TEST REPORT # EMCC-160592H, 2017-12-22

EQUIPMENT UNDER TEST:

Device:	Promate BT COM
Serial Number:	#1 #2
Application:	Bluetooth Headset
FCC ID:	TUFBTCOM
IC:	6574A-BTCOM
Manufacturer:	SAVOX Communications Oy Ab
Address:	Sinikalliontie 3B 02630 Espoo Finland
Phone :	+358 44 961 87 09
RELEVANT STANDARD(S) :	47 CFR 15.107, 15.109, ICES-003 47 CFR § 15.247, RSS-247 Issue 2

MEASUREMENT PROCEDURE:

☒ ANSI C63.10-2013
☒ ANSI C63.4-2014
☒ RSS-Gen Issue 4
☒ DA 00-705, dated 2000-03-30

TEST REPORT PREPARED BY:

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1 GENERAL INFORMATION

1.1 Purpose

The purpose of this report is to show compliance with the 47 CFR § 15.247 and RSS-247 Issue 2 requirements for the certification of licence-exempt Intentional Radiators, as well as with the Part 15B and ICES-003 requirements for Unintentional Radiators.

1.2 Limits and Reservations

1.3 Test Location

Test Laboratory:	EMCCons DR. RAŠEK GmbH & Co. KG
DAkkS Accreditation No.:	D-PL-12067-01-02
Address of Labs I, II, III and Head Office:	EMCCons DR. RAŠEK GmbH & Co. KG Boelwiese 8 91320 Ebermannstadt GERMANY
Address of Labs IV and V:	EMCCons DR. RAŠEK GmbH & Co. KG Stoernhofer Berg 15 91364 Unterleinleiter GERMANY
Laboratory:	Test Laboratory IV The 3 m & 10 m semi-anechoic chamber site has been fully described in a report submitted to ISED. This 3m/10m alternative test side is approved by Innovation, Science and Economic Development Canada under file number 3464C-1.
Phone:	+49 9194 7262-0
Fax:	+49 9194 7262-199
E-Mail:	emc.cons@emcc.de
Web:	www.emcc.de

1.4 Customer

Company Name:	Verkotan Oy
Street:	Elektroniikkatie 17
City:	90590 Oulu
Country:	Finland
Name for contact purposes:	Mr Jukka Ollila
Phone:	+358 40 543 3264
E-Mail:	jukka.ollila@verkotan.com

1.5 Manufacturer

Company Name:	SAVOX Communications Oy Ab
Street:	Sinikalliontie 3B
City:	02630 Espoo
Country:	Finland
Name for contact purposes:	Mr Olesya Kramar
Phone:	+358 44 961 87 09
E-Mail:	olesya.kramar@savox.com

1.6 Dates and Test Location

Date of receipt of EUT:	2017-09-05
Test Date:	CW 2017/42 and 43
Test Location:	Lab IV

1.7 Ordering Information

Purchase Order:	1022
Date:	2017-08-30
Vendor Number:	-

1.8 Climatic Conditions

Date	Temperature [°C]	Relative Humidity [%]	Air Pressure [hPa]	Lab	Customer attended tests
2017-10-18	23	45	975	IV	no
2017-10-19	23	43	975	IV	no
2017-10-20	23	45	974	IV	no
2017-10-25	22	49	982	IV	no
2017-10-26	23	49	984	IV	no
2017-10-27	23	49	980	IV	no

2 PRODUCT DESCRIPTION

2.1 Equipment Under Test (EUT)

The following data is based on customer's information.

Manufacturer:	SAVOX Communications Oy Ab
Trade Name:	Promate BT COM
Serial Number:	#1: sample in original configuration
	#2: sample with temporary antenna connector; for testing purpose, only.
No. of Variants:	0
Application:	Bluetooth Headset
Hardware Version:	Part Number K50924-10 rev. 1.3
Firmware Version:	Part Number K17731 rev. 1.1
FCC ID:	TUFBTCOM
IC:	6574A-BTCOM
Radio Standard:	Bluetooth 3.0
Modulation:	GFSK, π/4-DQPSK, 8-DPSK
Frequency Range:	2400 - 2483.5 MHz
No. of Channels:	79
Tested channels:	low: 1 (2402 MHz)
	middle: 40 (2441 MHz)
	high: 79 (2480 MHz)
Test Software of EUT:	CSR BlueTest3
Power Supply:	3.7 V DC from internal rechargeable battery
	5 V DC from USB for charging
Ports:	none
Antenna and Gain:	Integral, 2.0 dBi
Remarks:	None

2.2 Intended Use

The following information was delivered by the customer:

Wireless push-to-talk device for professional LTE, PoC, smartphones and tablets.

2.3 EUT Peripherals/Simulators

A standard notebook with USB interface was used to host the test software and set up the modes via USB interface.

2.4 Mode of operation during testing and test set-up

The equipment under test (EUT) was operated during the tests under the following conditions:

Test mode for tests as unintentional radiator:

Charging:
The EUT was connected via its USB cable to a standard power supply with USB outlet. During this mode, the Bluetooth connection was not activated.

Test modes for tests as intentional radiator:

Continuous Transmission:
The EUT was continuously transmitting modulated data and maximum power. The transmitter operated at one fixed channel (low/middle/high). The EUT was connected to a standard power supply with USB outlet in order to keep the supply voltage at a constant high level. This mode of operation was used for all tests.

The setting was done via a software tool called CSR BlueTest3:
- CFG PKT was used to set package type and modulation
- TXDATA1 was used to set the output power and start transmission at one fixed frequency

Continuous Hopping:
The EUT was continuously transmitting modulated data and maximum power. The transmitter operated in hopping mode employing all 79 channels. The EUT was connected to a standard power supply with USB outlet in order to keep the supply voltage at a constant high level. This mode of operation was used for all tests.

The setting was done via a software tool called CSR BlueTest3:
- CFG PKT was used to set package type and modulation
- TXDATA2 was used to set the output power and start transmission in hopping mode

Based on customer's information, the following settings have been used for testing:

		CFG PKT		TXDATA1	
Mode	**Packet**	**Packet Type**	**Packet Size**	**Power ext.**	**Power int.**
GFSK	DH5	15	339	255	63
π/4-DQPSK	2-DH5	30	679	255	104
8-DPSK	3-DH5	31	1021	255	104

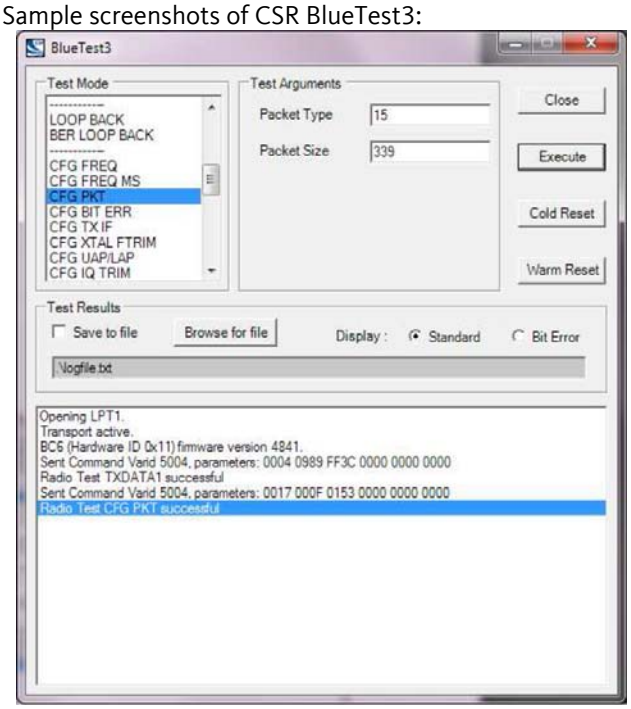
Prior testing the worst case modes of operation were figured out. Hence the packet type has no influence to spectrum and power package type DH5 was chosen due to its highest duty cycle. All three modulation types were tested except for emission tests, where DH5 was used as worst case mode of operation.

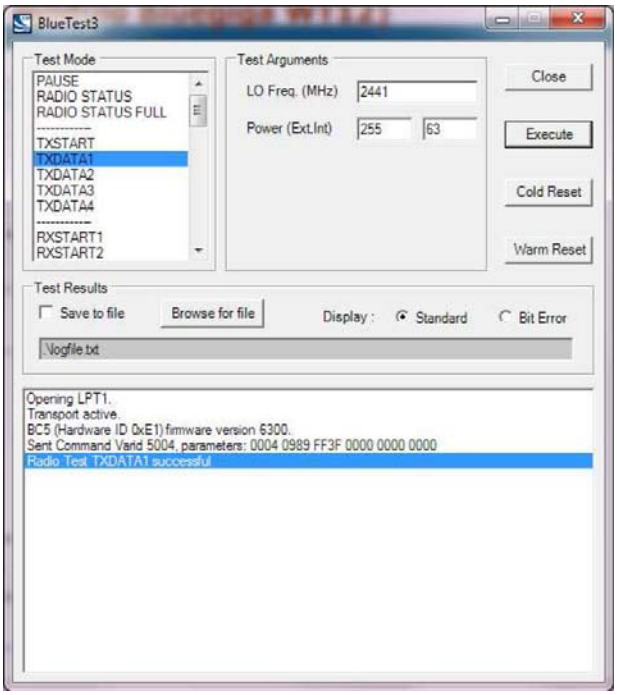
List of channels and their corresponding frequencies:

Frequency [MHz]	Channel #	Frequency [MHz]	Channel #	Frequency [MHz]	Channel #
2402	**1**	2429	28	2456	55
2403	2	2430	29	2457	56
2404	3	2431	30	2458	57
2405	4	2432	31	2459	58
2406	5	2433	32	2460	59
2407	6	2434	33	2461	60
2408	7	2435	34	2462	61
2409	8	2436	35	2463	62
2410	9	2437	36	2464	63
2411	10	2438	37	2465	64
2412	11	2439	38	2466	65
2413	12	2440	39	2467	66
2414	13	**2441**	**40**	2468	67
2415	14	2442	41	2469	68
2416	15	2443	42	2470	69
2417	16	2444	43	2471	70
2418	17	2445	44	2472	71
2419	18	2446	45	2473	72
2420	19	2447	46	2474	73
2421	20	2448	47	2475	74
2422	21	2449	48	2476	75
2423	22	2450	49	2477	76
2424	23	2451	50	2478	77
2425	24	2452	51	2479	78
2426	25	2453	52	**2480**	**79**
2427	26	2454	53	---	---
2428	27	2455	54	---	---

Note: Highlighted frequencies/channels were used for testing.

Sample screenshots of CSR BlueTest3:





2.5 Modifications required for compliance

None.

3 TEST RESULTS SUMMARY

Summary of test results for the following EUT:

Manufacturer: SAVOX Communications Oy Ab
Device: Promate BT COM
Serial No: #1, #2

Requirement	47 CFR Section	RSS Section	Report Section	Tested EUT	Result
Unintentional Radiator					
AC POWERLINE CONDUCTED EMISSIONS	§ 15.107, class B	ICES-003, 6.1, class B	4.1	#1	P
RADIATED EMISSIONS 30 - 1000 MHz	§ 15.109, class B	ICES-003, 6.2, class B	4.2	#1	P
Intentional Radiator					
CARRIER FREQUENCY SEPARATION	§ 15.247(a)	RSS-247, 5.1	5.1	#2	P
NUMBER OF HOPPING FREQUENCIES	§ 15.247(a)	RSS-247, 5.1	5.2	#2	P
TIME OF OCCUPANCY (DWELL TIME)	§ 15.247(a)	RSS-247, 5.1	5.3	#2	P
20 dB BANDWIDTH	§ 15.247(a)	RSS-247, 5.1	5.4	#2	P
PEAK OUTPUT POWER	§ 15.247(b)	RSS-247, 5.4	5.5	#2	P
BAND-EDGE COMPLIANCE	§ 15.247(d)	RSS-247, 5.5	5.6	#2	P
EMISSIONS IN RESTRICTED BANDS	§ 15.247(d)	RSS-247, 5.5	5.7	#1	P
RADIATED EMISSIONS 9 kHz - 30 MHz	§ 15.247 § 15.209	RSS-247, 5.5 RSS-Gen, 8.9	5.8	#1	P
RADIATED EMISSIONS 30 - 1000 MHz	§ 15.247 § 15.209	RSS-247, 5.5 RSS-Gen, 8.9	5.9	#1	P
RADIATED EMISSIONS 1 GHz – 26.5 GHz	§ 15.247 § 15.209	RSS-247, 5.5 RSS-Gen, 8.9	5.10	#1	P
RF EXPOSURE EVALUATION	§ 2.1093	RSS-102, Issue 5	5.11	#2	P

N.A. – not applicable; N.T. – Not tested acc. to applicant's order.

The client has made the determination that EUT Condition, Characterization, and Mode of Operation are representative of production units and meet the requirements of the specifications referenced herein.
Consistent with Industry practice, measurement and test equipment not directly involved in obtaining measurement results but having an impact on measurements (such as cable loss, antenna factors, etc.) are factored into the "Correction Factor" documented in certain test results. Instrumentation employed for testing meets tolerances consistent with known Industry Standards and Regulations.
The measurements contained in this report were made in accordance with the procedures described in ANSI C63.10-2013 and all applicable Public Notices received prior to the date of testing. All requirements were found to be within the limits outlined in this report.

The test results in this report apply only to the particular equipment under test as declared in this report.

Test Personnel: Patrick Reusch, Ludwig Kraft
Issuance Date: 2017-12-22

4 TEST RESULTS - UNINTENTIONAL RADIATOR

4.1 AC Powerline Conducted Emissions

Test Requirement: 47 CFR, § 15.107
ICES-003, 6.1
Test Procedure: ANSI C63.4

4.1.1 Regulation

§15.107 Conducted limits.
(a) Except for Class A digital devices, for equipment 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, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the band edges.

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

ICES-003, 6.1 AC Power Line Conducted Emissions Limits
Class B: ITE that does not meet the conditions for Class A operation shall comply with the Class B conducted limits set out in Table 2.

Table 2 — Class B Conducted Limits		
Frequency (MHz)	Class B 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

4.1.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
60-Hz-Converter	AEG / DAMK4/DAGK4	1	n/a	n/a
EMI Test Receiver	R&S / ESIB40	516	2017-03	2018-03
V-LISN	Schwarzbeck / NNLA8119	1469	2015-11	2017-11
Pulse Limiter	R&S / ESH3-Z2 357.8810.52	1519	2017-10	2019-10
Shielded Cabinet	EMCC / SC2-ULL	1890	n/a	n/a
V-LISN	R&S / ESH2-Z5	1901	2017-10	2019-10
Digital Multimeter	Agilent / U1241B	3880	2016-05	2018-05
Web-Thermo-Hygrobarograph	W&T / 57613 Web-T/Rh/P	4717	2016-04	2018-04
EMC Measurement Software	R&S / EMC32 v 10.0.0	5392	n/a	n/a
BNC cable	EMCC / BNC003m0	5551	2017-05	2018-05

4.1.3 Test Procedures

ANSI C63.4, 7.3.1 Measurements at a test site

a) Tabletop devices shall be placed on a nonconducting platform, of nominal size 1 m by 1.5 m, raised 80 cm above the reference ground plane. The vertical conducting plane, when used (see 5.2.3), or wall of a screened room shall be located 40 cm to the rear of the EUT. Floor-standing devices shall be placed either directly on the reference ground plane or on insulating material as described in 6.3.3.2. All other surfaces of tabletop or floor-standing EUTs shall be at least 80 cm from any other grounded conducting surface, including the case or cases of one or more LISNs. AC power-line adapters that are used with EUTs, such as notebook computers, should be placed as typically used (i.e., on the tabletop) if the adapter-to-EUT cord is too short to allow the power adapter to reach the floor.

b) Each current-carrying conductor of the EUT power cord(s), except the ground (safety) conductor(s), shall be individually connected through a LISN to the input power source. All 50 Ω ports of the LISN shall be resistively terminated into 50 Ω loads when not connected to the measuring instrument. When the test configuration consists of multiple units (EUT and associated/peripheral equipment, or EUT consisting of multiple equipment) that have their own power cords, ac power-line conducted emissions measurements shall be performed with the ac power-line cord of the particular unit under test connected to one LISN that is connected to the measuring instrument. The power cords for the units in the remainder of the configuration not under measurement shall be connected to a separate LISN or LISNs. This connection may be made using a multiple-receptacle device. Typical ac power-line conducted emissions test setups are shown in Figure 7 through Figure 9. Emissions from each current-carrying conductor of the EUT shall be individually measured. Where multiple portions of the EUT receive ac power from a common power strip, which is furnished by the manufacturer as part of the EUT, measurements need only be made on the current-carrying conductors of the common power strip. Adapters or extension cords connected between the EUT power cord plug and the LISN power receptacle shall be included in the LISN setup, such that the calibration of the combined adapter or extension cord with an adapter and the LISN meets the requirements of 5.2.4.

c) If the EUT consists of a number of devices that have their own separate ac power connections (e.g.,a floor-standing frame with independent power cords for each shelf that are able to connect directly to the ac power network), then each current-carrying conductor of one device is measured while the other devices are connected to a second (or more) LISN(s). All devices shall be separately measured. If the manufacturer provides a power strip to supply power to all of the devices making up the EUT, only the conductors in the common power cord to the power strip shall be measured.

d) If the EUT is normally operated with a ground (safety) connection, the EUT shall be connected to the ground at the LISN through a conductor provided in the lead from the ac power to the LISN.

e) The excess length of the power cord between the EUT and the LISN receptacle (or ac power receptacle where a LISN cannot be used), or an adapter or extension cord connected to and measured with the LISN, shall be folded back and forth at the center of the lead to form a bundle not exceeding 40 cm in length. If the EUT does not have a flexible power lead, the EUT shall be placed at a distance of 80 cm from the LISN (or power receptacle where a LISN cannot be used) and connected thereto by a power lead or appropriate connection no more than 1 m long. The measurement shall be made at the LISN end of this power lead or connection.

f) The LISN housing, measuring instrument case, reference ground plane, and vertical conducting plane, if used (see 5.2.3), shall be bonded together.

4.1.4 Test Result

Mode: Charging

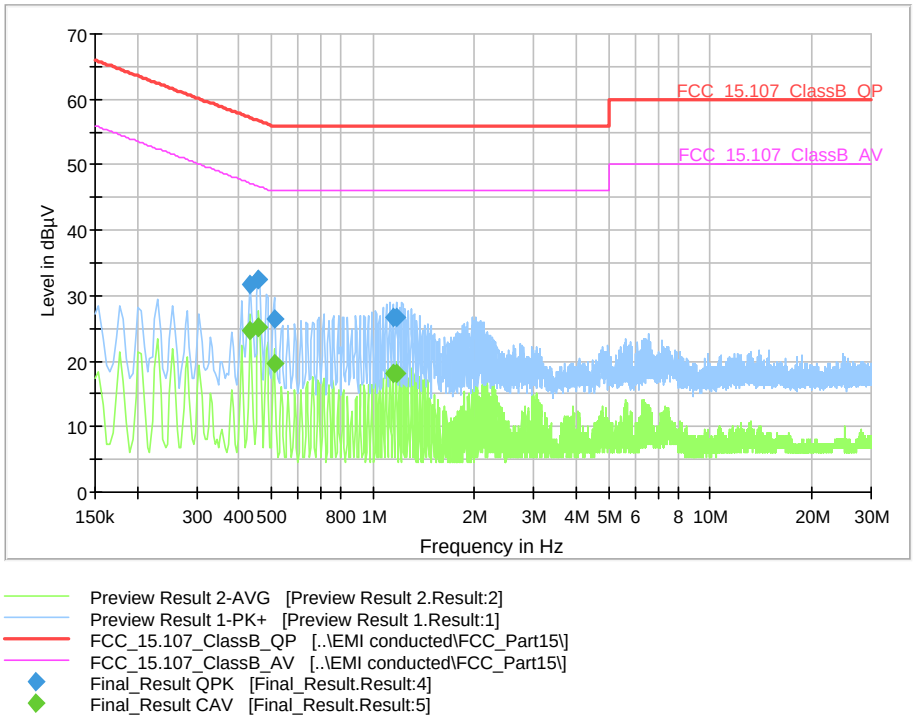
Frequency [MHz]	QuasiPeak [dBuV]	Average [dBuV]	Limit [dBuV]	Margin [dB]	Line
0.43	---	24.7	47.2	22.5	L1
0.43	31.6	---	57.2	25.6	L1
0.46	32.4	---	56.7	24.3	L1
0.46	---	25.1	46.7	21.6	L1
0.46	32.5	---	56.7	24.2	L1
0.46	---	25.3	46.7	21.4	L1
0.51	---	19.6	46.0	26.5	L1
0.51	26.4	---	56.0	29.6	L1
1.15	---	18.1	46.0	27.9	L1
1.15	26.7	---	56.0	29.4	L1
1.17	---	18.2	46.0	27.8	L1
1.17	26.8	---	56.0	29.2	L1

Manufacturer:	SAVOX Communications Oy Ab
Device:	Promate BT COM
Serial No:	#1
Mode:	Charging
Test date:	2017-10-27
Test Personnel:	L. Kraft

The EUT meets the requirements of this section.

4.1.5 Detailed Measurement Data

Mode: Charging



4.2 Radiated Emissions 30 - 1000 MHz

Test requirement: 47 CFR, § 15.109
ICES-003, 6.2
Test procedure: ANSI C63.4

4.2.1 Regulation

§15.109 Radiated emission limits.
(a) Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency of emission (MHz)	Field strength (microvolts/meter)
30-88	100
88-216	150
216-960	200
Above 960	500

(2) If, in accordance with §15.33 of this part, measurements must be performed above 1000 MHz, compliance above 1000 MHz shall be demonstrated with the emission limit in paragraph (a) or (b) of this section, as appropriate. Measurements above 1000 MHz may be performed at the distance specified in the CISPR 22 publications for measurements below 1000 MHz provided the limits in paragraphs (a) and (b) of this section are extrapolated to the new measurement distance using an inverse linear distance extrapolation factor (20 dB/decade), e.g., the radiated limit above 1000 MHz for a Class B digital device is 150 uV/m, as measured at a distance of 10 meters.

ICES-003, 6.2 Radiated Emissions Limits
6.2.1 Radiated Emissions Limits Below 1 GHz
Class B: ITE that does not meet the conditions for Class A operation shall comply with the Class B radiated limits set out in Table 5 determined at a distance of 3 metres.

Table 5 — Class B Radiated Limits Below 1 GHz	
Frequency of emission (MHz)	Class A Radiated Limit (dBµV/m)
	Quasi-peak
30 to 88	40
88 to 216	43.5
216 to 960	46
960 to 1000	54

4.2.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
60-Hz-Converter	AEG / DAMK4/DAGK4	0001	n/a	n/a
N-Cable N/50	R&S / HFU2-Z4	55	2017-09	2018-09
Loop Antenna	R&S / HFH 2-Z2	374	2016-07	2018-07
Anechoic Room SAC	EMCC/FRANK. / SAC-10	1889	n/a	n/a
Digital Multimeter	Agilent / U1241A	2720	2017-03	2019-03
EMI Test Receiver	R&S / ESU8	3846	2017-01	2018-01
Web-Thermo-Hygrobarograph	W&T / 57613 Web-T/Rh/P	4717	2016-04	2018-04
Log Per. Antenna	Schwarzbeck / VUSLP 9111B	5533	2017-01	2019-01
EMI Test Software	R&S / EMC32 v10.00.00	5392	n/a	n/a

4.2.3 Test Procedures

ANSI C63.4, 8.3.1.1 Exploratory radiated emission measurements (9 kHz to 1 GHz)
a) Exploratory radiated measurements shall be performed at the measurement distance or at a closer distance than that specified for compliance to determine the emission characteristics of the EUT (see also 10.2.8 and Annex E) and recorded in tabular or graphical form. Significant emissions are identified using a remote-controlled turntable and antenna positioner and monitoring the spectrum while changing the EUT (turntable) azimuth, antenna polarity, and height. This spectrum exploratory monitoring can also be performed by manually moving the receiving antenna around the EUT to pick up significant emissions. A shielded room may be used for exploratory testing, but care must be taken to account for shielded room reflections that can lead to significant errors in amplitude measurements.

b) Broadband antennas and a spectrum analyzer or an EMI receiver with a panoramic display are most often used in this type of testing. It is recommended that either a headset or loudspeaker be connected as an aid in detecting ambient signals and finding frequencies of significant emission from the EUT when the exploratory and final testing is performed at an OATS with strong ambient signals. Caution should be taken if either antenna heights between 1 m and 4 m or EUT azimuth is not fully explored. Not fully exploring these parameters during exploratory testing may require complete testing at the OATS or semi-anechoic chamber when the final full spectrum testing is conducted.

c) The EUT should be set up in its typical configuration and arrangement and operated in its various modes. For tabletop systems, cables or wires not bundled in the initial setup shall be manipulated within the range of likely arrangements. For floor-standing equipment, the cables or wires should be located in the same manner as the user would install them and no further manipulation is made. For combination EUTs, the tabletop and floor-standing portions of the EUT shall follow the procedures for their respective setups and cable manipulation. If the manner of cable installation is not known, or if it changes with each installation, cables or wires for floor-standing equipment shall be manipulated to the extent possible to produce the maximum level of emissions.

d) Exploratory radiated emissions testing of handheld and/or body-worn devices shall include rotation of the EUT through three orthogonal axes to determine the orientation (attitude) that maximizes the emissions. Subclause 6.3.6 applies for exploratory radiated emissions testing of ceiling-mounted devices. This equipment arrangement shall be used in the final measurements of radiated emission from the EUT.

e) For each mode of operation required to be tested, the frequency spectrum shall be monitored. Variations in antenna height between 1 m and 4 m, antenna polarization, EUT azimuth, and cable or wire placement (each variable within bounds specified elsewhere) shall be explored to produce the emission that has the highest amplitude relative to the limit. A suggested step-by-step technique for determining maximum radiated emission is given in Annex E.

ANSI C63.4, 8.3.2.1 Final radiated emission measurements (9 kHz to 1 GHz)
Based on the exploratory radiated emissions measurement results (i.e., see 8.3.1.1), the single EUT, cable and wire arrangement, and mode of operation that produces the emission that has the highest amplitude relative to the limit are selected for the final measurement. The final measurements are then performed on a site meeting the requirements of 5.3 or 5.4, as appropriate. If the EUT is relocated from an exploratory test site to a final test site, the highest emission relative to the limit shall be remaximized at the final test location before final radiated emissions measurements are performed. However, antenna height and polarization and EUT azimuth are to be varied. In addition, the full frequency range to be checked for meeting compliance shall be investigated.
This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated by 90° relative to the ground plane to repeat the measurements for both the horizontal and vertical antenna polarizations. During the full frequency range investigation, particular focus should be made on the frequencies found in exploratory testing that were used to find the final test configuration, mode of operation, and arrangement (associated with achieving the least margin with respect to the limit). This full range test constitutes the compliance measurement.

