06/2021	12/06/2018	12/12/2019	12/12/2018
	KMS102-0.2 m	02-02/50-11-020				
	18N-20	02-02/50-17-003				
	NMS111-GL200SC01-NMS11	02-02/50-17-012				
	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				

FCC ID: 2AHES-SMB **IC: 21152-SMB**

ATTACHMENT A

A1) Photo documentation of the EUT





- End of attachment A -