Radiated Emissions Test Characteristics	
Frequency range	30 MHz – 1000 MHz
Test distance	3 m
Test instrumentation resolution bandwidth	120 kHz
Receive antenna height	1 m - 4 m
Receive antenna polarization	Vertical/Horizontal

4.2.4 Calculation of Field Strength Limits

E.g. radiated spurious emissions field strength limits in restricted bands (e.g. 108 to 121.94 MHz (FCC) or 108 to 138 MHz (ISED)) acc. to §15.109 for the frequency band 88-216 MHz:

150 µV/m at 3 meters

Using the equation:

$E_{dB\mu V/m} = 20 * \log (E_{\mu V/m})$

where

$E_{dB\mu V/m}$ = Field Strength in logarithmic units (dBµV/m)

$E_{\mu V/m}$ = Field Strength in linear units (µV/m)

A field strength limit of 150 µV/m corresponds with 43.5 dBµV/m.

4.2.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor. The basic equation with a sample calculation is as follows:
FS = RA + AF + CF
where
FS = Field Strength in dBµV/m
RA = Receiver Amplitude in dBµV
AF = Antenna Factor in dB(1/m)
CF = Cable Attenuation Factor in dB
Assume a receiver reading of 23.5 dBµV is obtained. The Antenna Factor of 7.4 dB(1/m) and a Cable Factor of 1.1 dB are added, giving a field strength of 32 dBµV/m. The 32 dBµV/m value can be mathematically converted to its corresponding level in µV/m.

FS = 23.5 + 7.4 + 1.1 = 32 [dBµV/m]

Level in µV/m = Common Antilogarithm (32/20) = 39.8

Remark: All emission measurements described in this chapter performed using the EMI test program transducer factor setting capability, i.e. the field strength value at the test distance was measured directly without the necessity of additional correction factors.

4.2.6 Final Test Results

Frequency [MHz]	Result [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Remarks
438.6	37.3	46	8.7	---

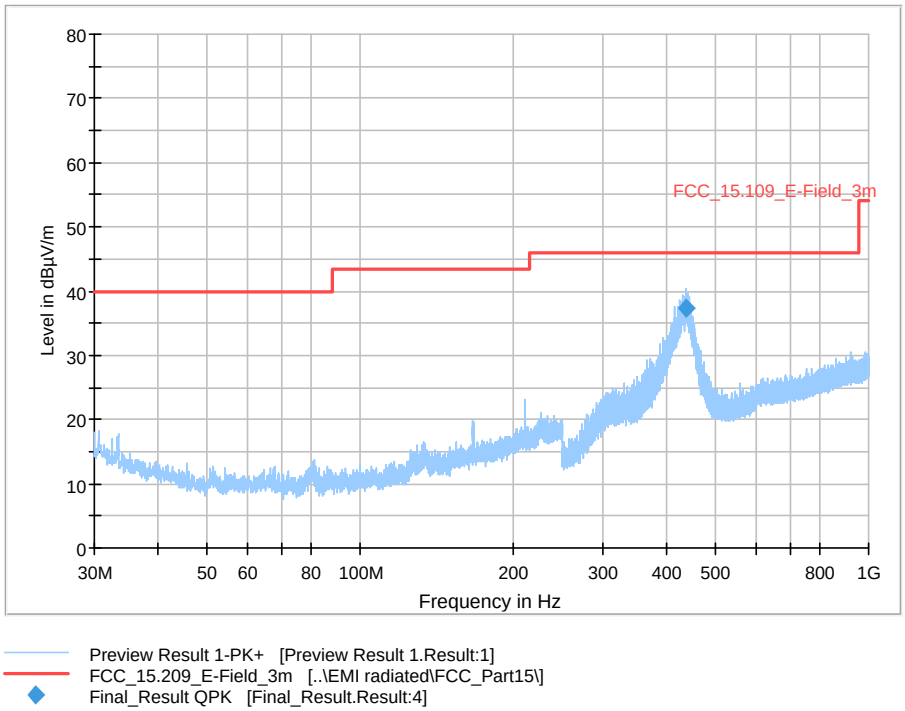
All tests performed at 3 m distance. The table above contains worst-case emissions, only. For further details refer to the detailed measurement data.

Manufacturer:	SAVOX Communications Oy Ab
Device:	Promate BT COM
Serial No:	#1
Mode:	Charging
Test date:	2017-10-25
Test Personnel:	L. Kraft

The EUT meets the requirements of this section.

4.2.7 Detailed Measurement Data

Radiated Emissions 30 MHz – 1000 MHz
Mode: Charging
Pos.: X



5 TEST RESULTS - INTENTIONAL RADIATOR

5.1 Carrier Frequency Separation

Test Requirement: 47 CFR, § 15.247(a)
RSS-247, 5.1
Test Procedure: DA 00-705

5.1.1 Regulation

§15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
(a) (1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

RSS-247, 5.1 Frequency hopping systems (FHS)
(b) FHSs shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, FHSs operating in the band 2400-2483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or two thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided that the systems operate with an output power no greater than 0.125 W.

5.1.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
60-Hz-Converter	AEG / DAMK4/DAGK4	0001	n/a	n/a
2 W Attenuator 10 dB	Weinschel / 54A-10	1745	2016-06	2018-06
Notebook	Samsung / P560	3195	n/a	n/a
Spectrum Analyzer	Rohde & Schwarz / FSU50	3831	2017-09	2018-09
Digital Multimeter	Agilent / U1241B	3880	2016-05	2018-05
Web-Thermo-Hygrobarograph	W&T / 57613 Web-T/Rh/P	4717	2016-04	2018-04
RF cable assembly	Rosenberger / LA1-008-1000	5611	2017-10	2018-10

5.1.3 Test Procedures

DA 00-705, Carrier Frequency Separation
The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = wide enough to capture the peaks of two adjacent channels
Resolution (or IF) Bandwidth (RBW) ≥ 1% of the span
Video (or Average) Bandwidth (VBW) ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section. Submit this plot.

5.1.4 Test Results

Carrier Frequency Separation					
Mode	**Operating Channel**	**f_{low} [MHz]**	**f_{high} [MHz]**	**Δf [MHz]**	**Limit * [MHz]**
DH5	1 – 2	2401.9952	2402.9904	0.995	≥ 0.54
	39 – 40	2439.9904	2440.9952	1.005	≥ 0.54
	78 – 79	2478.9856	2479.9808	0.995	≥ 0.54
2-DH5	1 – 2	2401.9904	2402.9952	1.005	≥ 0.80
	39 – 40	2439.9952	2440.9952	1.000	≥ 0.80
	78 – 79	2478.9904	2479.9904	1.000	≥ 0.80
3-DH5	1 – 2	2401.9904	2402.9904	1.000	≥ 0.80
	39 – 40	2439.9904	2440.9952	1.005	≥ 0.80
	78 – 79	2478.9856	2479.9952	1.010	≥ 0.80

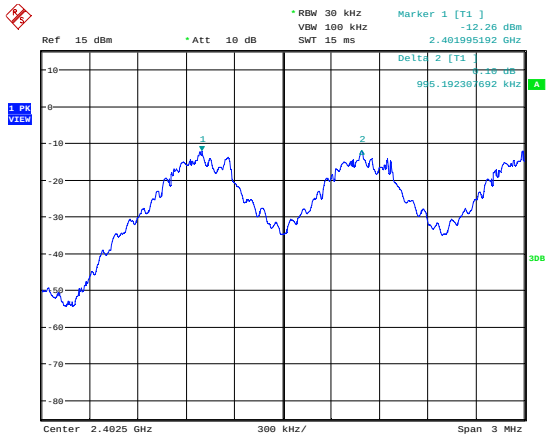
* Limit is defined in dependency of the 20 dB bandwidth, which was measured in chapter “20 dB Bandwidth”. The limit is the result of BW times 0.67 or 25 kHz, whichever is greater.

Manufacturer:	SAVOX Communications Oy Ab
Device:	Promate BT COM
Serial No:	#2
Mode:	Continuous Hopping
Test date:	2017-10-18
Test Personnel:	P. Reusch

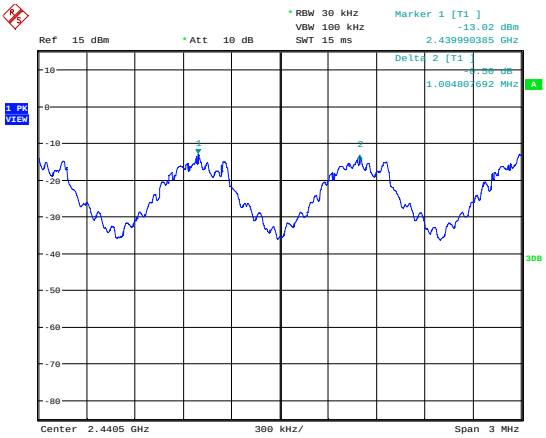
The EUT meets the requirements of this section.

5.1.5 Detailed Measurement Data

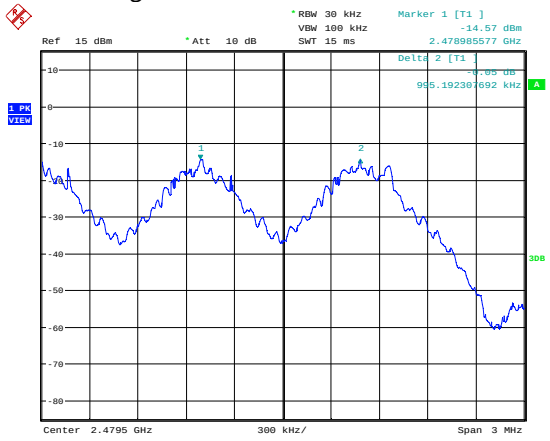
Carrier Frequency Separation
Mode: DH5
Channel: low



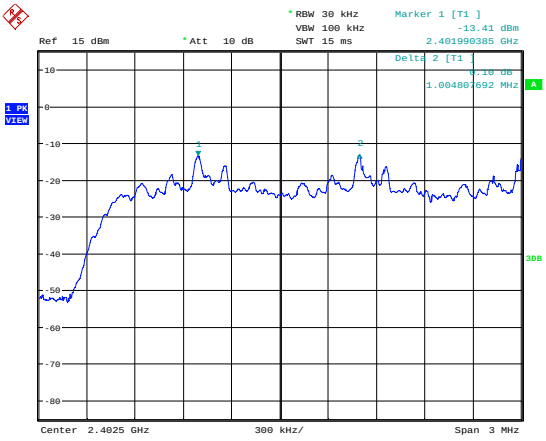
Carrier Frequency Separation
Mode: DH5
Channel: middle



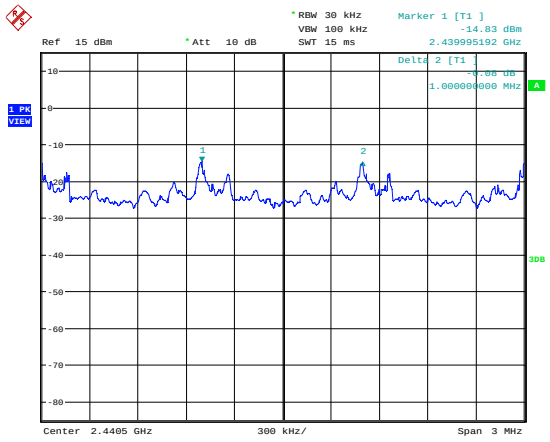
Carrier Frequency Separation
Mode: DH5
Channel: high



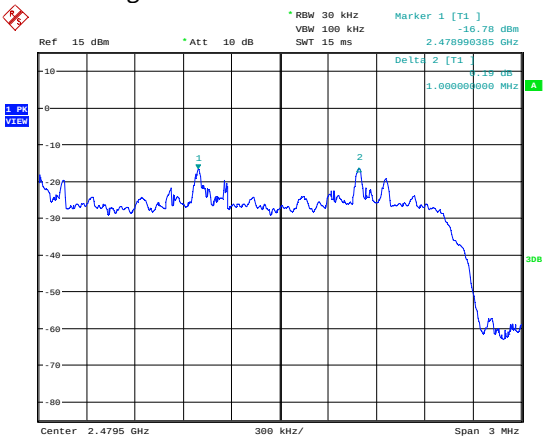
Carrier Frequency Separation
Mode: 2-DH5
Channel: low



Carrier Frequency Separation
Mode: 2-DH5
Channel: middle

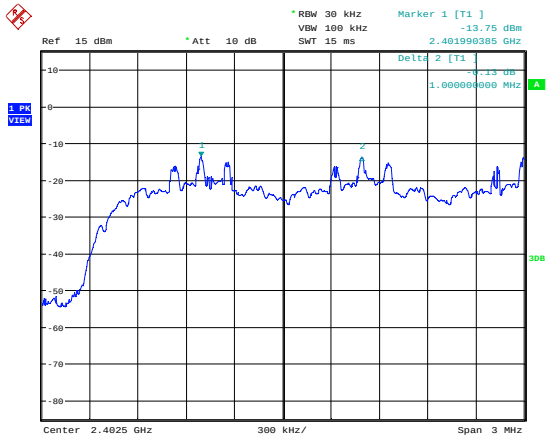


Carrier Frequency Separation
Mode: 2-DH5
Channel: high

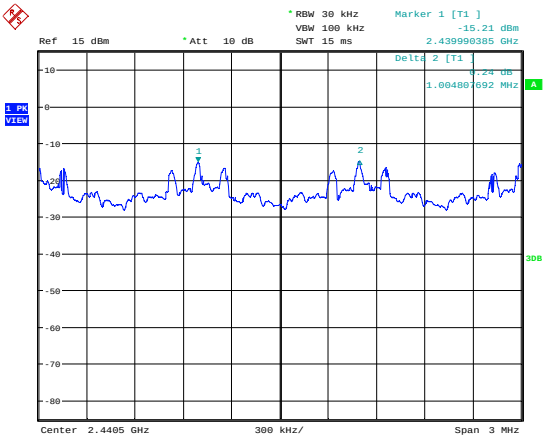


Test of SAVOX Communications Oy Ab Bluetooth Headset type Promate BT COM
to 47 CFR § 15.247 and RSS-247 Issue 2

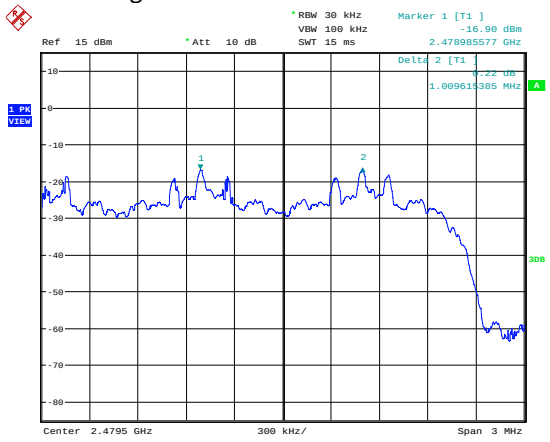
Carrier Frequency Separation
Mode: 3-DH5
Channel: low



Carrier Frequency Separation
Mode: 3-DH5
Channel: middle



Carrier Frequency Separation
Mode: 3-DH5
Channel: high



5.2 Number Of Hopping Frequencies

Test Requirement: 47 CFR, § 15.247(a)
RSS-247, 5.1
Test Procedure: DA 00-705

5.2.1 Regulation

§15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
(a) (1) (iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

RSS-247, 5.1 Frequency hopping systems (FHS)
(d) FHSs operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds, multiplied by the number of hopping channels employed. Transmissions on particular hopping frequencies may be avoided or suppressed provided that at least 15 hopping channels are used.

5.2.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
60-Hz-Converter	AEG / DAMK4/DAGK4	0001	n/a	n/a
2 W Attenuator 10 dB	Weinschel / 54A-10	1745	2016-06	2018-06
Notebook	Samsung / P560	3195	n/a	n/a
Spectrum Analyzer	Rohde & Schwarz / FSU50	3831	2017-09	2018-09
Digital Multimeter	Agilent / U1241B	3880	2016-05	2018-05
Web-Thermo-Hygrobarograph	W&T / 57613 Web-T/Rh/P	4717	2016-04	2018-04
RF cable assembly	Rosenberger / LA1-008-1000	5611	2017-10	2018-10

5.2.3 Test Procedures

DA 00-705, Number of Hopping Frequencies
The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = the frequency band of operation
RBW ≥ 1% of the span
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

Allow the trace to stabilize. It may prove necessary to break the span up to sections, in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

5.2.4 Test Results

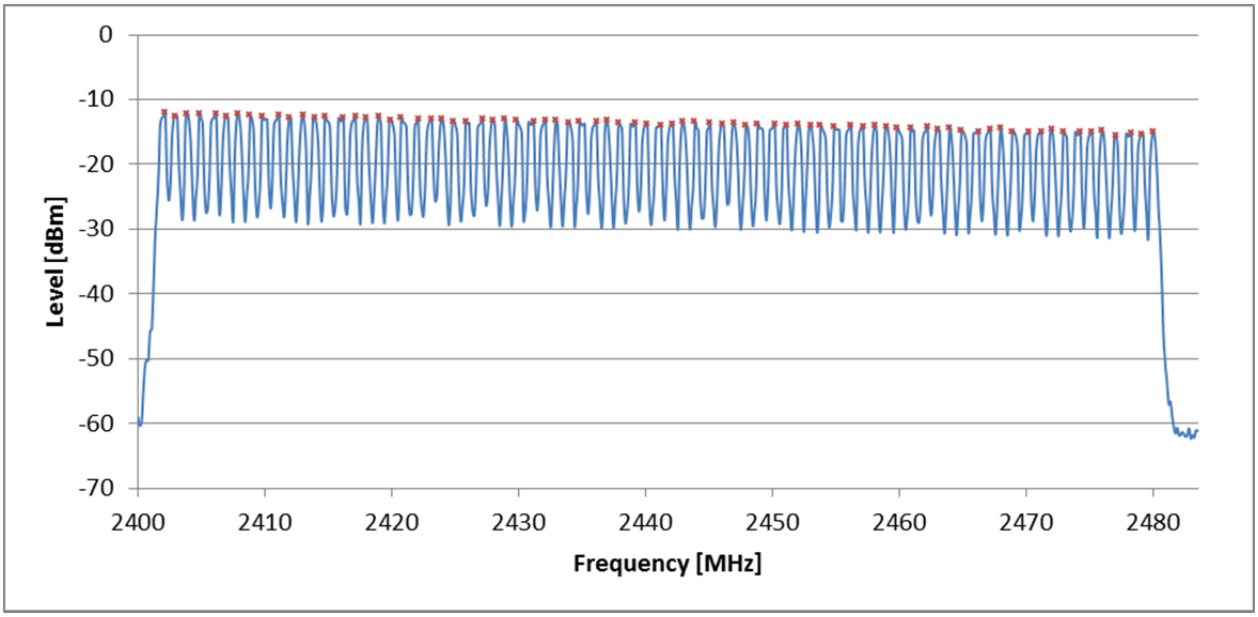
Number of Hopping Frequencies		
Mode	**Result**	**Limit**
DH5	79	≥ 15
2-DH5	79	≥ 15
3-DH5	79	≥ 15

Manufacturer:	SAVOX Communications Oy Ab
Device:	Promate BT COM
Serial No:	#2
Mode:	Continuous Hopping
Test date:	2017-10-18
Test Personnel:	P. Reusch

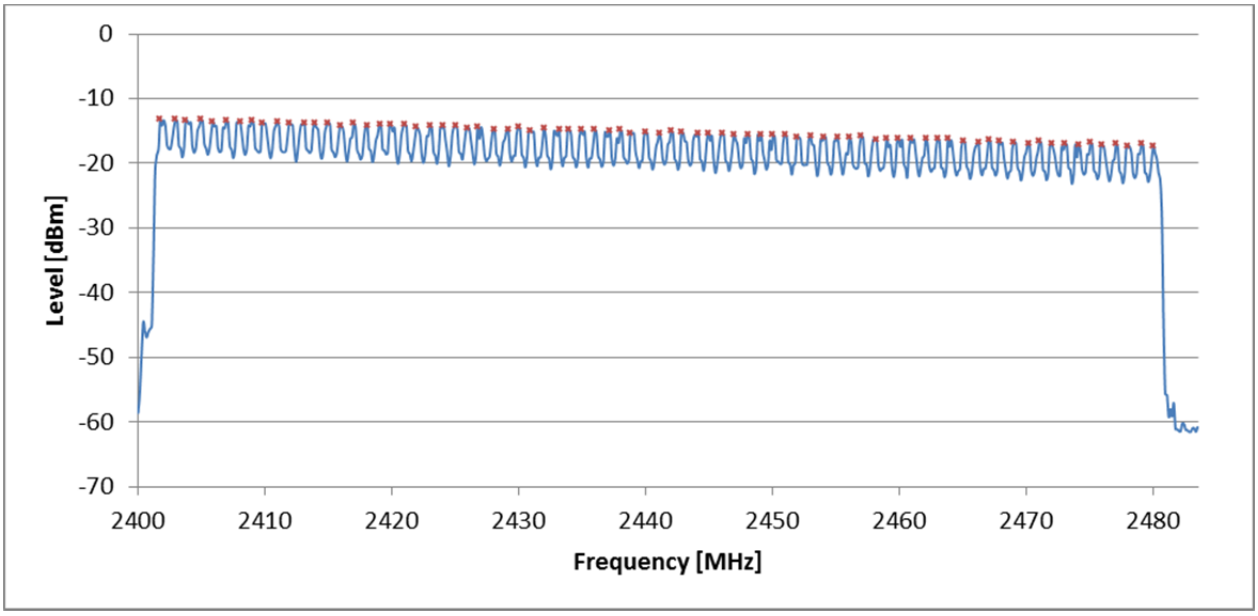
The EUT meets the requirements of this section.

5.2.5 Detailed Measurement Data

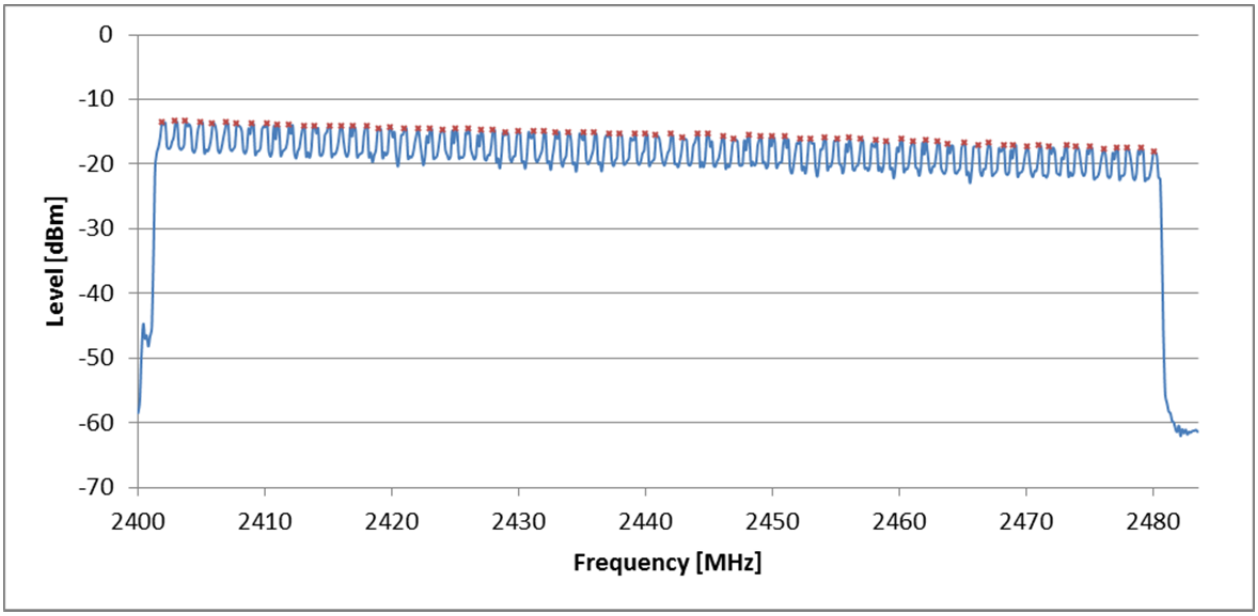
Number of Hopping Frequencies
Mode: DH5



Number of Hopping Frequencies
Mode: 2-DH5



Number of Hopping Frequencies
Mode: 3-DH5



5.3 Time Of Occupancy (Dwell Time)

Test Requirement: 47 CFR, § 15.247(a)
RSS-247, 5.1
Test Procedure: DA 00-705

5.3.1 Regulation

§15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
(a) (1) (iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

RSS-247, 5.1 Frequency hopping systems (FHS)
(d) FHSs operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds, multiplied by the number of hopping channels employed. Transmissions on particular hopping frequencies may be avoided or suppressed provided that at least 15 hopping channels are used.

5.3.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
60-Hz-Converter	AEG / DAMK4/DAGK4	0001	n/a	n/a
2 W Attenuator 10 dB	Weinschel / 54A-10	1745	2016-06	2018-06
Notebook	Samsung / P560	3195	n/a	n/a
Spectrum Analyzer	Rohde & Schwarz / FSU50	3831	2017-09	2018-09
Digital Multimeter	Agilent / U1241B	3880	2016-05	2018-05
Web-Thermo-Hygrobarograph	W&T / 57613 Web-T/Rh/P	4717	2016-04	2018-04
RF cable assembly	Rosenberger / LA1-008-1000	5611	2017-10	2018-10

5.3.3 Test Procedures

DA 00-705, Time of Occupancy (Dwell Time)

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = zero span, centered on a hopping channel
RBW = 1 MHz
VBW ≥ RBW
Sweep = as necessary to capture the entire dwell time per hopping channel
Detector function = peak
Trace = max hold

If possible, use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s). An oscilloscope may be used instead of a spectrum analyzer.

5.3.4 Calculation

The average time of occupancy within a period of 0.4 seconds multiplied by the number of hopping channels can be calculated by the following equation, which is defined by Bluetooth standard:

$$T = \frac{1600\frac{1}{s}}{79 \cdot N} \cdot x \cdot 0.4s \cdot 79 = \frac{1600\frac{1}{s}}{79 \cdot N} \cdot x \cdot 31.6s$$

where

T = Dwell Time in s
N = Index used time slots
with N = 2 for DH1
N = 4 for DH3
N = 6 for DH5
x = slot time in s
1600 = quantity of hops per second
79 = Number of channels

The typical Bluetooth system operating at DH1 has a time slot of up to 625 µs. The index N is 2 for DH1 and the number of hopping channels is 79.
For example the measured time slot (x) is 530 µs resulting with the above mentioned formula in a total dwell time of 170 ms.

5.3.5 Test Results

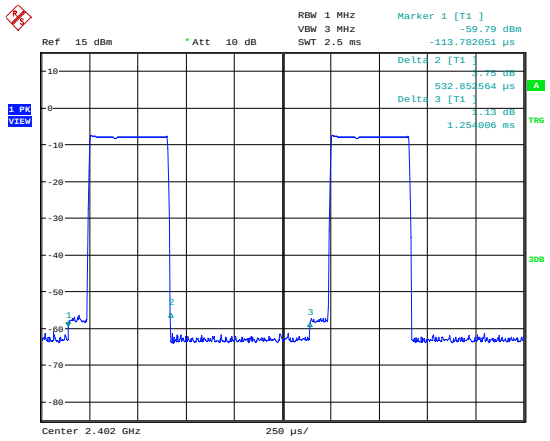
Time of Occupancy				
Mode	**Index "N"**	**Slot Time "x" [ms]**	**Dwell Time [ms]**	**Dwell Time Limit [ms]**
DH1	2	0.53	169.6	400
DH3	4	1.78	284.8	400
DH5	6	3.05	325.3	400
2-DH1	2	0.54	172.8	400
2-DH3	4	1.79	286.4	400
2-DH5	6	3.05	325.3	400
3-DH1	2	0.54	172.8	400
3-DH3	4	1.79	286.4	400
3-DH5	6	3.05	325.3	400

Manufacturer: SAVOX Communications Oy Ab
Device: Promate BT COM
Serial No: #2
Mode: Continuous Transmission
Test date: 2017-10-18
Test Personnel: P. Reusch

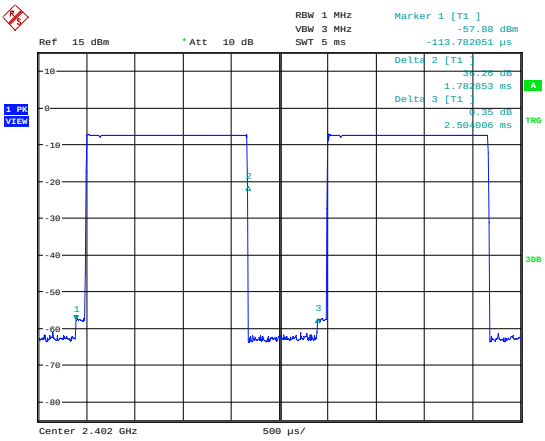
The EUT meets the requirements of this section.

5.3.6 Detailed Measurement Data

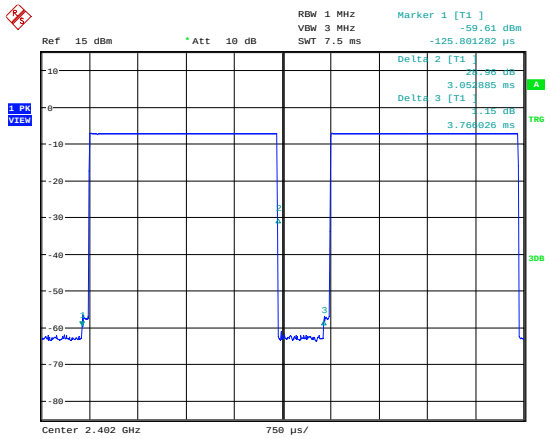
Time of Occupancy
Mode: DH1
Channel: low



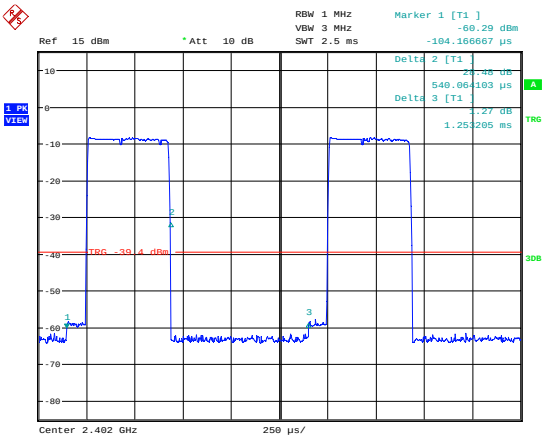
Time of Occupancy
Mode: DH3
Channel: low



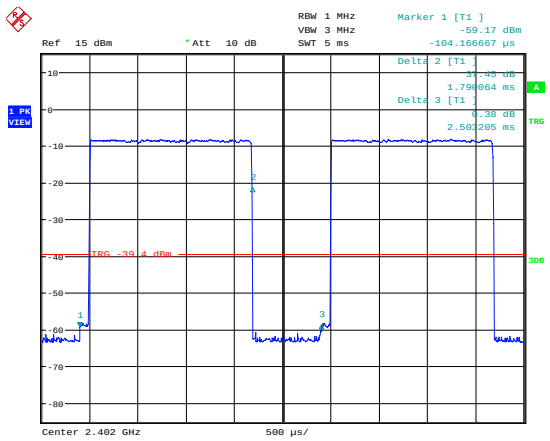
Time of Occupancy
Mode: DH5
Channel: low



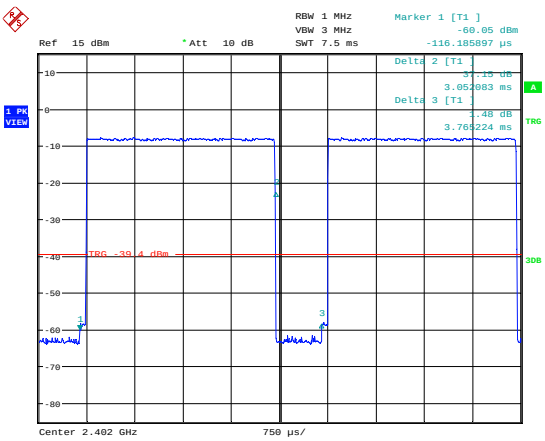
Time of Occupancy
Mode: 2-DH1
Channel: low



Time of Occupancy
Mode: 2-DH3
Channel: low

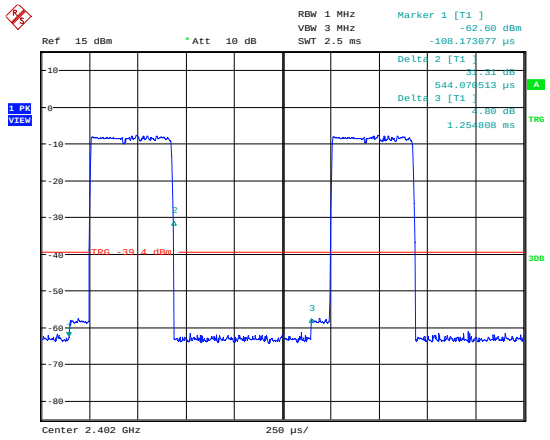


Time of Occupancy
Mode: 2-DH5
Channel: low

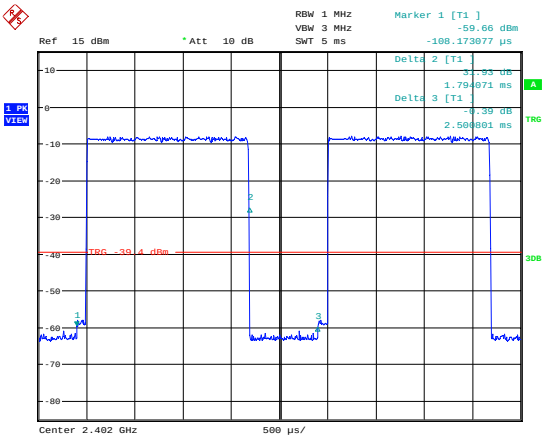


Test of SAVOX Communications Oy Ab Bluetooth Headset type Promate BT COM
to 47 CFR § 15.247 and RSS-247 Issue 2

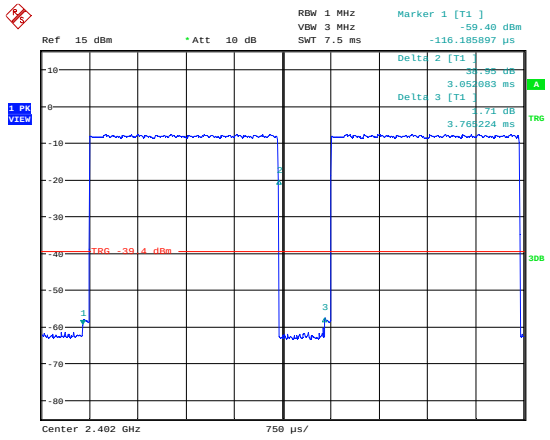
Time of Occupancy
Mode: 3-DH1
Channel: low



Time of Occupancy
Mode: 3-DH3
Channel: low



Time of Occupancy
Mode: 3-DH5
Channel: low



5.4 20 dB Bandwidth

Test Requirement: 47 CFR, § 15.247(a)
RSS-247, 5.1
Test Procedure: DA 00-705

5.4.1 Regulation

§15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
(a) (1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

RSS-247, 5.1 Frequency hopping systems (FHS)
The bandwidth of a frequency hopping channel is the 20 dB emission bandwidth, measured with the hopping stopped. The system's radio frequency (RF) bandwidth is equal to the channel bandwidth multiplied by the number of channels in the hopset. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

5.4.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
60-Hz-Converter	AEG / DAMK4/DAGK4	0001	n/a	n/a
2 W Attenuator 10 dB	Weinschel / 54A-10	1745	2016-06	2018-06
Notebook	Samsung / P560	3195	n/a	n/a
Spectrum Analyzer	Rohde & Schwarz / FSU50	3831	2017-09	2018-09
Digital Multimeter	Agilent / U1241B	3880	2016-05	2018-05
Web-Thermo-Hygrobarograph	W&T / 57613 Web-T/Rh/P	4717	2016-04	2018-04
RF cable assembly	Rosenberger / LA1-008-1000	5611	2017-10	2018-10

5.4.3 Test Procedures

DA 000-705, 20 dB Bandwidth
Use the following spectrum analyzer settings:

Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel
RBW ≥ 1% of the 20 dB bandwidth
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

The EUT should be transmitting at its maximum data rate. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 20 dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

5.4.4 Test Results

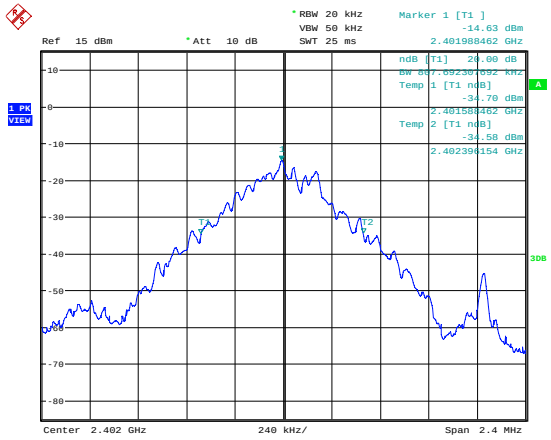
20 dB Bandwidth						
Mode	**Operating Channel**	**Nominal Tx Frequency [MHz]**	**Lower Edge [MHz]**	**Upper Edge [MHz]**	**20 dB Bandwidth [MHz]**	**Limit [MHz]**
DH5	1	2402	2401.588	2402.396	0.808	n/a
	40	2441	2440.588	2441.396	0.808	n/a
	79	2480	2479.588	2480.396	0.808	n/a
2-DH5	1	2402	2401.389	2402.601	1.212	n/a
	40	2441	2440.385	2441.596	1.212	n/a
	79	2480	2479.385	2480.582	1.197	n/a
3-DH5	1	2402	2401.399	2402.606	1.207	n/a
	40	2441	2440.399	2441.601	1.202	n/a
	79	2480	2479.399	2480.601	1.202	n/a

Manufacturer: SAVOX Communications Oy Ab
Device: Promate BT COM
Serial No: #2
Mode: Continuous Transmission
Test date: 2017-10-18
Test Personnel: P. Reusch

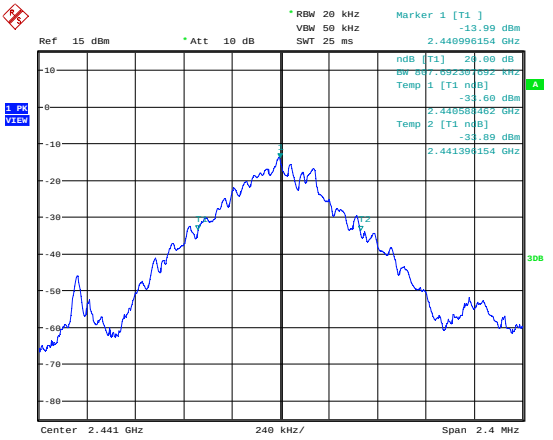
The EUT meets the requirements of this section.

5.4.5 Detailed Measurement Data

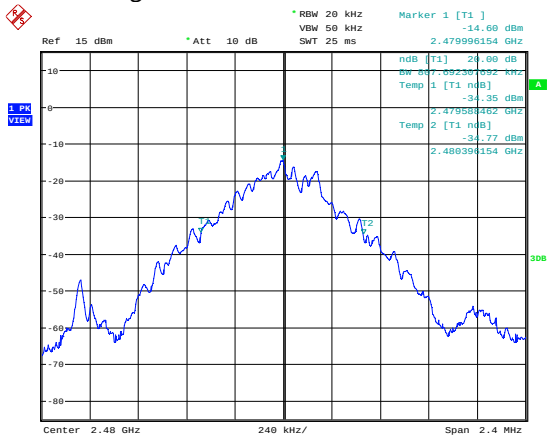
20 dB Bandwidth
Mode: DH5
Channel: low



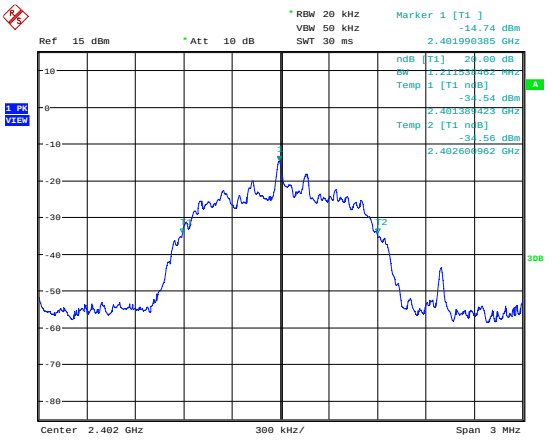
20 dB Bandwidth
Mode: DH5
Channel: middle



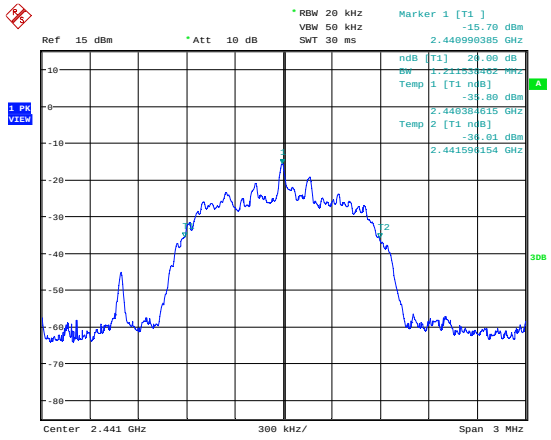
20 dB Bandwidth
Mode: DH5
Channel: high



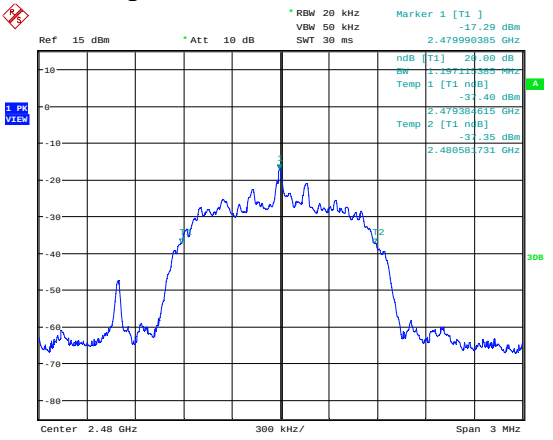
20 dB Bandwidth
Mode: 2-DH5
Channel: low



20 dB Bandwidth
Mode: 2-DH5
Channel: middle

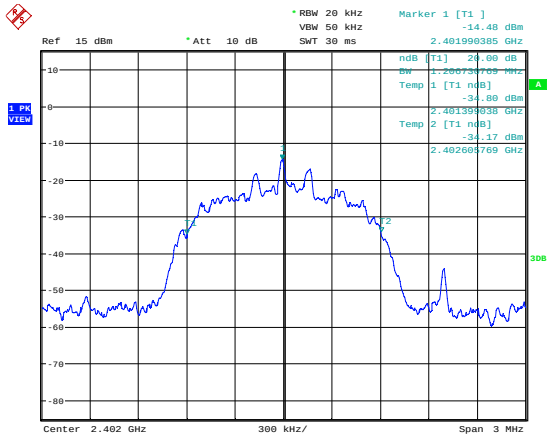


20 dB Bandwidth
Mode: 2-DH5
Channel: high

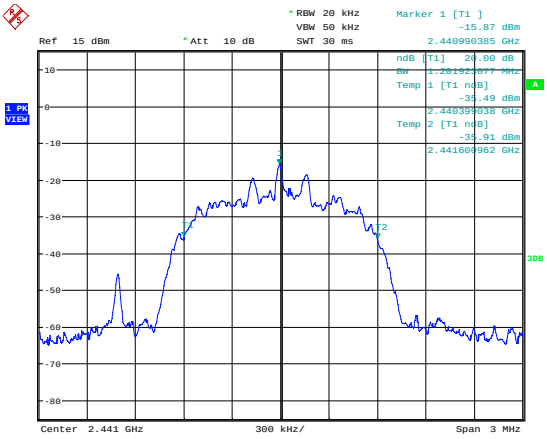


Test of SAVOX Communications Oy Ab Bluetooth Headset type Promate BT COM
to 47 CFR § 15.247 and RSS-247 Issue 2

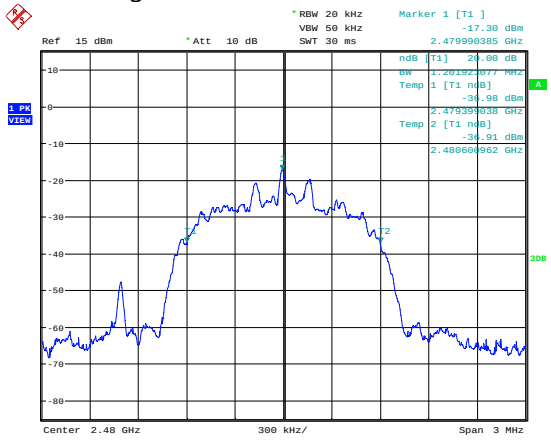
20 dB Bandwidth
Mode: 3-DH5
Channel: low



20 dB Bandwidth
Mode: 3-DH5
Channel: middle



20 dB Bandwidth
Mode: 3-DH5
Channel: high



5.5 Peak Output power

Test Requirement: 47 CFR, § 15.247(b)
RSS-247, 5.4
Test Procedure: DA 000-705

5.5.1 Regulation

§15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:
(1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

RSS-247, 5.4 Transmitter output power and equivalent isotropically radiated power (e.i.r.p.) requirements
(b) For FHSs operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W if the hopset uses less than 75 hopping channels. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

5.5.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
60-Hz-Converter	AEG / DAMK4/DAGK4	0001	n/a	n/a
2 W Attenuator 10 dB	Weinschel / 54A-10	1745	2016-06	2018-06
Notebook	Samsung / P560	3195	n/a	n/a
Spectrum Analyzer	Rohde & Schwarz / FSU50	3831	2017-09	2018-09
Digital Multimeter	Agilent / U1241B	3880	2016-05	2018-05
Web-Thermo-Hygrobarograph	W&T / 57613 Web-T/Rh/P	4717	2016-04	2018-04
RF cable assembly	Rosenberger / LA1-008-1000	5611	2017-10	2018-10

5.5.3 Test Procedures

DA 000-705, Peak Output Power
Use the following spectrum analyzer settings:

Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel
RBW > the 20 dB bandwidth of the emission being measured
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power (see the NOTE above regarding external attenuation and cable loss). The limit is specified in one of the subparagraphs of this Section. Submit this plot. A peak responding power meter may be used instead of a spectrum analyzer.

5.5.4 Test Result

Peak Output Power						
Mode	**Operating Channel**	**Nominal Tx Frequency [MHz]**	**Reading [dBm]**	**Correction Factor [dB]**	**Result [dBm]**	**Limit * [dBm]**
DH5	1	2402	-6.8	10.8	4.0	30
	40	2441	-8.1	10.8	2.7	30
	79	2480	-9.0	10.8	1.8	30
2-DH5	1	2402	-9.7	10.8	1.1	30
	40	2441	-10.1	10.8	0.7	30
	79	2480	-10.9	10.8	-0.1	30
3-DH5	1	2402	-7.9	10.8	2.9	30
	40	2441	-8.8	10.8	2.0	30
	79	2480	-10.0	10.8	0.8	30

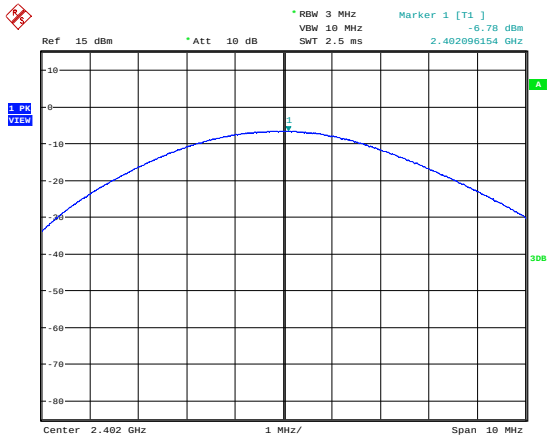
* Note: limit is 1 Watt (30 dBm), if there are at least 75 channels in use. According to chapter “Number of Hopping Frequencies”, there are 79 channels in use. Therefore, this criterion is met.

Manufacturer:	SAVOX Communications Oy Ab
Device:	Promate BT COM
Serial No:	#2
Mode:	Continuous Transmission
Test date:	2017-10-18
Test Personnel:	P. Reusch

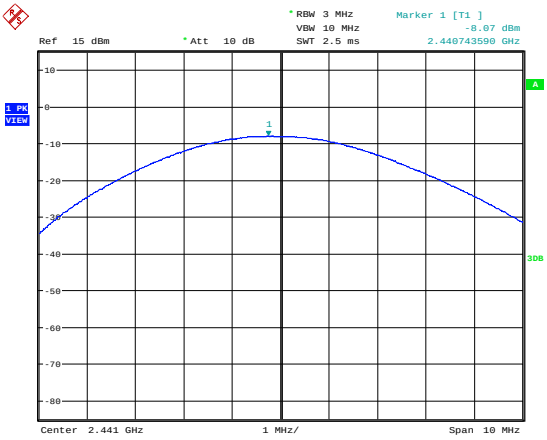
The EUT meets the requirements of this section.

5.5.5 Detailed Measurement Data

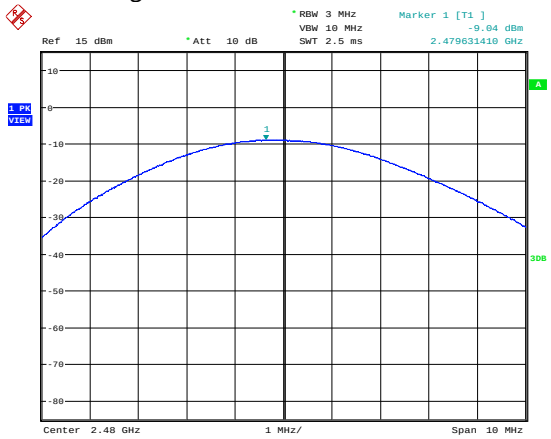
Peak Output Power
Mode: DH5
Channel: low



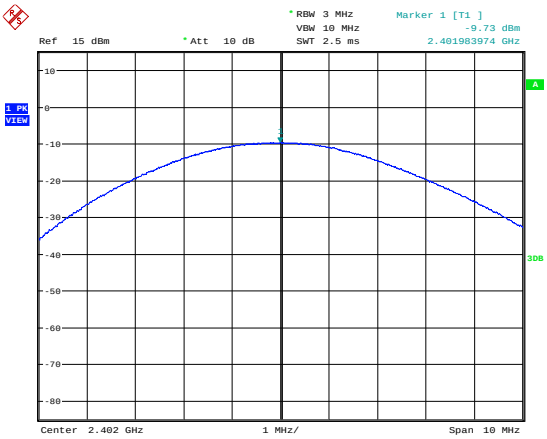
Peak Output Power
Mode: DH5
Channel: middle



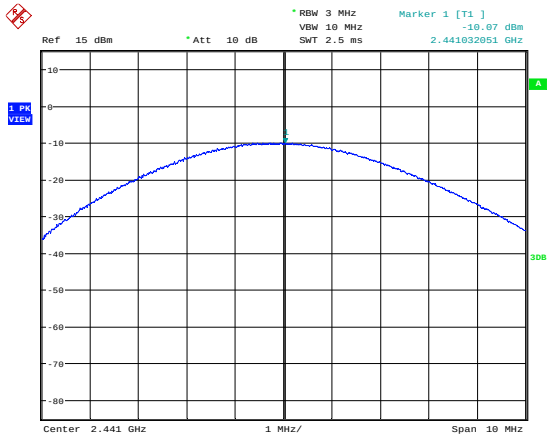
Peak Output Power
Mode: DH5
Channel: high



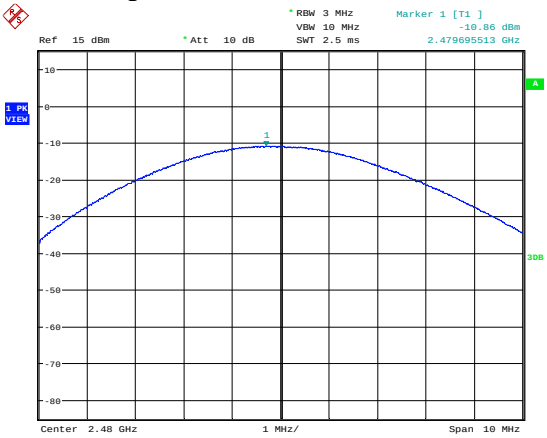
Peak Output Power
Mode: 2-DH5
Channel: low



Peak Output Power
Mode: 2-DH5
Channel: middle

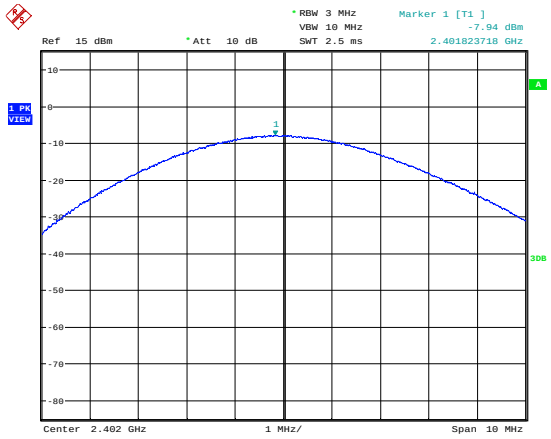


Peak Output Power
Mode: 2-DH5
Channel: high

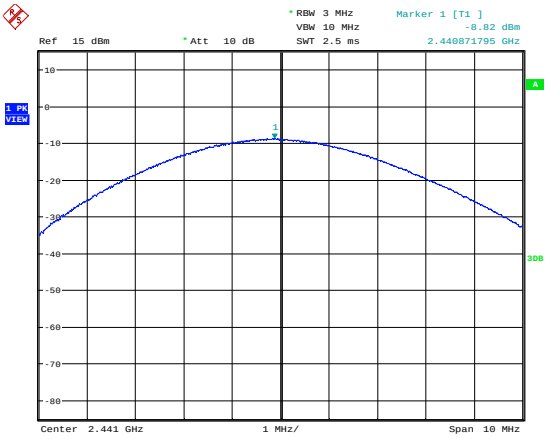


Test of SAVOX Communications Oy Ab Bluetooth Headset type Promate BT COM
to 47 CFR § 15.247 and RSS-247 Issue 2

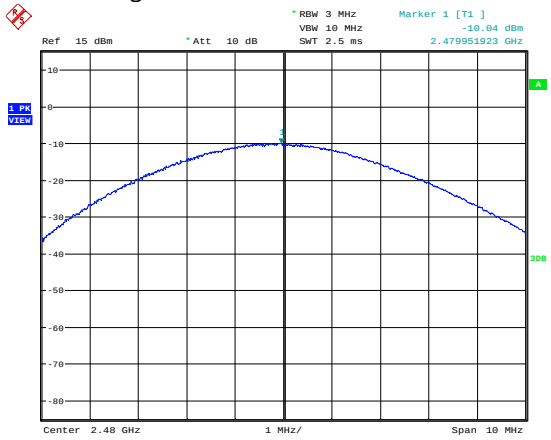
Peak Output Power
Mode: 3-DH5
Channel: low



Peak Output Power
Mode: 3-DH5
Channel: middle



Peak Output Power
Mode: 3-DH5
Channel: high



5.6 Band-Edge Compliance

Test Requirement: 47 CFR, § 15.247(d)
RSS-247, 5.5
Test Procedure: DA 000-705

5.6.1 Regulation

§15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. 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)).

§15.209 Radiated emission limits; general requirements
(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency	Field Strength		Measurement distance
[MHz]	[µV/m]	[dB(µV/m)]	[m]
30-88	100**	40	3
88-216	150**	43.5	3
216-960	200**	46.0	3
Above 960	500	54	3

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

(b) In the emission table above, the tighter limit applies at the band-edges.
(c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other sections within this part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
(d) The emission limits shown in the above table are based on measurements employing a CISPR quasi peak detector except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.
(e) The provisions in §§ 15.31, 15.33, and 15.35 for measuring emissions at distances other than the distances specified in the above table, determining the frequency range over which radiated emissions are to be measured, and limiting peak emissions apply to all devices operated under this part.

RSS-247, 5.5 Unwanted emissions
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

RSS-Gen, 8.9 Transmitter Emission Limits for Licence-Exempt Radio Apparatus
Except when the requirements applicable to a given device state otherwise, emissions from licence-exempt transmitters shall comply with the field strength limits shown in Table 4 and Table 5 below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

Table 4 – General Field Strength Limits for Licence-Exempt Transmitters at Frequencies Above 30 MHz	
Frequency (MHz)	Field Strength (µv/m at 3 metres
30-88	100
88-216	150
216-960	200
Above 960	500

Footnote
Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for licence-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.

Note: Transmitting devices are not permitted in restricted frequency bands unless stated otherwise in the specific RSS.

5.6.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
60-Hz-Converter	AEG / DAMK4/DAGK4	0001	n/a	n/a
2 W Attenuator 10 dB	Weinschel / 54A-10	1745	2016-06	2018-06
Notebook	Samsung / P560	3195	n/a	n/a
Spectrum Analyzer	Rohde & Schwarz / FSU50	3831	2017-09	2018-09
Digital Multimeter	Agilent / U1241B	3880	2016-05	2018-05
Web-Thermo-Hygrobarograph	W&T / 57613 Web-T/Rh/P	4717	2016-04	2018-04
RF cable assembly	Rosenberger / LA1-008-1000	5611	2017-10	2018-10

5.6.3 Test Procedures

DA 000-705, Band-edge Compliance of RF Conducted Emissions
Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation

RBW ≥ 1% of the span
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

Allow the trace to stabilize. Set the marker on the emission at the bandedge, or on the highest modulation product outside of the band, if this level is greater than that at the bandedge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission. The marker-delta value now displayed must comply with the limit specified in this Section. Submit this plot.

Now, using the same instrument settings, enable the hopping function of the EUT. Allow the trace to stabilize. Follow the same procedure listed above to determine if any spurious emissions caused by the hopping function also comply with the specified limit. Submit this plot.

5.6.4 Test Result

Band-edge Emissions – Lower Edge					
Mode	**Freq. [MHz]**	**Reading of Fundamental Emission [dBm]**	**Reading of Bandedge Emission [dBm]**	**Attenuation [dB]**	**Limit [dB]**
DH5, Ch. low	2400	-7.7	-53.6	45.9	20
DH5, hopping	2400	-7.6	-60.0	52.4	20
2-DH5, Ch. low	2400	-10.8	-55.6	44.8	20
2-DH5, hopping	2400	-10.7	-54.7	44.0	20
3-DH5, Ch. low	2400	-9.4	-58.7	49.3	20
3-DH5, hopping	2400	-9.3	-55.8	46.5	20

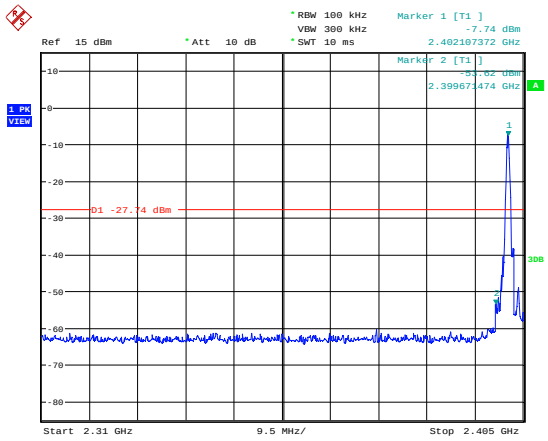
Note: Measurement performed at lower Bandedge, only, due to the upper Bandedge being adjacent to a restricted band which has to be treated differently.

Manufacturer:	SAVOX Communications Oy Ab
Device:	Promate BT COM
Serial No:	#2
Mode:	Continuous Transmission Continuous Hopping
Test date:	2017-10-18
Test Personnel:	P. Reusch

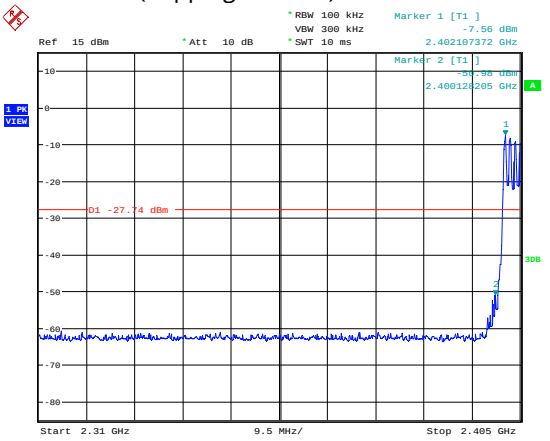
The EUT meets the requirements of this section.

5.6.5 Detailed Measurement Data

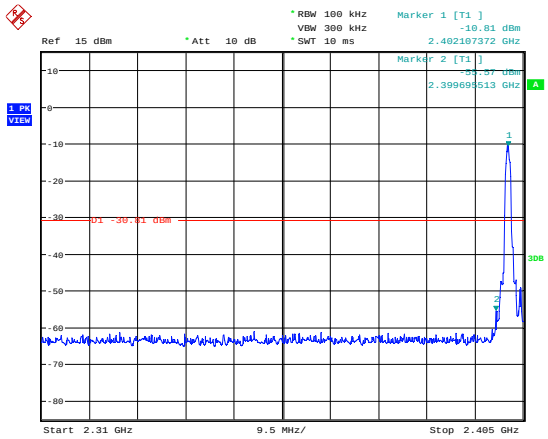
Band-Edge Compliance – Lower Edge
Mode: DH5
Channel: low



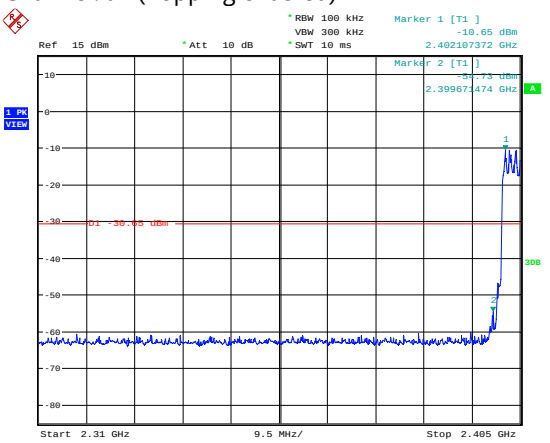
Band-Edge Compliance – Lower Edge
Mode: DH5
Channel: all (hopping enabled)



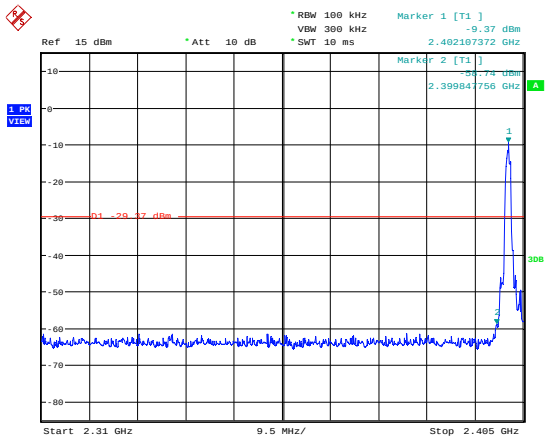
Band-Edge Compliance – Lower Edge
Mode: 2-DH5
Channel: low



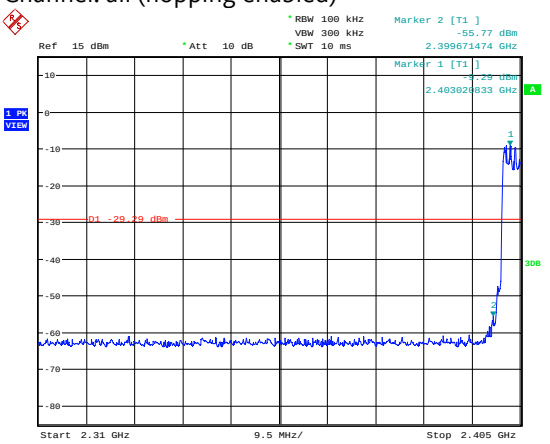
Band-Edge Compliance – Lower Edge
Mode: 2-DH5
Channel: all (hopping enabled)



Band-Edge Compliance – Lower Edge
Mode: 3-DH5
Channel: low



Band-Edge Compliance – Lower Edge
Mode: 3-DH5
Channel: all (hopping enabled)



5.7 Emissions In Restricted Bands

Test Requirement: 47 CFR, 47 CFR, § 15.247(d)
RSS-247, 5.5
Test Procedure: DA 000-705

5.7.1 Regulation

§15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. 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)).

§15.209 Radiated emission limits; general requirements
(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency	Field Strength		Measurement distance
[MHz]	[µV/m]	[dB(µV/m)]	[m]
30-88	100**	40	3
88-216	150**	43.5	3
216-960	200**	46.0	3
Above 960	500	54	3

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

(b) In the emission table above, the tighter limit applies at the band-edges.
(c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other sections within this part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
(d) The emission limits shown in the above table are based on measurements employing a CISPR quasi peak detector except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.
(e) The provisions in §§ 15.31, 15.33, and 15.35 for measuring emissions at distances other than the distances specified in the above table, determining the frequency range over which radiated emissions are to be measured, and limiting peak emissions apply to all devices operated under this part.

§15.205 Restricted bands of operation.
(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
[1]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	([2])
13.36-13.41			

[1]Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.
[2]Above 38.6

RSS-247, 5.5 Unwanted emissions
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

RSS-Gen, 8.9 Transmitter Emission Limits for Licence-Exempt Radio Apparatus
Except when the requirements applicable to a given device state otherwise, emissions from licence-exempt transmitters shall comply with the field strength limits shown in Table 4 and Table 5 below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

Table 4 – General Field Strength Limits for Licence-Exempt Transmitters at Frequencies Above 30 MHz	
Frequency (MHz)	Field Strength (µv/m at 3 metres
30-88	100
88-216	150
216-960	200
Above 960	500

Footnote
Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for licence-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.

Note: Transmitting devices are not permitted in restricted frequency bands unless stated otherwise in the specific RSS.

RSS-Gen, 8.10 Restricted Frequency Bands

Restricted bands, identified in Table 6, are designated primarily for safety-of-life services (distress calling and certain aeronautical bands), certain satellite downlinks, radio astronomy and some government uses. Except where otherwise indicated, the following restrictions apply:

a) Fundamental components of modulation of licence-exempt radio apparatus shall not fall within the restricted bands of Table 6 except for apparatus complying under RSS-287;
b) Unwanted emissions that fall into restricted bands of Table 6 shall comply with the limits specified in RSS-Gen; and
c) Unwanted emissions that do not fall within the restricted frequency bands of Table 6 shall comply either with the limits specified in the applicable RSS or with those specified in this RSS-Gen.

Table 6 — Restricted Frequency Bands		
MHz	MHz	GHz
0.090-0.110	240-285	9.0-9.2
2.1735-2.1905	322-335.4	9.3-9.5
3.020-3.026	399.9-410	10.6-12.7
4.125-4.128	608-614	13.25-13.4
4.17725-4.17775	960-1427	14.47-14.5
4.20725-4.20775	1435-1626.5	15.35-16.2
5.677-5.683	1645.5-1646.5	17.7-21.4
6.215-6.218	1660-1710	22.01-23.12
6.26775-6.26825	1718.8-1722.2	23.6-24.0
6.31175-6.31225	2200-2300	31.2-31.8
8.291-8.294	2310-2390	36.43-36.5
8.362-8.366	2655-2900	Above 38.6
8.37625-8.38675	3260-3267	
8.41425-8.41475	3332-3339	
12.29-12.293	3345.8-3358	
12.51975-12.52025	3500-4400	
12.57675-12.57725	4500-5150	
13.36-13.41	5350-5460	
16.42-16.423	7250-7750	
16.69475-16.69525	8025-8500	
16.80425-16.80475		
25.5-25.67		
37.5-38.25		
73-74.6		
74.8-75.2		
108-138		
156.52475-156.52525		
156.7-156.9		
16.80425-16.80475		
25.5-25.67		
37.5-38.25		
73-74.6		
74.8-75.2		
108-138		
156.52475-156.52525		
156.7-156.9		

5.7.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
60-Hz-Converter	AEG / DAMK4/DAGK4	0001	n/a	n/a
Anechoic Room SAC, SR-ULL-01	EMCC/FRANK. / SAC-10	1889	n/a	n/a
Digital Multimeter	Agilent / U1241A	2720	2017-03	2019-03
Notebook	Samsung / P560	3195	n/a	n/a
Double Ridged Guide Antenna	Schwarzbeck / BBHA 9120D	3235	2017-05	2019-05
Spectrum Analyzer	Rohde & Schwarz / FSU50	3831	2017-09	2018-09
Web-Thermo-Hygrobarograph	W&T / 57613 Web-T/Rh/P	4717	2016-04	2018-04
Band Reject Filter	ZYSEN / ZSBR2441.75-83.5U10CS	4993	2017-04	2019-04
EMC Measurement Software	Rohde & Schwarz / EMC32	5392	n/a	n/a
Rotary table	Rohde&Schwarz / HCT12	5536	n/a	n/a
Antenna Mast	innco systems GmbH / MA 5000-XPET	5544	n/a	n/a
RF cable assembly	Rosenberger / LA2-025-7000	5616	2017-09	2018-09

5.7.3 Test Procedures

DA 000-705, Spurious Radiated Emissions

This test is required for any spurious emission or modulation product that falls in a Restricted Band, as defined in Section 15.205. It must be performed with the highest gain of each type of antenna proposed for use with the EUT. Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured
RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

Follow the guidelines in ANSI C63.4-1992 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization, etc. A pre-amp and a high pass filter are required for this test, in order to provide the measuring system with sufficient sensitivity. Allow the trace to stabilize. The peak reading of the emission, after being corrected by the antenna factor, cable loss, pre-amp gain, etc., is the peak field strength, which must comply with the limit specified in Section 15.35(b). Submit this data.

Now set the VBW to 10 Hz, while maintaining all of the other instrument settings. This peak level, once corrected, must comply with the limit specified in Section 15.209. If the dwell time per channel of the hopping signal is less than 100 ms, then the reading obtained with the 10 Hz VBW may be further adjusted by a “duty cycle correction factor”, derived from 20log(dwell time/100 ms), in an effort to demonstrate compliance with the 15.209 limit. Submit this data.

If the emission on which a radiated measurement must be made is located at the edge of the authorized band of operation, then the alternative “marker-delta” method, listed at the end of this document, may be employed.

5.7.4 Calculation of Field Strength Limits

E.g. radiated spurious emissions field strength limits acc. to §15.209 for frequencies above 960 MHz:

500 µV/m at 3 meters

Using the equation:

$E_{dB\mu V/m} = 20 * \log (E_{\mu V/m})$

where

$E_{dB\mu V/m}$ = Field Strength in logarithmic units (dBµV/m)

$E_{\mu V/m}$ = Field Strength in linear units (µV/m)

A field strength limit of 500 µV/m corresponds with 54 dBµV/m.

5.7.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF
where
FS = Field Strength in dBµV/m
RA = Receiver Amplitude in dBµV
AF = Antenna Factor in dB(1/m)
CF = Cable Attenuation Factor in dB

Assume a receiver reading of 19.4 dBµV is obtained. The Antenna Factor of 27.6 dB(1/m) and a Cable Factor of 1.6 dB are added, giving a field strength of 48.6 dBµV/m. The 48.6 dBµV/m value can be mathematically converted to its corresponding level in µV/m.

FS = 19.4 + 27.6 + 1.6 = 48.6 [dBµV/m]
Level in µV/m = Common Antilogarithm (48.6/20) = 269

All emission measurements described in this chapter performed using the EMI receiver's transducer factor setting capability, i.e. the peak field strength value at the test distance was measured directly without the necessity of additional correction factors.

For average measurements, the measured peak field strength is corrected additionally by a Duty Cycle correction factor DCF. Please refer to chapter 2.6 for details.

FS_{AV} = FS + DCF
where
FS_{AV} = Average Field Strength in dBµV/m
FS = Peak Field Strength in dBµV/m
DCF = Correction Factor in dB

Assuming a peak field strength of 48.6 dBµV/m, the value for the average field strength with a Duty Cycle correction factor DCF of -10.5 dB corresponds with 38.1 dBµV/m.

5.7.6 Test Result

Emissions in Restricted Bands – Band: 2310 – 2390 MHz					
Mode	**Freq. [MHz]**	**Detector**	**Result [dBµV/m]**	**Limit [dBµV/m]**	**Margin [dB]**
DH5	2376.0	PK	48.9	74	25.1
DH5	2376.0	AV	44.6	54	9.4

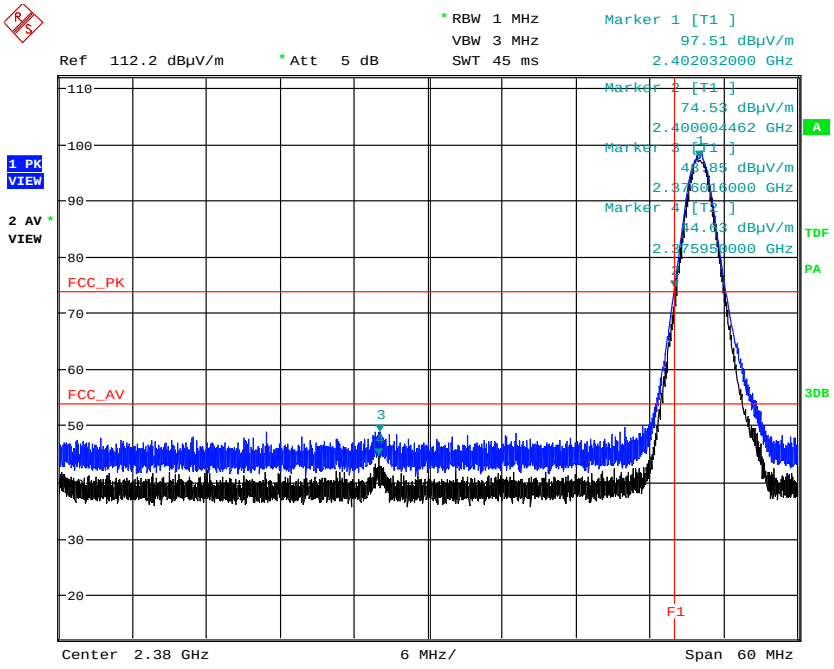
Emissions in Restricted Bands – Band: 2483.5 – 2500 MHz					
Mode	**Freq. [MHz]**	**Detector**	**Result [dBµV/m]**	**Limit [dBµV/m]**	**Margin [dB]**
DH5	2483.5	PK	56.5	74	17.5
DH5	2483.5	AV	51.4	54	2.6
DH5	2506.0	AV	44.4	54	9.6

Manufacturer: SAVOX Communications Oy Ab
Device: Promate BT COM
Serial No: #1
Mode: Continuous Transmission
Test date: 2017-10-26
Test Personnel: L. Kraft

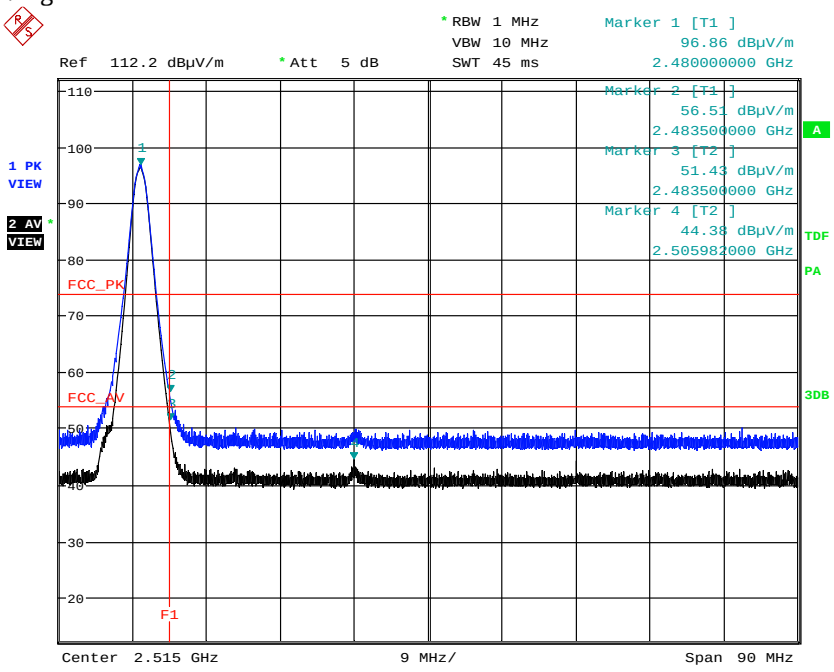
The EUT meets the requirements of this section.

5.7.7 Detailed Measurement Data

Radiated Measurement
Restricted Band Compliance – 2310 - 2390 MHz
Mode: Channel: low



Radiated Measurement
Restricted Band Compliance – 2483.5 - 2500 MHz
Mode: Channel: high



5.8 Radiated Emissions 9 kHz - 30 MHz

Test requirement: 47 CFR, §§ 15.247, 15.209
RSS-247, 5.5; RSS-Gen, 8.9
Test procedure: ANSI C63.10

5.8.1 Regulation

§15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. 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)).

§15.209 Radiated emission limits; general requirements
(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency	Field Strength		Measurement distance
[MHz]	[µV/m]	[dB(µV/m)]	[m]
0.009–0.490	2400/F[kHz]	67.6 – 20 logF[kHz]	300
0.490–1.705	24000/F[kHz]	87.6 – 20 logF[kHz]	30
1.705–30.0	30	29.5	30

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

(b) In the emission table above, the tighter limit applies at the band-edges.
(c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other sections within this part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
(d) The emission limits shown in the above table are based on measurements employing a CISPR quasi peak detector except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.
(e) The provisions in §§ 15.31, 15.33, and 15.35 for measuring emissions at distances other than the distances specified in the above table, determining the frequency range over which radiated emissions are to be measured, and limiting peak emissions apply to all devices operated under this part.

RSS-247, 5.5 Unwanted emissions

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

RSS-Gen, 8.9 Transmitter Emission Limits for Licence-Exempt Radio Apparatus

Except when the requirements applicable to a given device state otherwise, emissions from licence-exempt transmitters shall comply with the field strength limits shown in Table 4 and Table 5 below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

Table 4 – General Field Strength Limits for Licence-Exempt Transmitters at Frequencies Above 30 MHz	
Frequency (MHz)	Field Strength (µv/m) at 3 metres
30-88	100
88-216	150
216-960	200
Above 960	500

Footnote
Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for licence-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.

Note: Transmitting devices are not permitted in restricted frequency bands unless stated otherwise in the specific RSS.

Table 5 – General Field Strength Limits for Licence-Exempt Transmitters at Frequencies Below 30 MHz			
Frequency	Electric Field Strength (µV/m)	Magnetic Field Strength (H-Field) (µA/m)	Measurement Distance (metres)
9-490 kHz	2,400/F (F in kHz)	2,400/377F (F in kHz)	300
490-1,705 kHz	24,000/F (F in kHz)	24,000/377F (F in kHz)	30
1,705-30 MHz	30	N/A	30

Note: The emission limits for the bands 9-90 kHz and 110-490 kHz are based on measurements employing a linear average detector. Transmitting devices are not permitted in restricted frequency bands unless stated otherwise in the relevant RSS.

5.8.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
60-Hz-Converter	AEG / DAMK4/DAGK4	0001	n/a	n/a
Loop Antenna	R&S / HFH 2-Z2	374	2016-07	2018-07
Anechoic Room SAC	EMCC/FRANK. / SAC-10	1889	n/a	n/a
Digital Multimeter	Agilent / U1241A	2720	2017-03	2019-03
EMI Test Receiver	R&S / ESU8	3846	2017-01	2018-01
Web-Thermo-Hygrobarograph	W&T / 57613 Web-T/Rh/P	4717	2016-04	2018-04
EMI Test Software	R&S / EMC32 v10.00.00	5392	n.a.	n.a.

5.8.3 Test Procedures

ANSI C63.10, 5.3.2 Test distance for frequencies below 30 MHz
Radiated emissions limits are usually defined at a specific distance from the EUT. Where possible, measurements shall be made at the distance specified in the limits. This might not be possible in all cases, however, due to the physical limitations of the test facility, physical access problems at the required distance (especially for measurements that must be made in situ or on-site), or levels of ambient noise or other radiated signals present at the time and location where measurements are made. See 6.4.3 for more information about antenna selection, location, and test distance. If measurements cannot practically be made at the EUT limit distance, then they may be made at a different distance (usually closer) and extrapolated to the limit distance using one of the procedures described in 6.4.4, 6.4.5, or 7.7, depending on the EUT source and size.31 The test report shall specify the extrapolation method used to determine compliance of the EUT.

ANSI C63.10, 6.4.6 Exploratory radiated emission tests
The tests shall be performed in the frequency range specified in 5.5 and 5.6, using the procedures in Clause 5, applying the appropriate modulating signal to the EUT, to determine cable or wire positions of the EUT system that produce the emission with the highest amplitude relative to the limit.
Exploratory measurements below 30 MHz are useful in determining the maximum level of emissions while manipulating and rotating the EUT; however, exploratory and final measurements may be made concurrently, provided care is taken to determine the maximum level of emissions for all configurations and orientations.
The test arrangement, measuring antenna guidelines and operational configurations in 6.3.1 and 6.3.2, shall be followed. The measurement antenna shall be positioned with its plane perpendicular to the ground at the specified distance. When perpendicular to the ground plane, the lowest height of the magnetic antenna shall be 1 m above the ground and shall be positioned at the specified distance from the EUT.50 When the EUT contains a loop antenna that can only be placed in a vertical axis, normal measurements shall be made aligning the measurement antenna along the site axis, and then orthogonal to the axis. For each measurement antenna alignment, the EUT shall be rotated through 0° to 360° on a turntable. When the EUT contains a loop antenna that can be placed in a horizontal or vertical axis, normal measurements shall be made aligning the measurement antenna along the site axis, orthogonal to the axis, and then with the measurement antenna horizontal. For each measurement antenna alignment, the EUT shall be rotated through 0° to 360° on a turntable. The report shall list the six emissions with the smallest margin relative to the limit, for each of the three antenna orientations (parallel, perpendicular, and ground-parallel) unless the margin is greater than 20 dB, then the following statement shall be made: “all emissions were greater than 20 dB below the limit.”

ANSI C63.10, 6.4.7 Final radiated emission tests
Using the orientation and equipment arrangement of the EUT determined in 6.4.6, and applying the appropriate modulating signal to the EUT, perform final radiated emission measurements on the fundamental and highest spurious emissions.
Unless otherwise specified by the regulatory authority, the instrumentation, detector functions, and bandwidths specified in 4.1.4.2.1 shall be used. For pulsed emissions, the procedure in 4.1.4.2.4 shall be used.

Radiated Emissions Test Characteristics	
Frequency range	9 kHz - 30 MHz
Test distance	3 m*
Test instrumentation resolution bandwidth	200 Hz (9 kHz - 150 kHz)
	10 kHz (150 kHz - 30 MHz)
Receive antenna height	1 m
Receive antenna polarization	Vertical, two orientations
Measurement location	Semi Anechoic Chamber (SAC)

* According to Section 15.31 (f)(2): At frequencies below 30 MHz, measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field. Pending the development of an appropriate measurement procedure for measurements performed below 30 MHz, when performing measurements at a closer distance than specified, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade). The 40 dB/decade factor was used.

5.8.4 Calculation of Field Strength Limits

E.g. radiated spurious emissions field strength limits for the restricted band 2.1735 - 2.1905 MHz:

30 µV/m at 30 meters

Using the equation:

$E_{dB\mu V/m} = 20 * \log (E_{\mu V/m})$

where

$E_{dB\mu V/m}$ = Field Strength in logarithmic units (dBµV/m)

$E_{\mu V/m}$ = Field Strength in linear units (µV/m)

A field strength limit of 30 µV/m corresponds with 29.5 dBµV/m.

5.8.5 Field Strength Calculation

All emission measurements described in this chapter performed using the EMI test program transducer factor setting capability, i.e. the field strength value at the test distance was measured directly without the necessity of additional correction factors.
For test distance other than what is specified, but fulfilling the requirements of Section 15.31 (f)(2) the field strength result is calculated by adding additionally an extrapolation factor of 40 dB/decade (inverse linear-distance for field strength measurements). The basic equation with a sample calculation is as follows:

FS = FST + DF
where
FS = Field Strength in dBµV/m
FST = Field Strength at test distance in dBµV/m
DF = Distance Extrapolation Factor in dB,
where DF = 40 log (Dtest/Dspec) where Dtest = Test Distance and Dspec = Specified distance

Assume the tests performed at a reduced Test Distance of 3 m instead of the Specified Distance of 300 m giving a Distance Extrapolation Factor of DF = 40 log (3 m/300 m) = -80 dB.

Assuming a measured field strength of 55.8 dBµV/m (reading 35.8 dBµV and antenna factor 20 dB(1/m)) is obtained. The Distance Factor of -80 dB is added, giving a field strength of -24.2 dBµV/m. The -24.2 dBµV/m value can be mathematically converted to its corresponding level in µV/m.
FS = 55.8 - 80 = -24.2 [dBµV/m]
Level in µV/m = Common Antilogarithm (-24.2/20) = 0.06

5.8.6 Final Test Results

Freq. [MHz]	Meas. [PK / QPK]	Reading [dB(µV)]	Ant. factor [dB(1/m)]	DF [dB]	Result [dB(µV/m)]	Limit [dB(µV/m)]	Margin [dB]

All prescan results more than 20 dB below limit, therefore no final measurement performed.

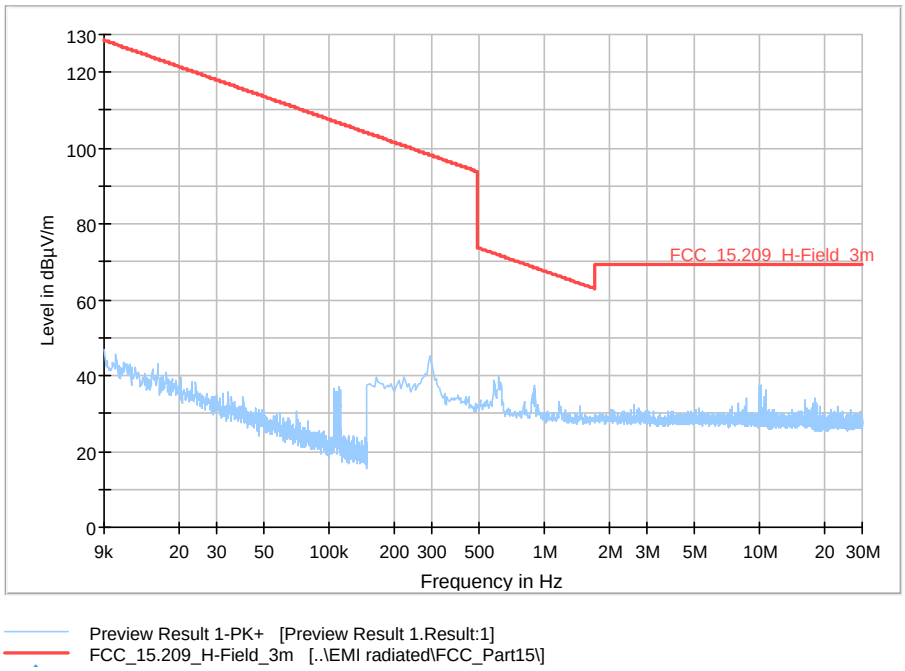
Manufacturer: SAVOX Communications Oy Ab
Device: Promate BT COM
Serial No: #1
Mode: Continuous Transmission
Test date: 2017-10-19/20
Test Personnel: L. Kraft

The EUT meets the requirements of this section.

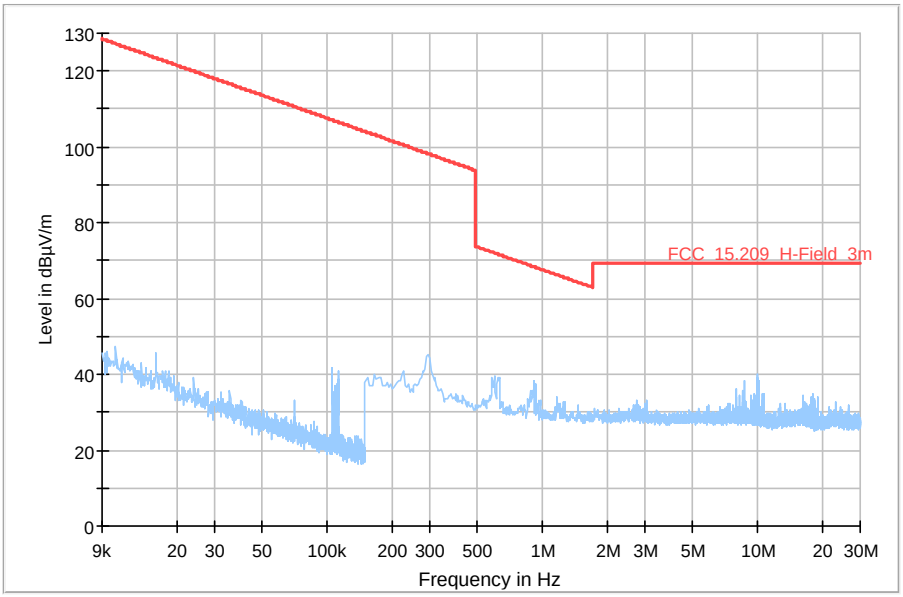
5.8.7 Detailed Measurement Data

Measurement was performed at 3 m distance. Plots show field strength reading at 3 m distance.
In order to compare the 3 m reading with the specified field strength limits a distance correction as described in 9.5 (40 dB/decade) was applied to the limit (represented by the limit line „FCC_15.209_HField_3m“).

Radiated Emissions 9kHz – 30 MHz
Channel: low
Mode: DH5
Pos.: X

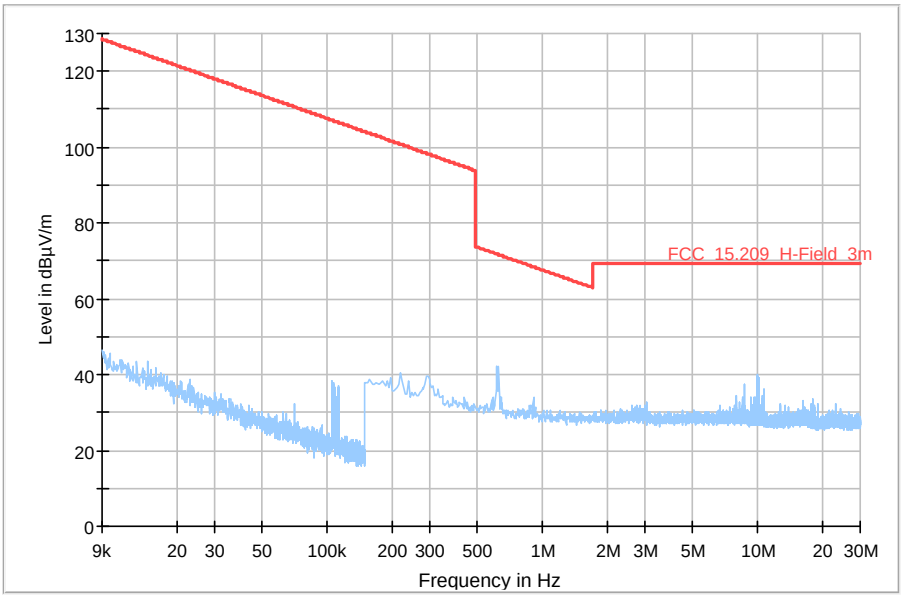


Radiated Emissions 9kHz – 30 MHz
Channel: middle
Mode: DH5
Pos.: Y



Preview Result 1-PK+ [Preview Result 1.Result:1]
FCC_15.209_H-Field_3m [..\EMI radiated\FCC_Part15\]

Radiated Emissions 9kHz – 30 MHz
Channel: high
Mode: DH5
Pos.: Z



Preview Result 1-PK+ [Preview Result 1.Result:1]
FCC_15.209_H-Field_3m [..\EMI radiated\FCC_Part15\]

5.9 Radiated Emissions 30 - 1000 MHz

Test requirement: 47 CFR, §§ 15.247, 15.209
RSS-247, 5.5; RSS-Gen, 8.9
Test procedure: ANSI C63.10

5.9.1 Regulation

§15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. 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)).

§15.209 Radiated emission limits; general requirements
(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency	Field Strength		Measurement distance
[MHz]	[µV/m]	[dB(µV/m)]	[m]
30-88	100**	40	3
88-216	150**	43.5	3
216-960	200**	46.0	3
Above 960	500	54	3

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

(b) In the emission table above, the tighter limit applies at the band-edges.
(c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other sections within this part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
(d) The emission limits shown in the above table are based on measurements employing a CISPR quasi peak detector except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.
(e) The provisions in §§ 15.31, 15.33, and 15.35 for measuring emissions at distances other than the distances specified in the above table, determining the frequency range over which radiated emissions are to be measured, and limiting peak emissions apply to all devices operated under this part.

RSS-247, 5.5 Unwanted emissions
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

RSS-Gen, 8.9 Transmitter Emission Limits for Licence-Exempt Radio Apparatus
Except when the requirements applicable to a given device state otherwise, emissions from licence-exempt transmitters shall comply with the field strength limits shown in Table 4 and Table 5 below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

Table 4 – General Field Strength Limits for Licence-Exempt Transmitters at Frequencies Above 30 MHz	
Frequency (MHz)	Field Strength (µv/m at 3 metres
30-88	100
88-216	150
216-960	200
Above 960	500

Footnote
Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for licence-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.

Note: Transmitting devices are not permitted in restricted frequency bands unless stated otherwise in the specific RSS.

5.9.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
60-Hz-Converter	AEG / DAMK4/DAGK4	0001	n/a	n/a
N-Cable N/50	R&S / HFU2-Z4	55	2017-09	2018-09
Loop Antenna	R&S / HFH 2-Z2	374	2016-07	2018-07
Anechoic Room SAC	EMCC/FRANK. / SAC-10	1889	n/a	n/a
Digital Multimeter	Agilent / U1241A	2720	2017-03	2019-03
EMI Test Receiver	R&S / ESU8	3846	2017-01	2018-01
Web-Thermo-Hygrobarograph	W&T / 57613 Web-T/Rh/P	4717	2016-04	2018-04
Log Per. Antenna	Schwarzbeck / VUSLP 9111B	5533	2017-01	2019-01
EMI Test Software	R&S / EMC32 v10.00.00	5392	n/a	n/a

5.9.3 Test Procedures

ANSI C63.10, 6.3.1 Test arrangement

[..] Tabletop devices shall be placed on a nonconducting platform with nominal top surface dimensions 1 m by 1.5 m. For emissions testing at or below 1 GHz, the table height shall be 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m (see 6.6.3.1). A method for evaluating the effects of the table on EUT radiated emissions is given in 5.5 of CISPR 16-1-4:2010 for frequencies up to 18 GHz. The EUT shall be set up in its typical configuration and arrangement and operated in its various modes as described in 5.10. An antenna shall be connected to the EUT in accordance with 5.8 and 5.10.4. The EUT and transmitting antenna shall be centered on the turntable. For devices with multiple antennas that are active simultaneously, the EUT shall be positioned, to the extent possible, with the antennas equally distributed around the center of the device. The exact setup shall be documented in the test report.
Any controlling device (e.g., notebook, laptop, or desktop computer) shall be positioned such that it shall not significantly influence the measurement results. No other peripherals are required to be connected to the controlling device for this test unless the radio is being tested as part of the notebook or PDA qualifications.

ANSI C63.10, 6.5.3 Exploratory radiated emission tests

Exploratory measurements are used to identify the frequencies and amplitudes of the emissions while manipulating and rotating the EUT.
Exploratory radiated measurements shall be performed at the measurement distance or at a closer distance than that specified for compliance to determine the emission characteristics of the EUT. At near distances, for EUTs of comparably small size, it is relatively easy to determine the spectrum signature of the EUT and, if applicable, the EUT configuration that produces the maximum level of emissions. Exploratory measurements shall be made on a test site per 5.2. Shielded rooms, not treated with RF absorption material, shall not be used for exploratory measurements.
For each mode of operation required to be tested, the frequency spectrum shall be monitored. The highest signal levels relative to the limit shall be determined by rotating the EUT from 0° to 360° and with varying the measurement antenna height between 1 m and 4 m in vertical and horizontal polarizations.

ANSI C63.10, 6.5.4 Final radiated emission tests

Using the orientation and equipment arrangement of the EUT, and based on the measurement results found during the exploratory measurement in 6.5.3, the EUT arrangement, appropriate modulation, and modes of operation that produce the emissions that have the highest amplitude relative to the limit shall be selected for the final measurement. The final measurement shall follow all the procedures in 6.3 with the EUT operating on frequencies per 5.6. For each mode selected, record the frequency and amplitude of the highest fundamental emission (if applicable) and the frequency and amplitude of the six highest spurious emissions relative to the limit; emissions more than 20 dB below the limit do not need to be reported.

Measurements are performed with the EUT rotated from 0° to 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. Variations in cable or wire placement shall be explored to maximize the measured emissions.

Radiated Emissions Test Characteristics	
Frequency range	30 MHz – 1000 MHz
Test distance	3 m
Test instrumentation resolution bandwidth	120 kHz
Receive antenna height	1 m - 4 m
Receive antenna polarization	Vertical/Horizontal

5.9.4 Calculation of Field Strength Limits

E.g. radiated spurious emissions field strength limits in restricted bands (e.g. 108 to 121.94 MHz (FCC) or 108 to 138 MHz (ISED)) acc. to §15.209 for the frequency band 88-216 MHz:

150 µV/m at 3 meters

Using the equation:

$E_{dB\mu V/m} = 20 * \log (E_{\mu V/m})$

where

$E_{dB\mu V/m}$ = Field Strength in logarithmic units (dBµV/m)

$E_{\mu V/m}$ = Field Strength in linear units (µV/m)

A field strength limit of 150 µV/m corresponds with 43.5 dBµV/m.

5.9.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor. The basic equation with a sample calculation is as follows:
FS = RA + AF + CF
where
FS = Field Strength in dBµV/m
RA = Receiver Amplitude in dBµV
AF = Antenna Factor in dB(1/m)
CF = Cable Attenuation Factor in dB
Assume a receiver reading of 23.5 dBµV is obtained. The Antenna Factor of 7.4 dB(1/m) and a Cable Factor of 1.1 dB are added, giving a field strength of 32 dBµV/m. The 32 dBµV/m value can be mathematically converted to its corresponding level in µV/m.

FS = 23.5 + 7.4 + 1.1 = 32 [dBµV/m]

Level in µV/m = Common Antilogarithm (32/20) = 39.8

Remark: All emission measurements described in this chapter performed using the EMI test program transducer factor setting capability, i.e. the field strength value at the test distance was measured directly without the necessity of additional correction factors.

5.9.6 Final Test Results

Frequency [MHz]	Result [dBµV/m]	Limit * [dBµV/m]	Margin [dB]	Remarks
210.0	25.3	43.5	18.2	---
439.7	36.5	46	9.5	---
443.2	35.6	46	10.4	---
445.4	36.1	46	9.9	---

All tests performed at 3 m distance. The table above contains worst-case emissions, only. For further details refer to the detailed measurement data.

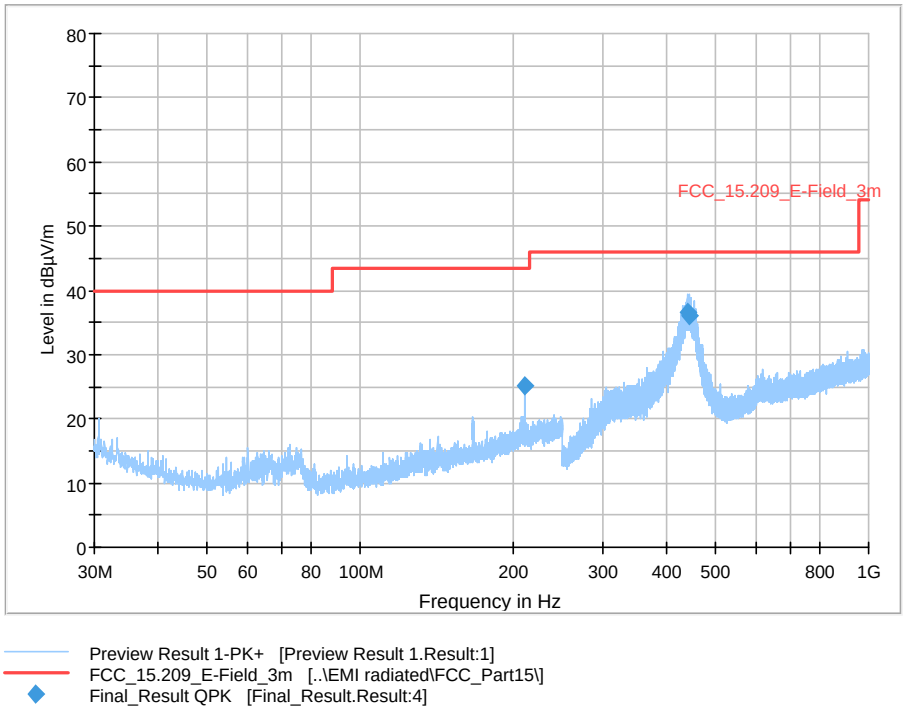
* Note: Limits acc. to 47 CFR §15.209 resp. RSS-Gen 8.9 were used as worst case consideration.

Manufacturer:	SAVOX Communications Oy Ab
Device:	Promate BT COM
Serial No:	#1
Mode:	Continuous Transmission
Test date:	2017-10-20
Test Personnel:	L. Kraft

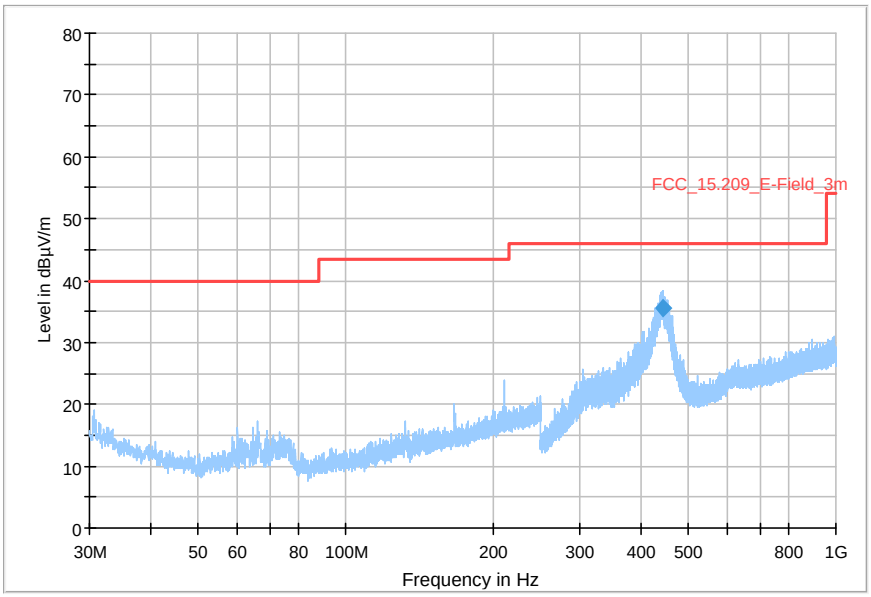
The EUT meets the requirements of this section.

5.9.7 Detailed Measurement Data

Radiated Emissions 30 MHz – 1000 MHz
Mode: DH5
Channel: low
Pos.: X

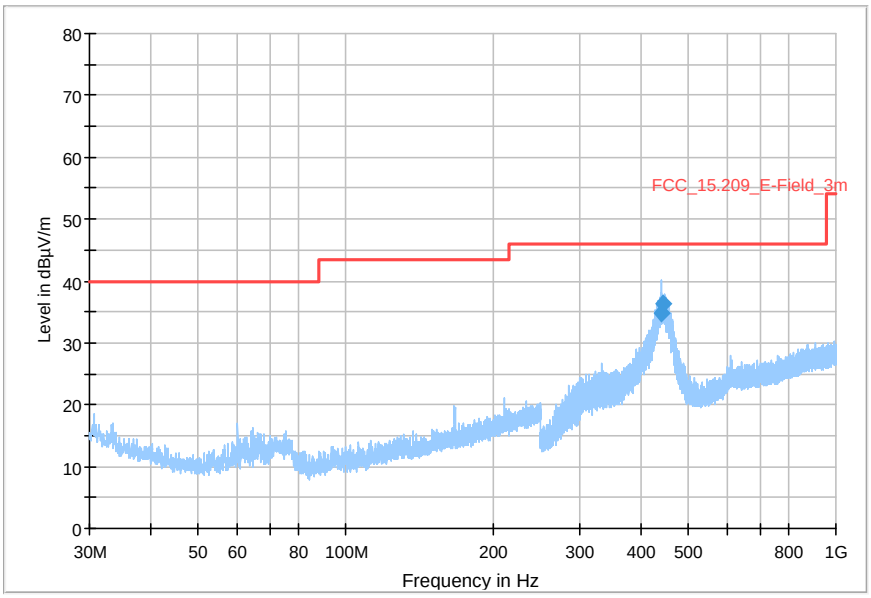


Radiated Emissions 30 MHz – 1000 MHz
Mode: DH5
Channel: middle
Pos.: Y



Preview Result 1-PK+ [Preview Result 1.Result:1]
FCC_15.209_E-Field_3m [..\EMI radiated\FCC_Part15\]
Final_Result QPK [Final_Result.Result:4]

Radiated Emissions 30 MHz – 1000 MHz
Mode: DH5
Channel: high
Pos.: Z



Preview Result 1-PK+ [Preview Result 1.Result:1]
FCC_15.209_E-Field_3m [..\EMI radiated\FCC_Part15\]
Final_Result QPK [Final_Result.Result:4]

5.10 Radiated Emissions 1 GHz – 26.5 GHz

Test requirement: 47 CFR, §§ 15.247, 15.209
RSS-247, 5.5; RSS-Gen, 8.9
Test procedure: ANSI C63.10

5.10.1 Regulation

§15.209 Radiated emission limits; general requirements
(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency	Field Strength		Measurement distance
[MHz]	[µV/m]	[dB(µV/m)]	[m]
30-88	100**	40	3
88-216	150**	43.5	3
216-960	200**	46.0	3
Above 960	500	54	3

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

(b) In the emission table above, the tighter limit applies at the band-edges.
(c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other sections within this part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
(d) The emission limits shown in the above table are based on measurements employing a CISPR quasi peak detector except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.
(e) The provisions in §§ 15.31, 15.33, and 15.35 for measuring emissions at distances other than the distances specified in the above table, determining the frequency range over which radiated emissions are to be measured, and limiting peak emissions apply to all devices operated under this part.

§15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. 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)).

RSS-247, 5.5 Unwanted emissions
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

RSS-Gen, 8.9 Transmitter Emission Limits for Licence-Exempt Radio Apparatus
Except when the requirements applicable to a given device state otherwise, emissions from licence-exempt transmitters shall comply with the field strength limits shown in Table 4 and Table 5 below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

Table 4 – General Field Strength Limits for Licence-Exempt Transmitters at Frequencies Above 30 MHz	
Frequency (MHz)	Field Strength (µv/m at 3 metres
30-88	100
88-216	150
216-960	200
Above 960	500

Footnote
Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for licence-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.

Note: Transmitting devices are not permitted in restricted frequency bands unless stated otherwise in the specific RSS.

5.10.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
Standard Gain Horn Ant.	Mid Century / MC 20/31B	1300	2016-08	2018-08
K-Cable K/50	Insulated Wire / KPS-1501-600-KPS	3061	2017-05	2018-05
Double Ridged Guide Ant.	Schwarzbeck / BBHA 9120D	3235	2015-06	2017-06
Spectrum Analyzer	R&S / FSU50	3831	2017-09	2018-09
Digital Multimeter	Agilent / U124B	3880	2016-05	2018-05
Web-Thermo-Hygrobarograph	W&T / 57613 Web-T/Rh/P	4717	2016-04	2018-04
DC Power Supply	Tektronix / PWS205	4721	n/a	n/a
Band Reject Filter	ZYSEN / ZSBR2441.75-83.5U10CS	4993	2017-04	2019-04
High Pass Filter	dBd com / DBD-FTR-15SH-U3500-O/O	5366	2017-10	2019-10
RF cable assembly	Rosenberger / LA2-025-7000	5616	2017-09	2018-09

5.10.3 Test Procedures

ANSI C63.10, 6.6.3.1 Tabletop equipment

For emission measurements above 1 GHz, the EUT shall be placed at a height of 1.5 m above the floor on a support that is RF transparent for the frequencies of interest. The 1.5 m height EUT support shall be constructed using a low permittivity and low loss tangent (tanδ) material with a height of 1.5 m, or a low permittivity and low loss tangent (tanδ) material may be placed on top of a typical table with a height of 0.8 m or 1 m. One typical low-permittivity and low-loss tangent material is styrene. Due to its dielectric properties for frequencies above 1 GHz, the use of styrene or building insulation foam is recommended, rather than, for example, wood. Support equipment shall be placed far enough away from the EUT, such that changes in relative position of the EUT and support equipment do not cause changes in measured values. Final measurements for the EUT require a measurement antenna height scan of 1 m to 4 m.

Where possible, the methods for portable, handheld, or body-worn equipment detailed in 6.6.3.3 may be employed for smaller tabletop equipment to allow the use of shorter cabling between measurement antennas and measuring receiver/spectrum analyzer by restricting the upper height of the measurement antenna.

ANSI C63.10, 6.6.4.2 Exploratory radiated emissions measurements

Exploratory radiated measurements shall be performed at the measurement distance or at a closer distance than that specified for compliance to determine the emission characteristics of the EUT and, if applicable, the EUT configuration that produces the maximum level of emissions. The frequencies of maximum emission may be determined by manually positioning the antenna close to the EUT, and then moving the antenna over all sides of the EUT while observing a spectral display. It is advantageous to have prior knowledge of the frequencies of emissions, although this may be determined from such a near-field scan. The near-field scan shall only be used to determine the frequency but not the amplitude of the emissions. Where exploratory measurements are not adequate to determine the worst-case operating modes and are used only to identify the frequencies of the highest emissions, additional preliminary tests can be required.

Preliminary tests shall be performed following the procedures in 6.3 on a site meeting the requirements of 5.2. For emissions from the EUT, the maximum level shall be determined by rotating the EUT and its antenna through 0° to 360°. For each mode of operation required to be tested, the frequency spectrum (based on findings from exploratory measurements) shall be monitored.

Broadband antennas and a spectrum analyzer or a radio-noise meter with a panoramic display are often useful in this type of test. If either antenna height or EUT azimuth are not fully measured during exploratory testing, then

complete testing can be required at the OATS or semi-anechoic chamber when the final full spectrum testing is performed.

ANSI C63.10, 6.6.4.3 Final radiated emissions measurements

The final measurements are performed on a site meeting the requirements of 5.2. Using the orientation and equipment arrangement of the EUT based on the measurement results found during the preliminary (exploratory) measurements per 6.6.4.2, the EUT arrangement, appropriate modulation, and modes of operation that produce the emissions that have the highest amplitude relative to the limit shall be selected for the final measurement. The final measurement shall follow all the procedures in 6.3 with the EUT operating on frequencies per 5.6. For each mode selected, record the frequency and amplitude of the highest fundamental emission (if applicable), as well as the frequency and amplitude of the six highest spurious emissions relative to the limit. Emissions more than 20 dB below the limit do not need to be reported.

Measurements are performed with the EUT rotated from 0° to 360°; the antenna height scanned in accordance with 6.6.3.1, 6.6.3.2, or 6.6.3.3, as appropriate; and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. Variations in cable or wire placement shall be explored to maximize the measured emissions.

The emission signal shall be kept within the illumination area of the 3 dB beamwidth of the antenna so that the maximum emission from the EUT is measured. This may be achieved by either pointing the antenna at an angle toward the source of the emission or by testing the EUT as described in 6.6.3.3.

If the emission is pulsed, then refer to Annex C for guidelines on selecting bandwidth and determining pulse desensitization factors, as necessary.

As noted in 6.6.4.1, when performing these measurements, the sensitivity of the complete measurement system relative to the limit shall be determined before the test. If the overall measurement sensitivity is inadequate, then low-noise preamplifiers, closer measurement distances, higher gain antennas, or narrower bandwidths may be used. If closer measurement distances or higher gain antennas are used, then the beamwidth of the measurement antenna versus the physical size of the EUT shall be taken into account, so that the physical sizes of the EUT dimensions are encompassed by the beamwidth of the measurement antenna. Also, measurement system overload protection shall be determined to be adequate when preamplifiers are used. The effects on the measured emission value using bandwidths different from those specified shall be determined if such bandwidth changes are made. Any changes from the specific measurement conditions shall be described in the report of the measurements.

Radiated Emissions Test Characteristics	
Frequency range	1 GHz – 26.5 GHz
Test distance	3 m [1)]
Test instrumentation resolution bandwidth	1 MHz
Receive antenna height	1 m – 4 m [1)]
Receive antenna polarization	Vertical/Horizontal

[1)] Explorative measurements performed at closer distance and without height scan

5.10.4 Calculation of Field Strength Limits

E.g. radiated spurious emissions field strength limits acc. to §15.209 for frequencies above 960 MHz:

500 µV/m at 3 meters

Using the equation:

$E_{dB\mu V/m} = 20 * \log (E_{\mu V/m})$

where

$E_{dB\mu V/m}$ = Field Strength in logarithmic units (dBµV/m)

$E_{\mu V/m}$ = Field Strength in linear units (µV/m)

A field strength limit of 500 µV/m corresponds with 54 dBµV/m.

5.10.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF
where
FS = Field Strength in dBµV/m

RA = Receiver Amplitude in dBµV
AF = Antenna Factor in dB(1/m)
CF = Cable Attenuation Factor in dB
Assume a receiver reading of 23.5 dBµV is obtained. The Antenna Factor of 7.4 dB(1/m) and a Cable Factor of 1.1 dB are added, giving a field strength of 32 dBµV/m. The 32 dBµV/m value can be mathematically converted to its corresponding level in µV/m.

FS = 23.5 + 7.4 + 1.1 = 32 [dBµV/m]
Level in µV/m = Common Antilogarithm (32/20) = 39.8

Remark: All emission measurements described in this chapter performed using the EMI test program transducer factor setting capability, i.e. the field strength value at the test distance was measured directly without the necessity of additional correction factors.

5.10.6 Final Test Results

Radiated Spurious Emissions 1 – 26.5 GHz – Average Results				
Frequency	**Result**	**Limit**	**Margin**	**Remarks**
[MHz]	**[dBµV/m]**	**[dBµV/m]**	**[dB]**	
1018.4	39.1	54	14.9	---
1018.5	41.1	54	12.9	---
1120.2	42.6	54	11.4	---
1499.9	42.0	54	12.0	---
1733.0	37.1	54	16.9	---
3000.0	41.3	54	12.7	---
4804.2	43.7	54	10.3	---
4881.9	48.5	54	5.5	---
4960.5	46.1	54	8.0	---

For further details refer to chapter 2.6 of the report.
* Note: Limits acc. to 47 CFR §15.209 resp. RSS-Gen 8.9 were used as worst case consideration.

Radiated Spurious Emissions 1 – 26.5 GHz – Peak Results				
Frequency	**Result**	**Limit**	**Margin**	**Remarks**
[MHz]	**[dBµV/m]**	**[dBµV/m]**	**[dB]**	

All peak results are more than 20 dB below limit.

Remark:
The table above contains worst-case emissions, only. For further details refer to the pre-scan test plots.

* Note: Limits acc. to 47 CFR §15.209 resp. RSS-Gen 8.9 were used as worst case consideration.

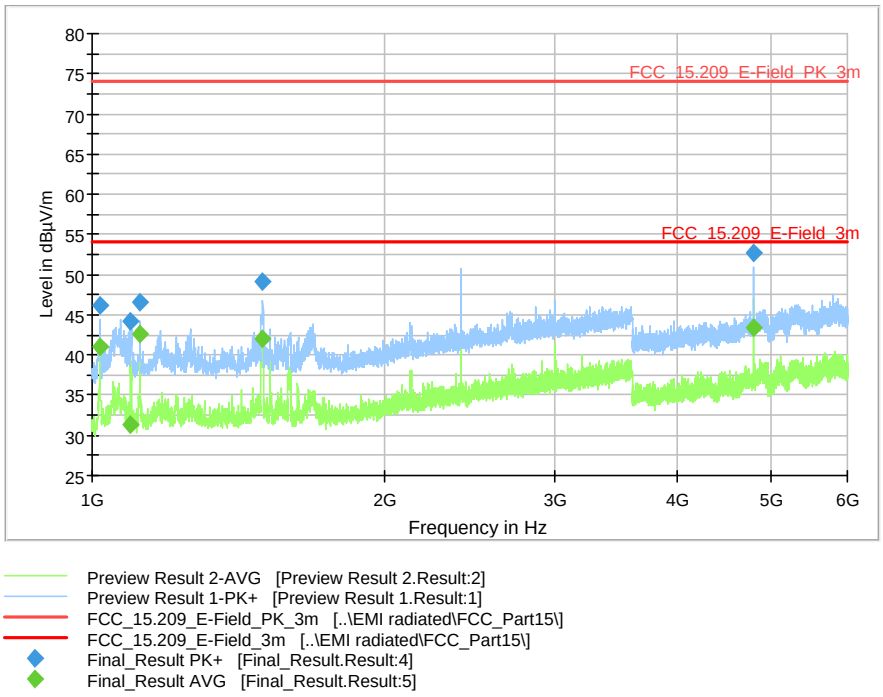
Manufacturer:	SAVOX Communications Oy Ab
Device:	Promate BT COM
Serial No:	#1
Mode:	Continuous Transmission
Test date:	2017-10-26
Test Personnel:	L. Kraft

The EUT meets the requirements of this section.

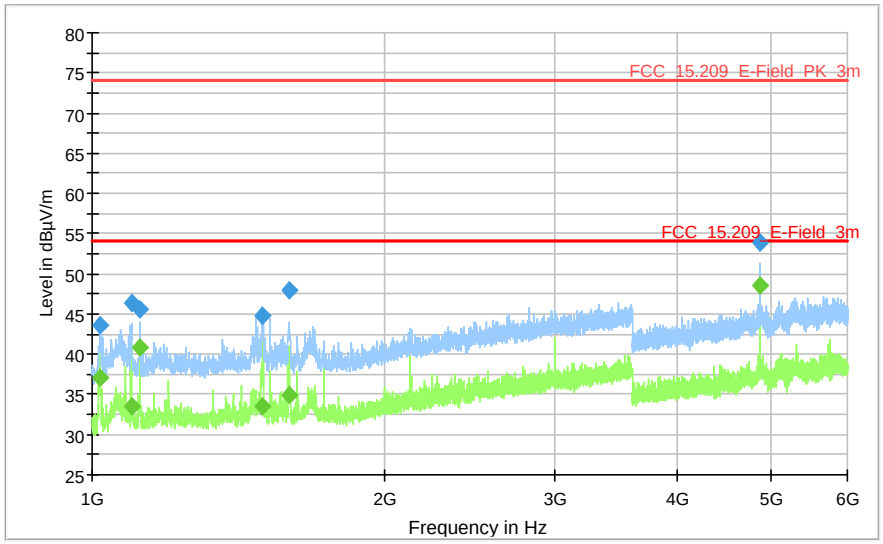
5.10.7 Detailed Measurement Data

Prescan measurements below 6 GHz were performed at 3 m distance, above 6 GHz measurement was performed as explorative measurement in close distance of approx. 20 cm. All final measurements were performed at 3m distance.

Radiated Emissions 1 – 6 GHz
Mode: DH5
Channel: low
Pos.: X

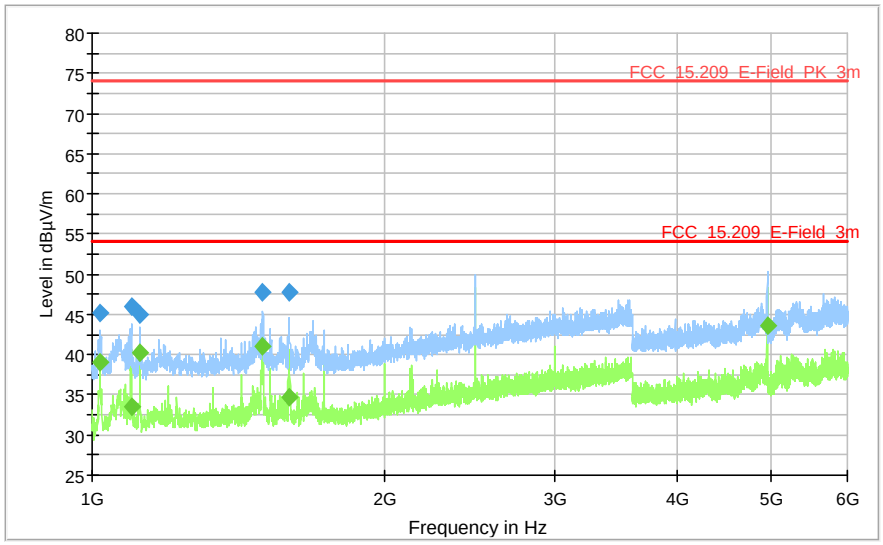


Radiated Emissions 1 – 6 GHz
Mode: DH5
Channel: middle
Pos.: X



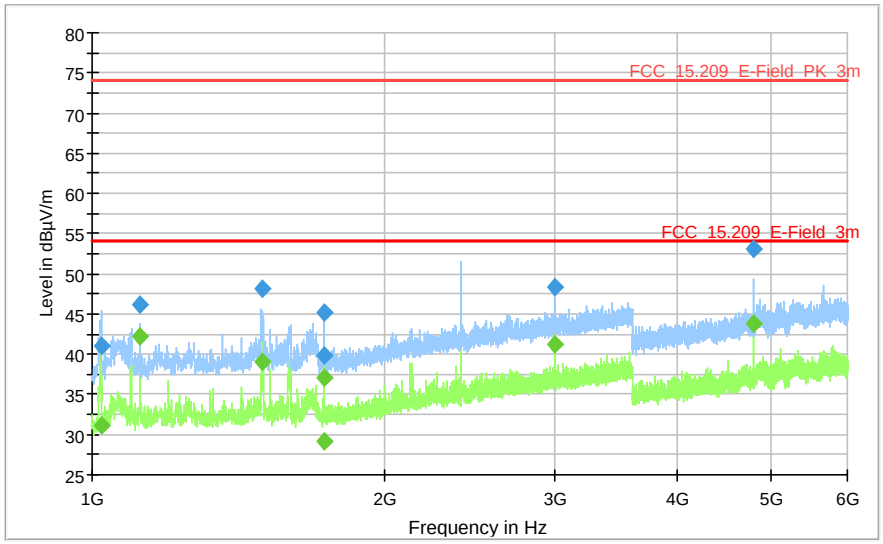
Preview Result 2-AVG [Preview Result 2.Result:2]
Preview Result 1-PK+ [Preview Result 1.Result:1]
FCC_15.209_E-Field_PK_3m [..\EMI radiated\FCC_Part15\]
FCC_15.209_E-Field_3m [..\EMI radiated\FCC_Part15\]
Final_Result PK+ [Final_Result.Result:4]
Final_Result AVG [Final_Result.Result:5]

Radiated Emissions 1 – 6 GHz
Mode: DH5
Channel: high
Pos.: X



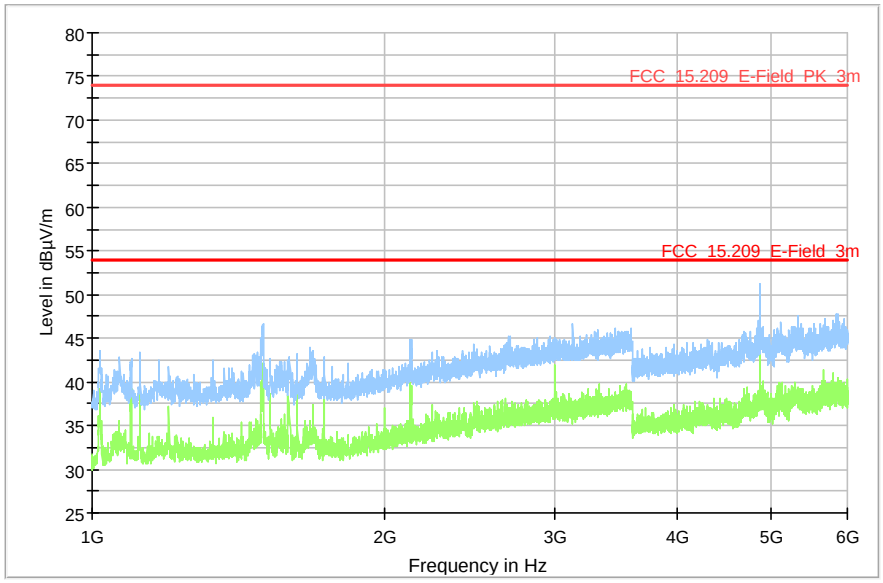
Preview Result 2-AVG [Preview Result 2.Result:2]
Preview Result 1-PK+ [Preview Result 1.Result:1]
FCC_15.209_E-Field_PK_3m [..\EMI radiated\FCC_Part15\]
FCC_15.209_E-Field_3m [..\EMI radiated\FCC_Part15\]
Final_Result PK+ [Final_Result.Result:4]
Final_Result AVG [Final_Result.Result:5]

Radiated Emissions 1 – 6 GHz
Mode: DH5
Channel: low
Pos.: Y



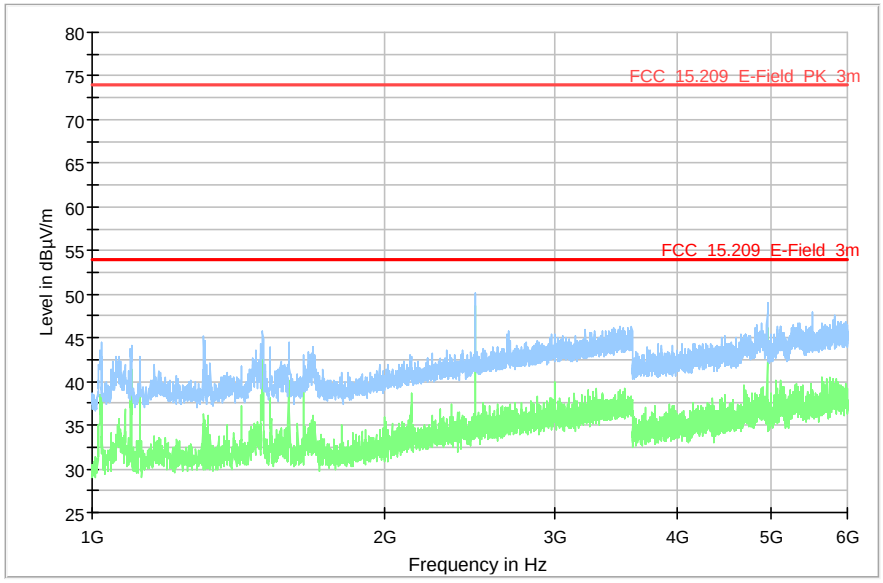
Preview Result 2-AVG [Preview Result 2.Result:2]
Preview Result 1-PK+ [Preview Result 1.Result:1]
FCC_15.209_E-Field_PK_3m [..\EMI radiated\FCC_Part15\]
FCC_15.209_E-Field_3m [..\EMI radiated\FCC_Part15\]
Final_Result PK+ [Final_Result.Result:4]
Final_Result AVG [Final_Result.Result:5]

Radiated Emissions 1 – 6 GHz
Mode: DH5
Channel: middle
Pos.: Y



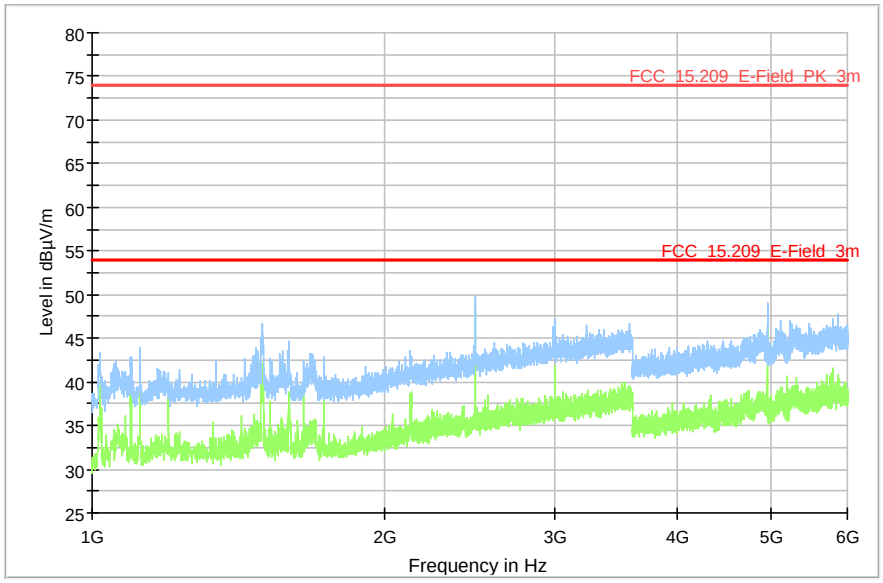
Preview Result 2-AVG [Preview Result 2.Result:2]
Preview Result 1-PK+ [Preview Result 1.Result:1]
FCC_15.209_E-Field_PK_3m [..\EMI radiated\FCC_Part15\]
FCC_15.209_E-Field_3m [..\EMI radiated\FCC_Part15\]

Radiated Emissions 1 – 6 GHz
Mode: DH5
Channel: high
Pos.: Y



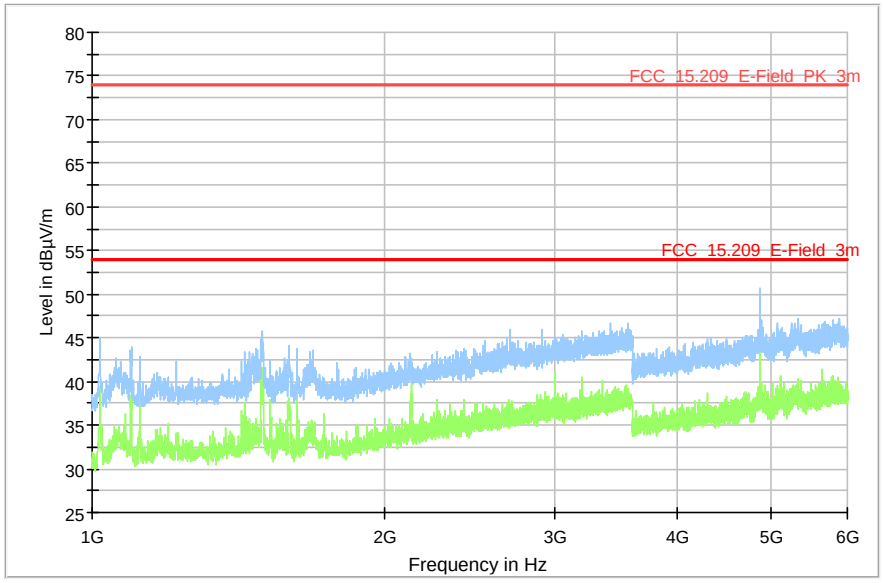
AVG_MAXH@RE_1-6GHz_006 [Preview Result 1.Result:2]
Preview Result 1-PK+ [Preview Result 1.Result:1]
FCC_15.209_E-Field_PK_3m [..\EMI radiated\FCC_Part15\]
FCC_15.209_E-Field_3m [..\EMI radiated\FCC_Part15\]

Radiated Emissions 1 – 6 GHz
Mode: DH5
Channel: low
Pos.: Z



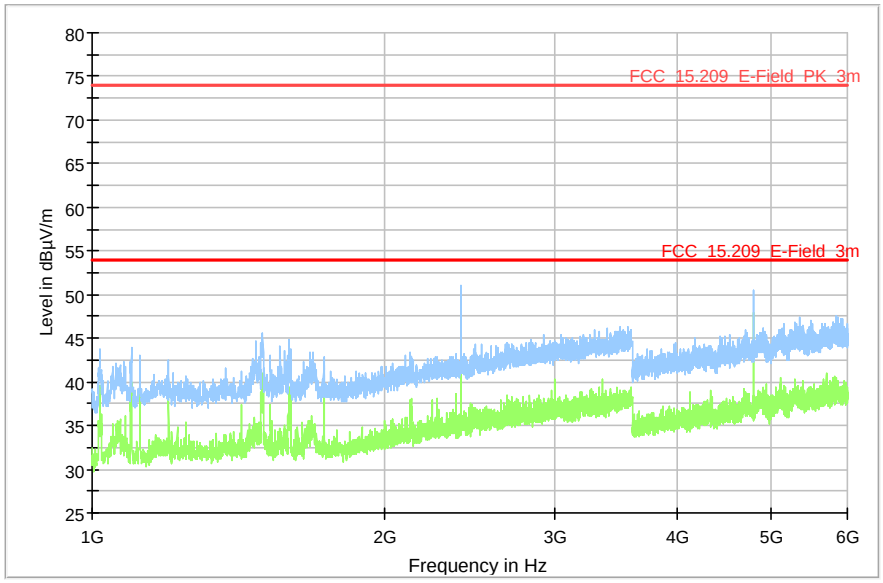
Preview Result 2-AVG [Preview Result 2.Result:2]
Preview Result 1-PK+ [Preview Result 1.Result:1]
FCC_15.209_E-Field_PK_3m [..\EMI radiated\FCC_Part15\]
FCC_15.209_E-Field_3m [..\EMI radiated\FCC_Part15\]

Radiated Emissions 1 – 6 GHz
Mode: DH5
Channel: middle
Pos.: Z



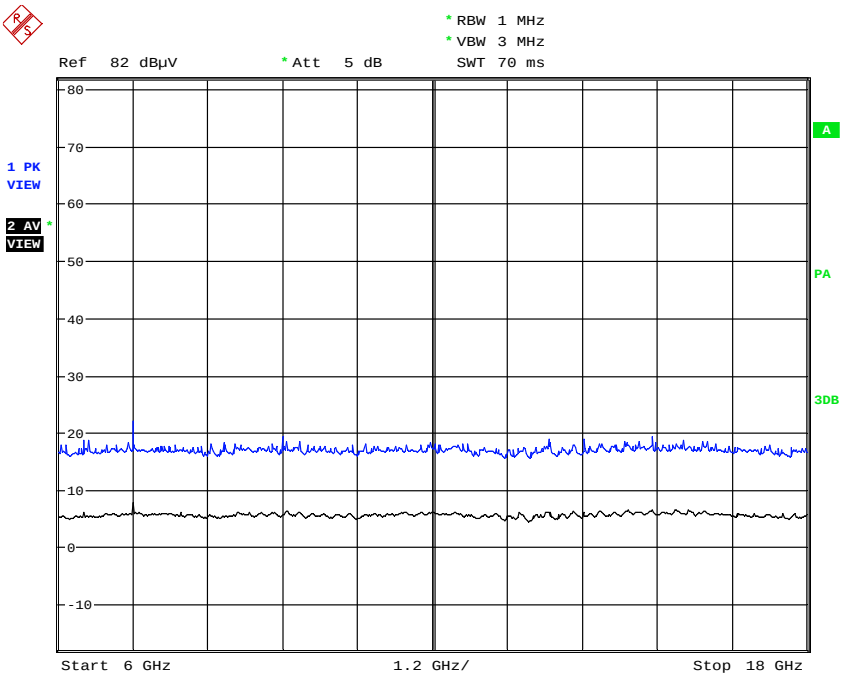
Preview Result 2-AVG [Preview Result 2.Result:2]
Preview Result 1-PK+ [Preview Result 1.Result:1]
FCC_15.209_E-Field_PK_3m [..\EMI radiated\FCC_Part15\]
FCC_15.209_E-Field_3m [..\EMI radiated\FCC_Part15\]

Radiated Emissions 1 – 6 GHz
Mode: DH5
Channel: high
Pos.: Z

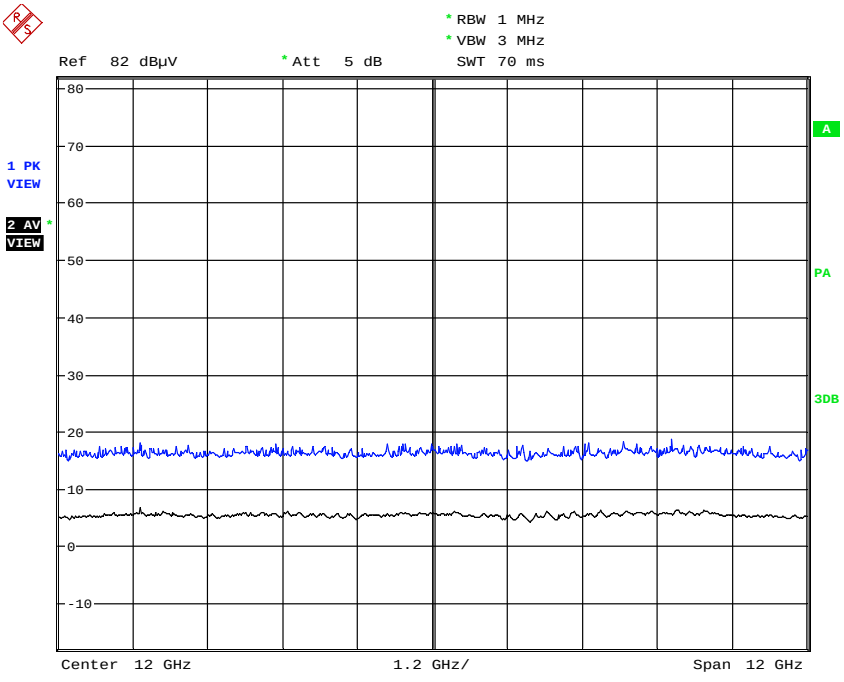


Preview Result 2-AVG [Preview Result 2.Result:2]
Preview Result 1-PK+ [Preview Result 1.Result:1]
FCC_15.209_E-Field_PK_3m [..\EMI radiated\FCC_Part15\]
FCC_15.209_E-Field_3m [..\EMI radiated\FCC_Part15\]

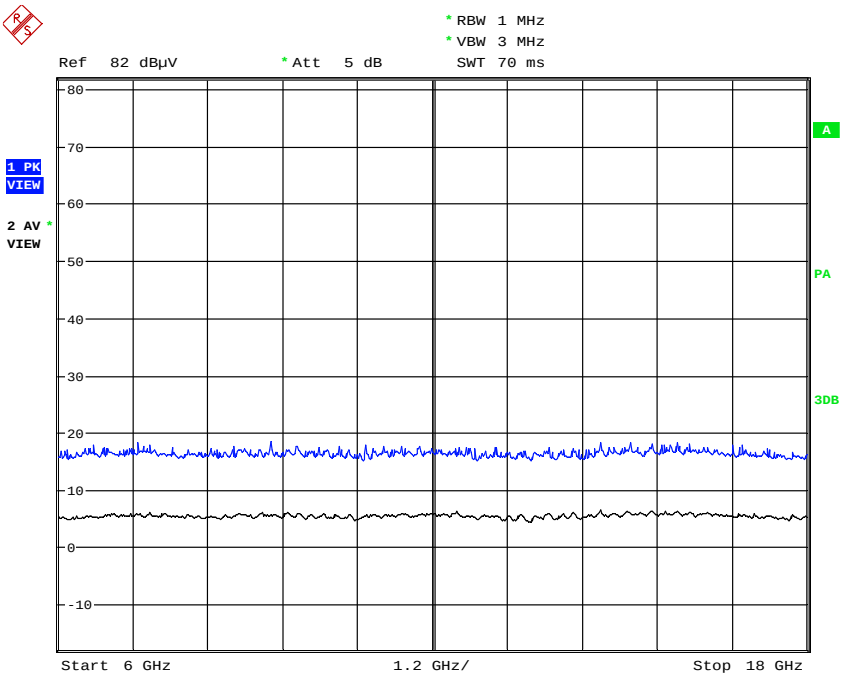
Exploratory rad. emission meas. 6-18 GHz
Mode: DH5
Channel: low



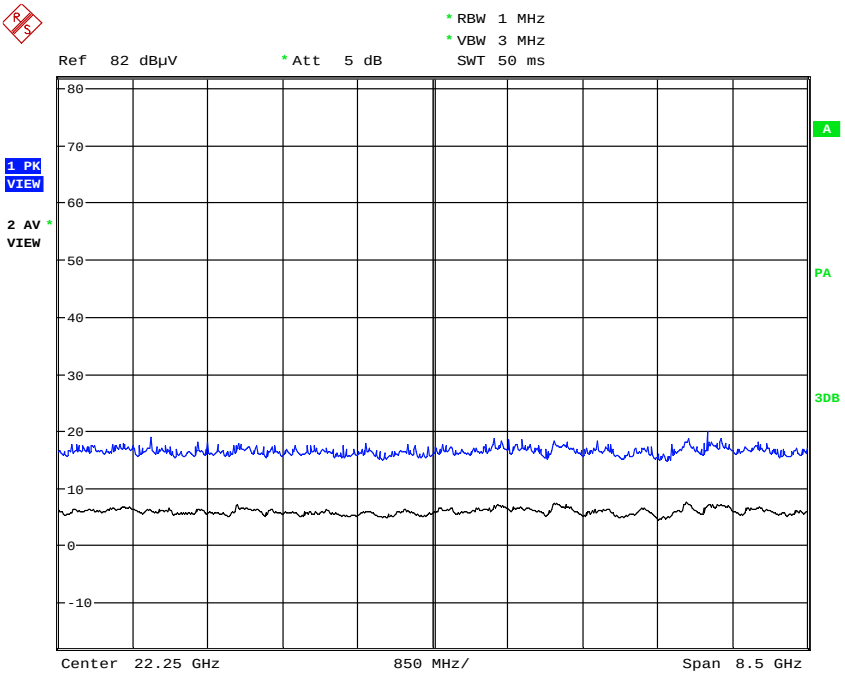
Exploratory rad. emission meas. 6-18 GHz
Mode: DH5
Channel: middle



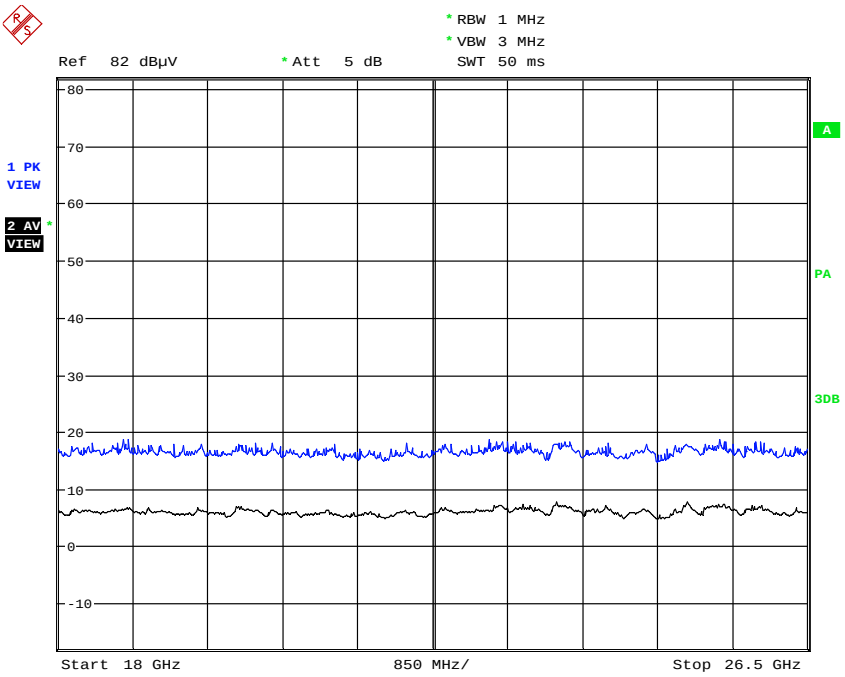
Exploratory rad. emission meas. 6-18 GHz
Mode: DH5
Channel: high



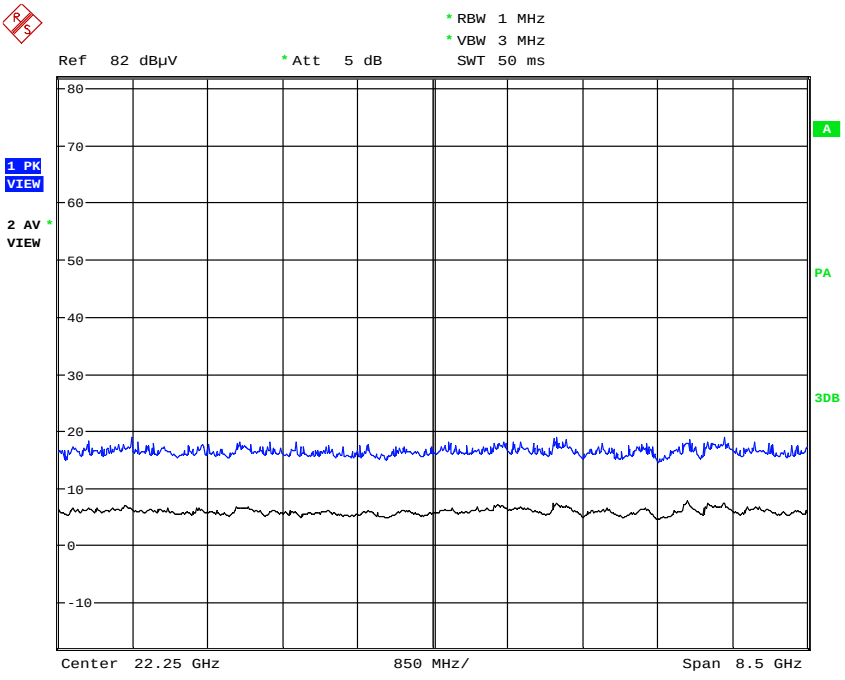
Exploratory rad. emission meas. 18-26.5 GHz
Mode: DH5
Channel: low



Exploratory rad. emission meas. 18-26.5 GHz
Mode: DH5
Channel: middle



Exploratory rad. emission meas. 18-26.5 GHz
Mode: DH5
Channel: high



5.11 RF Exposure Evaluation

Test Requirement: 47 CFR, § 2.1093
RSS-102, Issue 5
Test Procedure: 447498 D01 General RF Exposure Guidance v06

5.11.1 Regulation

§2.1093 Radiofrequency radiation exposure evaluation: portable devices.
(a) Requirements of this section are a consequence of Commission responsibilities under the National Environmental Policy Act to evaluate the environmental significance of its actions. See subpart I of part 1 of this chapter, in particular §1.1307(b).
(b) For purposes of this section, a portable device is defined as a transmitting device designed to be used so that the radiating structure(s) of the device is/are within 20 centimeters of the body of the user.
(d) The limits to be used for evaluation are based generally on criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate ("SAR") in Section 4.2 of "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz," ANSI/IEEE C95.1-1992, Copyright 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017. These criteria for SAR evaluation are similar to those recommended by the National Council on Radiation Protection and Measurements (NCRP) in "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," NCRP Report No. 86, Section 17.4.5. Copyright NCRP, 1986, Bethesda, Maryland 20814. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards. The criteria to be used are specified in paragraphs (d)(1) and (d)(2) of this section and shall apply for portable devices transmitting in the frequency range from 100 kHz to 6 GHz. Portable devices that transmit at frequencies above 6 GHz are to be evaluated in terms of the MPE limits specified in §1.1310 of this chapter. Measurements and calculations to demonstrate compliance with MPE field strength or power density limits for devices operating above 6 GHz should be made at a minimum distance of 5 cm from the radiating source.
(2) The SAR limits for general population/uncontrolled exposure are 0.08 W/kg, as averaged over the whole body, and a peak spatial-average SAR of 1.6 W/kg, averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the parts of the human body treated as extremities, such as hands, wrists, feet, ankles, and pinnae, where the peak spatial-average SAR limit is 4 W/kg, averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube). Exposure may be averaged over a time period not to exceed 30 minutes to determine compliance with general population/uncontrolled SAR limits.
(i) General Population/Uncontrolled limits apply when the general public may be exposed, or when persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or do not exercise control over their exposure.

447498 D01 General RF Exposure Guidance v06
4.3. General SAR test exclusion guidance
4.3.1. Standalone SAR test exclusion considerations
Unless specifically required by the published RF exposure KDB procedures, standalone 1-g head or body and 10-g extremity SAR evaluation for general population exposure conditions, by measurement or numerical simulation, is not required when the corresponding SAR Test Exclusion Threshold condition(s), listed below, is (are) satisfied. These test exclusion conditions are based on source-based time-averaged maximum conducted output power of the RF channel requiring evaluation, adjusted for tune-up tolerance, and the minimum test separation distance required for the exposure conditions.28 The minimum test separation distance defined in 4.1 f) is determined by the smallest distance from the antenna and radiating structures or outer surface of the device, according to the host form factor, exposure conditions and platform requirements, to any part of the body or extremity of a user or bystander. To qualify for SAR test exclusion, the test separation distances applied must be fully explained and justified, typically in the SAR measurement or SAR analysis report, by the operating configurations and exposure conditions of the transmitter and applicable host platform requirements, according to the required published RF exposure KDB procedures. When no other RF exposure testing or reporting are required, a statement of justification and compliance must be included in the equipment approval, in lieu of the SAR report, to qualify for SAR test exclusion.

When required, the device specific conditions described in the other published RF exposure KDB procedures must be satisfied before applying these SAR test exclusion provisions; for example, handheld PTT two-way radios, handsets, laptops and tablets, etc.29
a) For 100 MHz to 6 GHz and test separation distances ≤ 50 mm, the 1-g and 10-g SAR test exclusion thresholds are determined by the following:
[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] x
[√f(GHz)] ≤ 3.0 for 1-g SAR, and ≤ 7.5 for 10-g extremity SAR,
where
- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison
- The values 3.0 and 7.5 are referred to as numeric thresholds in step b) below
The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm, and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm according to 4.1 f) is applied to determine SAR test exclusion

RSS-102, 2.5.1 Exemption Limits for Routine Evaluation — SAR Evaluation
SAR evaluation is required if the separation distance between the user and/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm, except when the device operates at or below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in Table 1.

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤300	71 mW	101 mW	132 mW	162 mW	193 mW
450	52 mW	70 mW	88 mW	106 mW	123 mW
835	17 mW	30 mW	42 mW	55 mW	67 mW
1900	7 mW	10 mW	18 mW	34 mW	60 mW
2450	4 mW	7 mW	15 mW	30 mW	52 mW
3500	2 mW	6 mW	16 mW	32 mW	55 mW
5800	1 mW	6 mW	15 mW	27 mW	41 mW

Output power level shall be the higher of the maximum conducted or equivalent isotropically radiated power (e.i.r.p.) source-based, time-averaged output power. For controlled use devices where the 8 W/kg for 1 gram of tissue applies, the exemption limits for routine evaluation in Table 1 are multiplied by a factor of 5. For limb-worn devices where the 10 gram value applies, the exemption limits for routine evaluation in Table 1 are multiplied by a factor of 2.5. If the operating frequency of the device is between two frequencies located in Table 1, linear interpolation shall be applied for the applicable separation distance. For test separation distance less than 5 mm, the exemption limits for a separation distance of 5 mm can be applied to determine if a routine evaluation is required.

5.11.2 Test Equipment

None.

Note: Data from chapters “Peak Output Power” and “Time of Occupancy” was used.

5.11.3 Test Result

The maximum measured conducted peak output power is 4.0 dBm in mode DH5. These values are used for further consideration as a worst case assumption.

The RF Exposure Evaluation demands a time-averaged output power. Therefore, a duty cycle correction factor has to be applied. The worst case duty cycle is 80.9 % (= -1.8 dB) in all DH5 modes (DH5, 2-DH5, 3-DH5).

FCC:

Conducted Peak Output Power [dBm]	Duty Cycle Correction Factor [dB]	Time averaged output power		Exclusion Limit
		[dBm]	[mW]	[mW]
4	-1.8	2.2	1.7	10

ISED:

EIRP * [dBm]	Duty Cycle Correction Factor [dB]	Time averaged equivalent isotropically radiated power		Exclusion Limit
		[dBm]	[mW]	[mW]
6	-1.8	4.2	2.6	4

* Note: the equivalent isotropically radiated power (EIRP) is calculated by adding the max. antenna gain of the used antenna to the conducted peak output power.

The EUT meets the Exemption Limits for Routine Evaluation for distanced ≤ 5 cm. No further evaluation is necessary.

Manufacturer:	SAVOX Communications Oy Ab
Device:	Promate BT COM
Serial No:	#2
Mode:	Continuous Transmission
Test date:	2017-10-18
Test Personnel:	P. Reusch

The EUT meets the requirements of this section.

6 MEASUREMENT UNCERTAINTY

Measurement	Measurement Uncertainty
Radiated emissions, H field (9 kHz – 30 MHz)	± 3.0 dB
Radiated Emissions (30 MHz – 1000 MHz)	± 5.7 dB
Radiated Emissions (Above 1000 MHz)	± 5.3 dB

The reported uncertainty values are based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of 95%.

If not otherwise stated, the given values are worst case values calculated on the basis of the following documents:
TR 100 028-1 V1.4.1 (2001-12)
TR 100 028-2 V1.4.1 (2001-12)
ISO: Guide to the Expression of Uncertainty in Measurement: 1993.

7 LIST OF ANNEXES

Following annexes are separated parts from this test report.

Description	Pages
Annex 1: Photographs of test set-up	5
Annex 2: External photographs of equipment under test (EUT)	6
Annex 3: Internal photographs of equipment under test (EUT)	4
Annex 4: Photographs of ancillary equipment	2

Annex 1 to Test Report # EMCC-160592H, 2017-12-22

PHOTOGRAPHS OF TEST SET-UP

EQUIPMENT UNDER TEST:

Device:	Promate BT COM
Serial Number:	#1 #2
Application:	Bluetooth Headset
FCC ID:	TUFBTCOM
IC:	6574A-BTCOM
Manufacturer:	SAVOX Communications Oy Ab
Address:	Sinikalliontie 3B 02630 Espoo Finland
Phone :	+358 44 961 87 09

RELEVANT STANDARD(S) : 47 CFR 15.107, 15.109, ICES-003

47 CFR § 15.247, RSS-247 Issue 2

MEASUREMENT PROCEDURE:

☒ ANSI C63.10-2013

☒ ANSI C63.4-2014

☒ RSS-Gen Issue 4

☒ DA 00-705, dated 2000-03-30

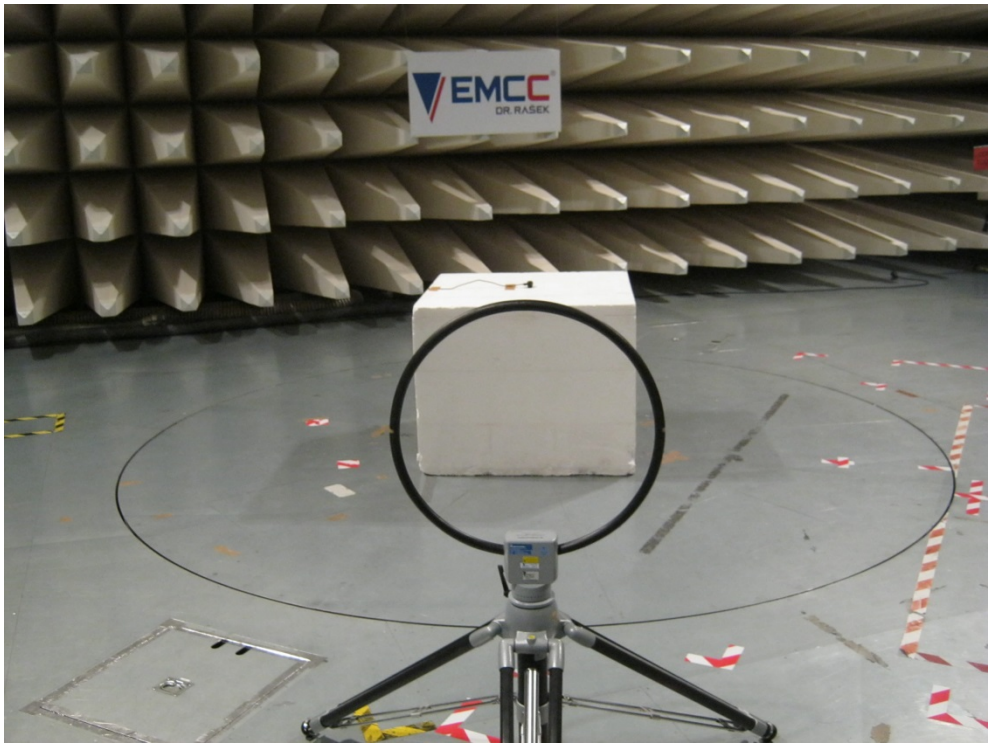


Photo A1-1: Radiated emissions measurement at 3 m distance, 9 kHz – 30 MHz

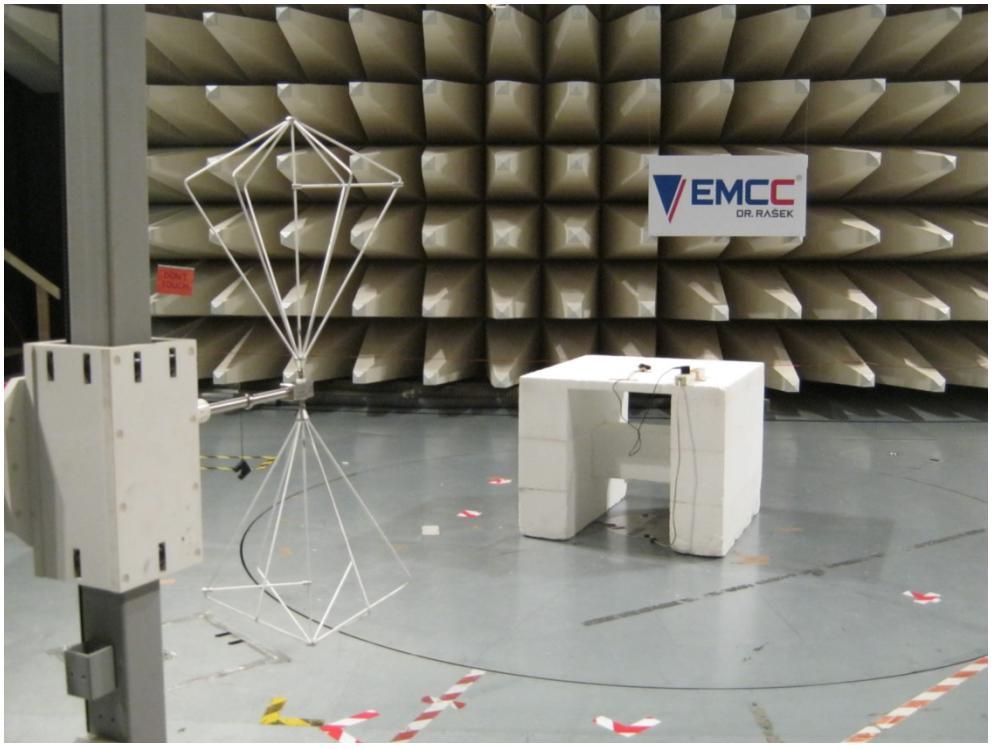


Photo A1-2: Radiated emissions measurement at 3 m distance, 30 MHz – 250 MHz

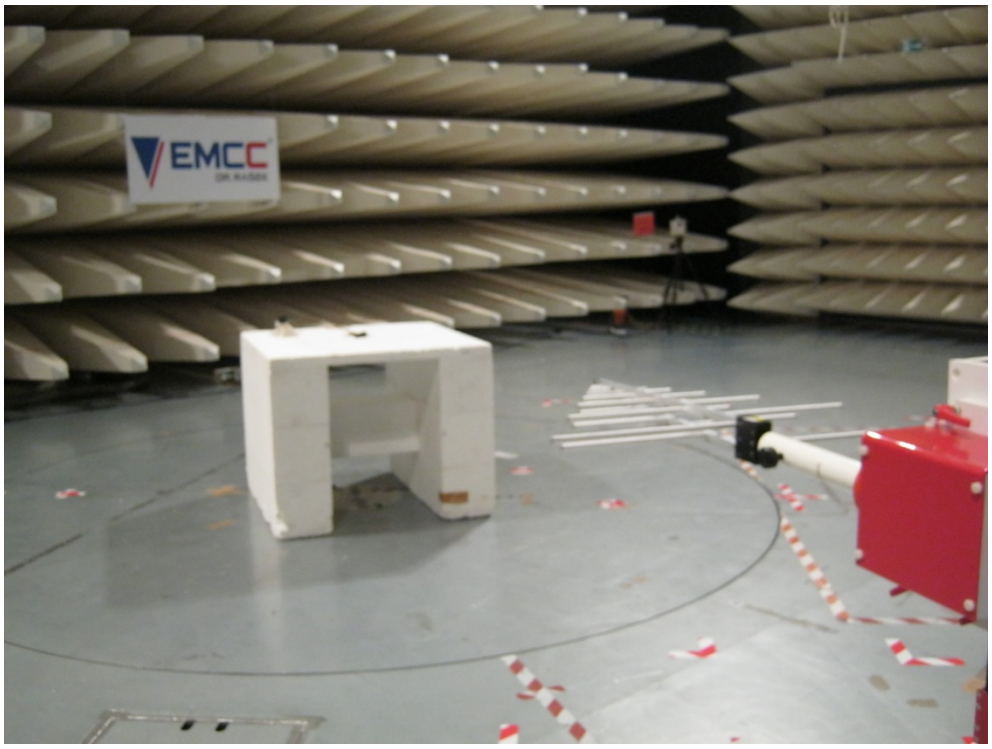


Photo A1-3: Radiated emissions measurement at 3 m distance, 250 MHz – 1000 MHz

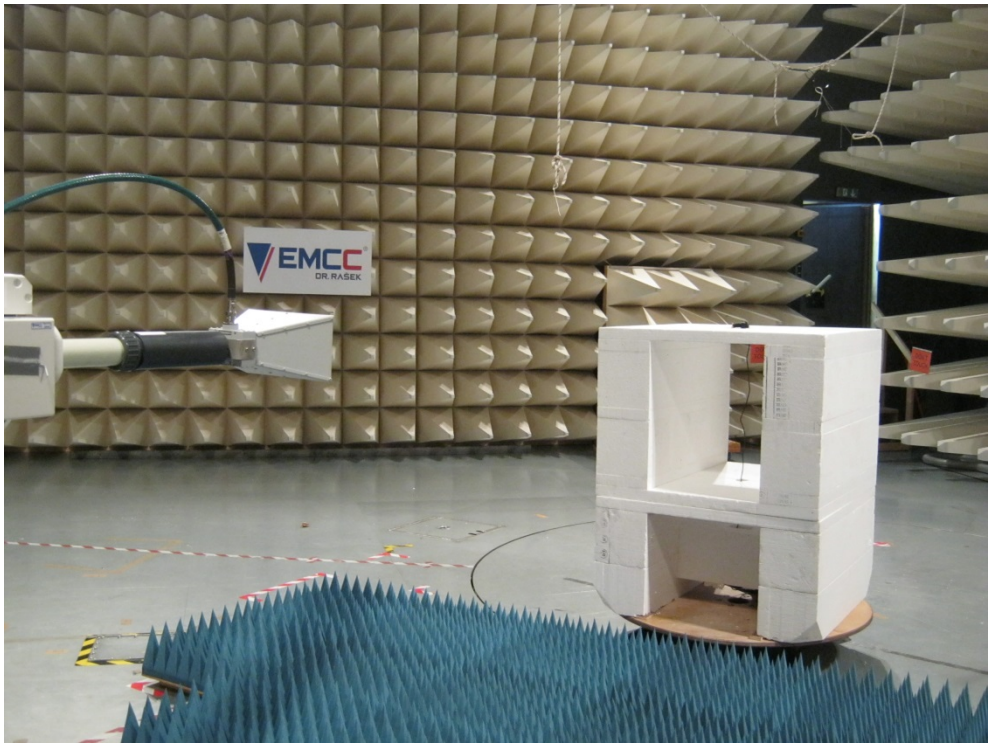


Photo A1-4: Radiated emissions measurement at 3 m distance, 1 GHz – 6 GHz

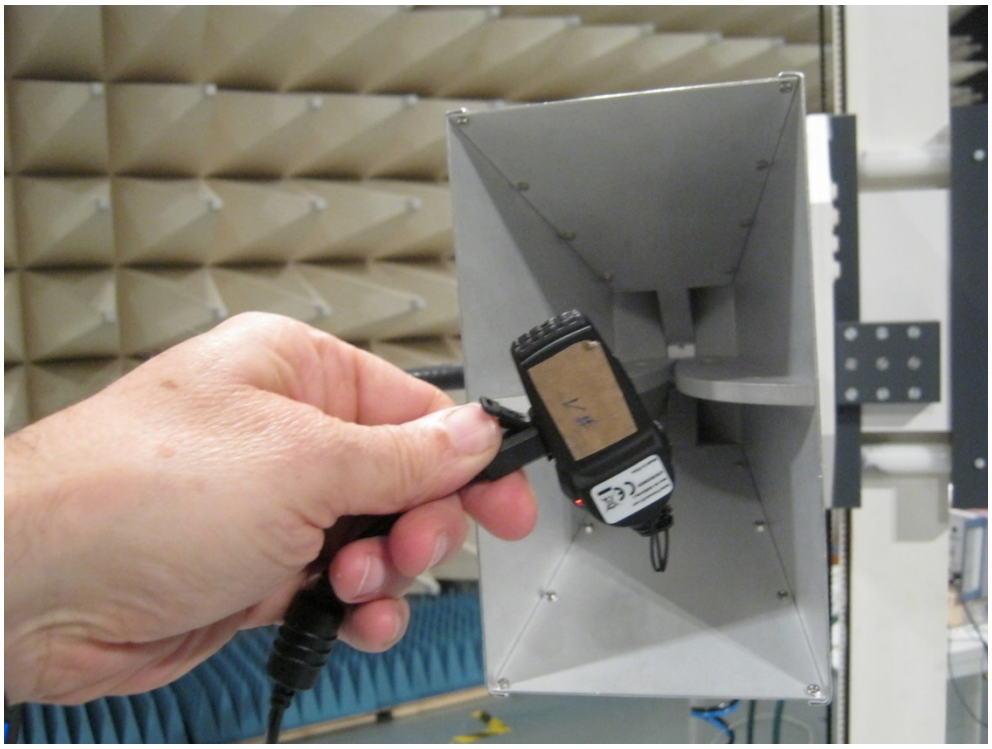


Photo A1-5: Exploratory radiated emissions measurements at closer distance, 6 GHz – 18 GHz

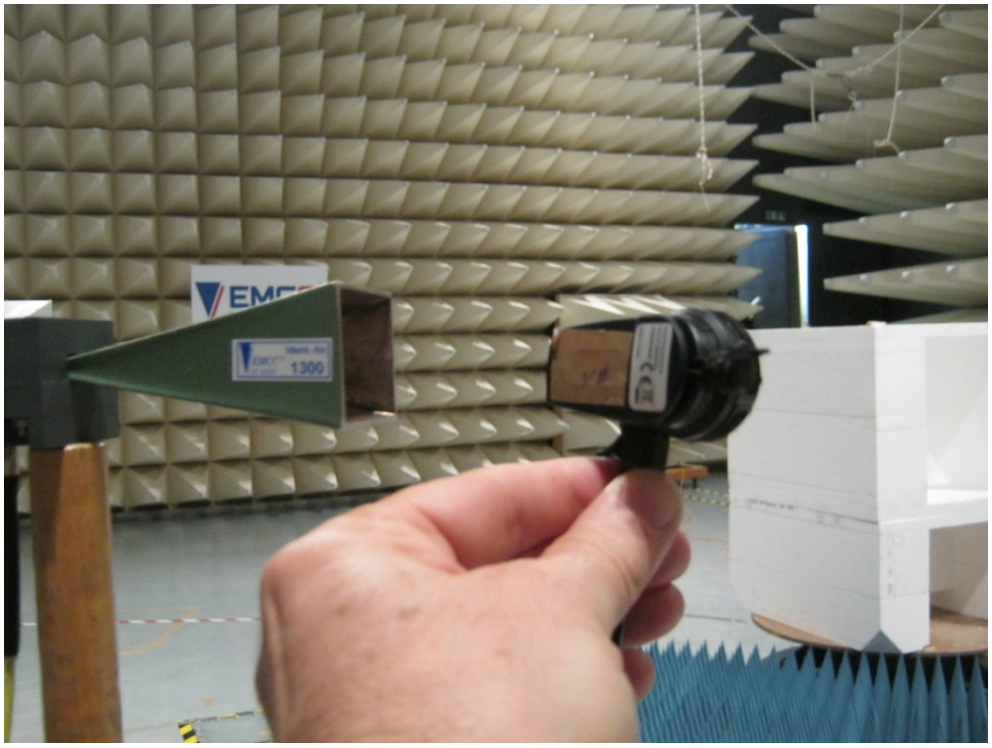


Photo A1-6: Exploratory radiated emissions measurements at closer distance, 18 GHz – 25 GHz

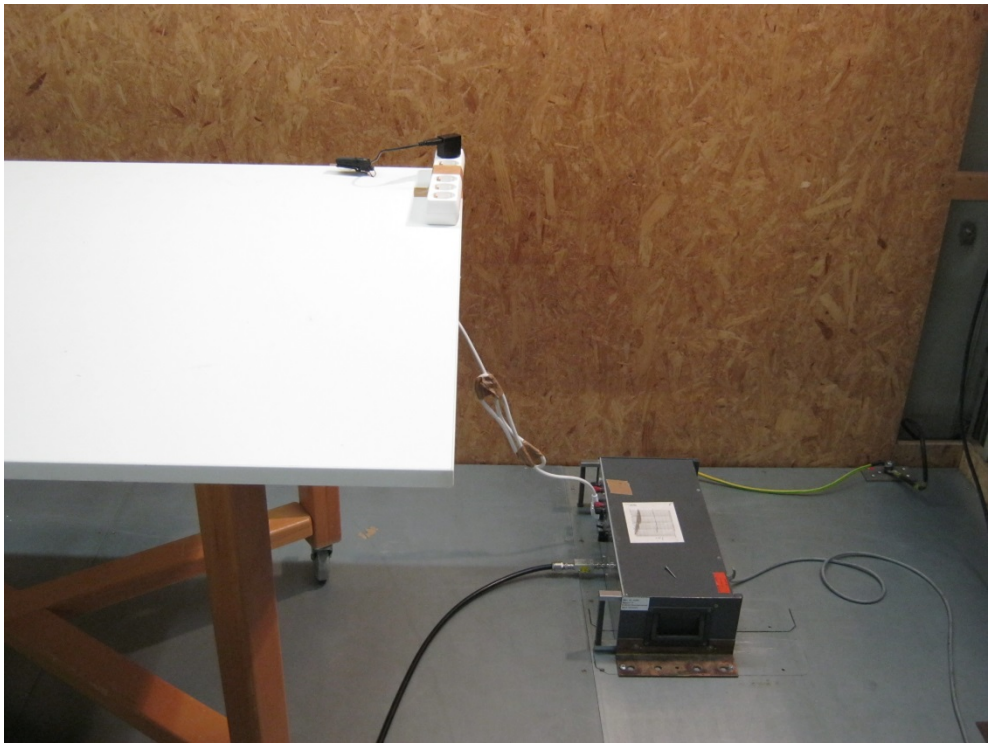


Photo A1-7: AC Powerline conducted emission measurement

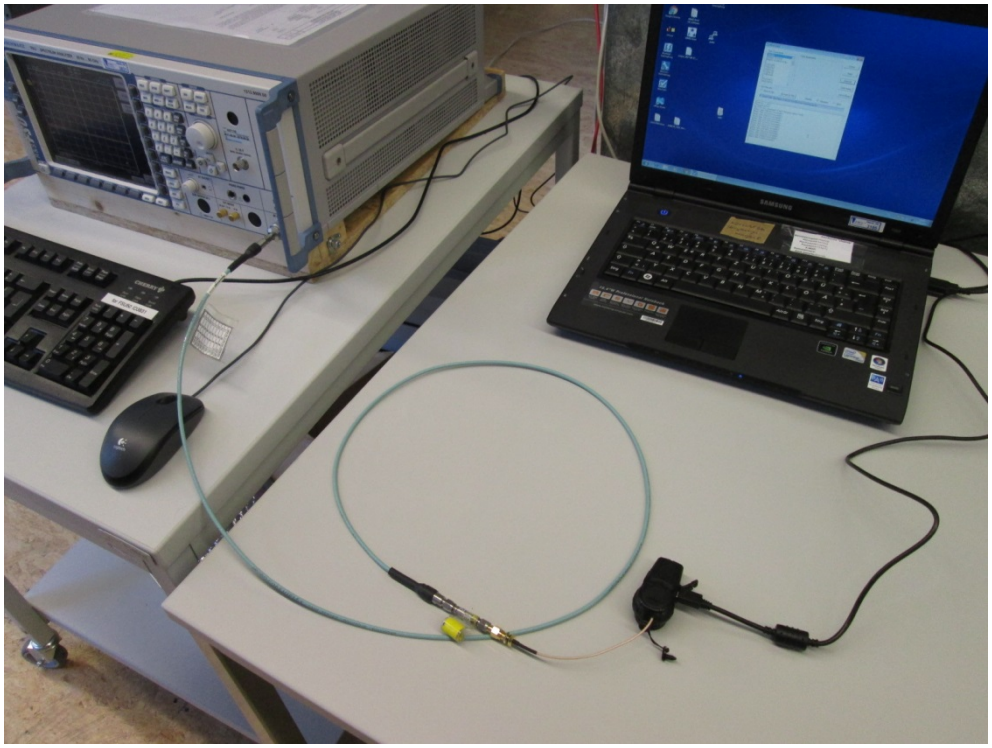


Photo A1-8: Conducted measurements at temporary antenna connector

Annex 2 to Test Report # EMCC-160592H, 2017-12-22

EXTERNAL PHOTOGRAPHS OF EUT

EQUIPMENT UNDER TEST:

Device:	Promate BT COM
Serial Number:	#1 #2
Application:	Bluetooth Headset
FCC ID:	TUFBTCOM
IC:	6574A-BTCOM
Manufacturer:	SAVOX Communications Oy Ab
Address:	Sinikalliontie 3B 02630 Espoo Finland
Phone :	+358 44 961 87 09
RELEVANT STANDARD(S) :	47 CFR 15.107, 15.109, ICES-003 47 CFR § 15.247, RSS-247 Issue 2

MEASUREMENT PROCEDURE:

☒ ANSI C63.10-2013
☒ ANSI C63.4-2014
☒ RSS-Gen Issue 4
☒ DA 00-705, dated 2000-03-30

Photo A2-1: EUT #1 – Top

Photo A2-2: EUT #1 – Rear

Photo A2-3: EUT #1 – Side 1

Photo A2-4: EUT #1 – Side 2

Photo A2-5: EUT #1 – Side 3

Photo A2-6: EUT #1 – Side 4

Photo A2-7: EUT #1 – Label

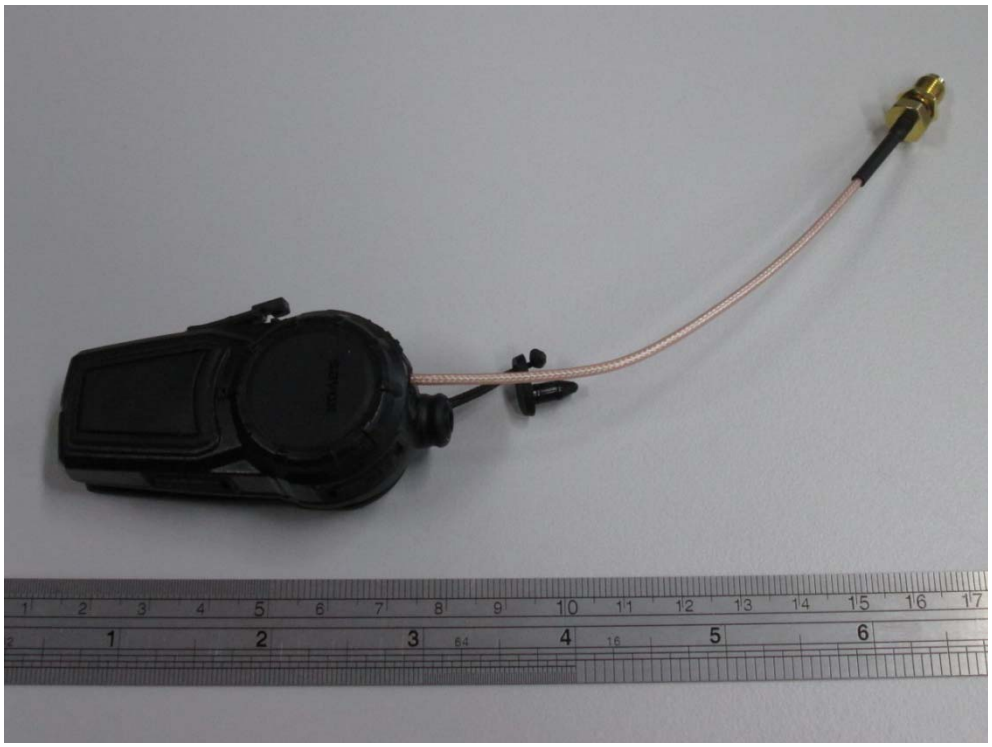


Photo A2-8: EUT #2 (for testing purposes, only) – Top

Photo A2-9: EUT #2 (for testing purposes, only) – Rear

Photo A2-10: EUT #2 (for testing purposes, only) – Label

Annex 3 to Test Report # EMCC-160592H, 2017-12-22

INTERNAL PHOTOGRAPHS OF EUT

EQUIPMENT UNDER TEST:

Device:	Promate BT COM
Serial Number:	#1 #2
Application:	Bluetooth Headset
FCC ID:	TUFBTCOM
IC:	6574A-BTCOM
Manufacturer:	SAVOX Communications Oy Ab
Address:	Sinikalliontie 3B 02630 Espoo Finland
Phone :	+358 44 961 87 09
RELEVANT STANDARD(S) :	47 CFR 15.107, 15.109, ICES-003 47 CFR § 15.247, RSS-247 Issue 2

MEASUREMENT PROCEDURE:

☒ ANSI C63.10-2013
☒ ANSI C63.4-2014
☒ RSS-Gen Issue 4
☒ DA 00-705, dated 2000-03-30

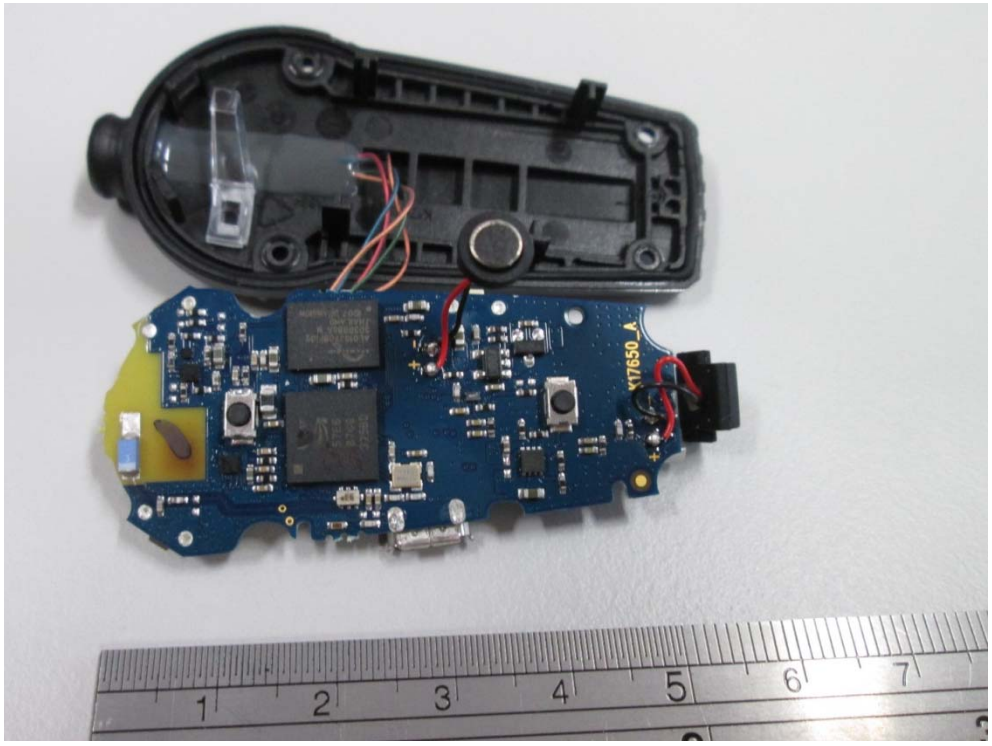


Photo A3-1: EUT #1 – PCB top

Photo A3-2: EUT #1 – PCB bottom

Photo A3-3: EUT #1 – Label on PCB

Photo A3-4: EUT #1 – Label on battery

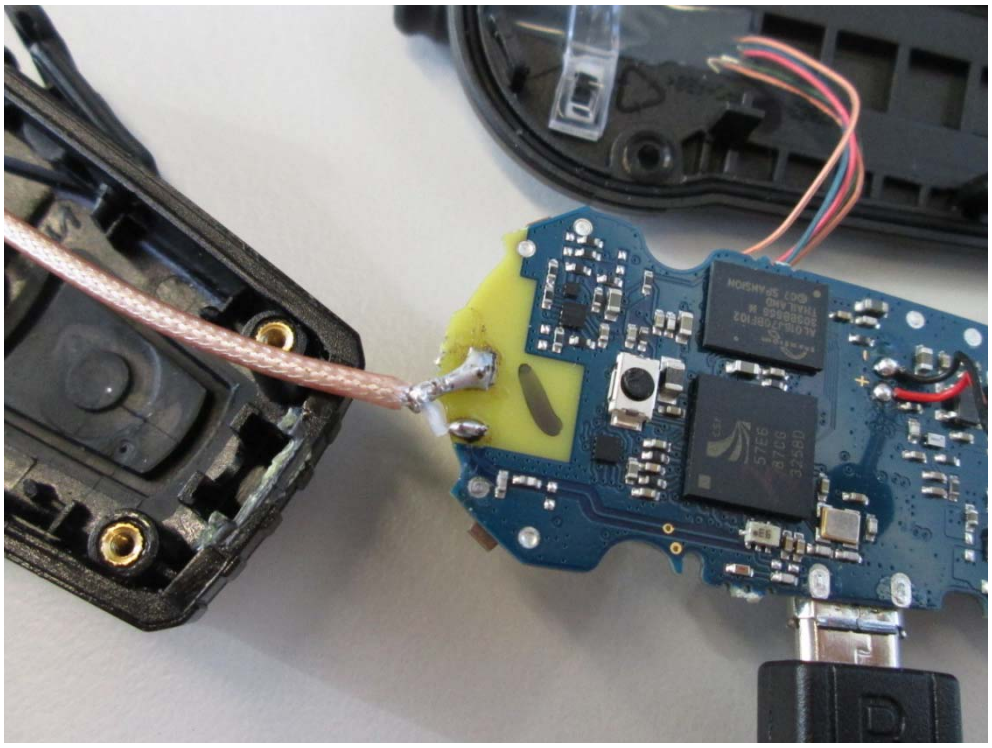


Photo A3-5: EUT #2 (for testing purposes, only) – temporary antenna connector

Annex 4 to Test Report # EMCC-160592H, 2017-12-22

PHOTOGRAPHS OF ANCILLARY EQUIPMENT

EQUIPMENT UNDER TEST:

Device:	Promate BT COM
Serial Number:	#1 #2
Application:	Bluetooth Headset
FCC ID:	TUFBTCOM
IC:	6574A-BTCOM
Manufacturer:	SAVOX Communications Oy Ab
Address:	Sinikalliontie 3B 02630 Espoo Finland
Phone :	+358 44 961 87 09
RELEVANT STANDARD(S) :	47 CFR 15.107, 15.109, ICES-003 47 CFR § 15.247, RSS-247 Issue 2

MEASUREMENT PROCEDURE:

☒ ANSI C63.10-2013
☒ ANSI C63.4-2014
☒ RSS-Gen Issue 4
☒ DA 00-705, dated 2000-03-30

Photo A4-1: USB Cable for charging

Photo A4-2: Headset