REPORT

issued by an Accredited Testing Laboratory

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2019-12-16

Reference
9P08169

Husqvarna AB
Drottninggatan 2
561 82 HUSKVARNA

Equipment Authorization measurements on 2402-2480 MHz Transceiver Unit

Test object

Product name: Husqvarna Brushcutter 535iRXT with BLE User Interface Medium (UI-M)
Article no: 967850601
Serial no: 08
Contains: FCC id: ZAS-HQ-HH-001
IC: 23307-HQHH001

RISE Research Institutes of Sweden AB
Electronics - EMC

Performed by

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Monika Fuller

Accred. No. 1002
Testing
ISO/IEC 17025

Table of Content

Summary 3

Commission 4

Test object 4

Operational test mode 6

Ancillary and/or support equipment 6

References 7

Uncertainties 8

Test results 9

Restricted bands of operation measurements according to FCC 47 CFR part 15.247 (d) / RSS-247 5.5 9

Band edge measurements according to 47CFR 2.1049 / RSS-247 5.5 26

Photos 32

Summary

Standard	Compliant	Remarks
FCC 47 CFR Part 15 C 15.247 Operation within the band 2400-2483.5 MHz		Note 1
ISED RSS-247 Issue 2, February 2017		Note 1
15.247 (d) / RSS-247 5.5 Unwanted emission	Yes	
2.1049 / RSS-247 5.5 Band Edge	Yes	

Note 1: The test was performed to verify that the object complies with the Tx unwanted emissions according to 15.247 (d)/RSS-247 Issue 2, 5.5 (unwanted emission) when the pre-approved radio module is mounted in the final host.

Commission

The tests were performed to verify that the electromagnetic emission from the test object meets the requirements of radiated spurious and band edge measurements according to FCC Part 15C and RSS-247.

Manufacturer representative

Therese Berg
Husqvarna AB
Drottninggatan 2
561 82 Huskvarna

Test object

Robust and high-efficiency battery-powered clearing saw adapted for use in grass, silt and less forest vegetation. Well balanced and light weight. Weather resistant (IPX4).
A Bluetooth radio (BLE) is integrated in the User Interface medium (UI-M) of the clearing saw. The UI-M also controls other functions with the keypad which are indicated by LED.

The UI-M is mainly supplied by regulated DC voltage +9VDC through a motor controller that are sourced from the 36V battery. The UI-M also has the possibility to function during a limited time powered from a 3V coin cell battery.

UI-M is running from an 32 MHz oscillator and the Real-Time Clock is provided from a oscillator with frequency 32.768 kHz.

Illustrative picture of assembled User Interface

Transceiver	User Interface Medium (UI-M)
Husqvarna art. number:	592 64 78 - 01
Certified for USA	FCC id: ZAS-HQ-HH-001
Certified for Canada	IC: 23307-HQHH001
Antenna:	Integral, Ceramic Chip Antenna, 2450AT18E0100
Antenna gain, Peak (typical):	1 dBi
Antenna gain, Average (typical):	-3 dBi
Frequency range:	2402-2480 MHz
Frequencies used during test:	2402, 2440 and 2480 MHz
Output power, max, setting	0dBm
Modulation:	GFSK
Channel bandwidth	2 MHz
Data rate (max):	2 Mbit/s
Software:	S132 v5.0.0 (Bluetooth soft device)

The EUT was tested stand-alone, not equipped with any external cables.
The test object was tested in one orientation, normal use, specified by the client.

The highest frequency generated in the EUT is the radio module, 2480 MHz.

The test items were delivered to RISE 2019-11-20.

Testing was carried by Maulo Rivera Avalos and Fredrik Isaksson at 2019-11-20—2019-11-22.

Operational test mode

The EUT was tested as a table top, which deemed to be worst case.

The EUT was in standby/idle mode (motor not running).
The BLE radio in the UI unit was set to continuous transmission (100% duty cycle) and with normal modulation (random pattern).
A laptop was used to set the BLE radio to the specific modes.
A software called Radiotest, Nordic's SDK 15.3 is used to control DUT and put the radio in different modes such as Modulated TX carrier with specified duty cycle. Several parameters can also be adjusted like :Channels used, Duty Cycle and Output Power.

The EUT was powered by the 36 V DC internal battery. The voltage of the battery was checked regularly during the measurements.

Test was performed at lowest, middle and the highest channel.

Ancillary and/or support equipment

Lap top PC, Dell DP/N: TTYFJ ADO with dedicated software	Client equipment
Software used during radio test: - Radiotest, Nordic's SDK 15.3	Client software

Measurement equipment

Measurement equipment	RISE number	Calibration Due
Semi anechoic chamber, Edison	504114	2021-09
Computer Lenovo ThinkCentre	-	-
Software R&S EMC32, ver.10.50.40	503889	-
EMI test receiver R&S ESU 26	902210	2020-07
Emco 6502, Active loop antenna	502916	2020-05
Antenna Schaffner CBL 6143	504079	2021-07
Antenna ETS-Lindgren 3115	902212	2021-11
Standard gain horn Flann 16240-20	503673	2021-01
Standard gain horn Flann 18240-20	503673	2021-01
Standard gain horn Flann 20240-20	BX92412	2021-01
Low Noise Amplifier Schwarzbeck BBV9742	504085	2020-02
Low Noise Amplifier Miteq	504160	2020-01
Low Noise Amplifier Miteq	503278	2020-01
3 GHz High pass filter Wainwright WHNX	901502	2020-06
Coaxial cable	BX32218	2020-06
Coaxial cable	504102	2020-03
Coaxial cable	504103	2020-03
Coaxial cable	504104	2020-03
Coaxial cable	503989	2020-01
Coaxial cable	503697	2020-01
Multimeter Fluke 83	501522	2020-06
Temperature and humidity meter Testo 625	504117	2020-06

Test facility

The used semi-anechoic chamber is compliant with ANSI C63.4. RISE is an ISO 17025 accredited test facility for Electromagnetic Compatibility (EMC) and Radio testing. RISE is a Recognized Lab under FCC and ISED (registration No. 3482A) rules.

References

Measurements were done according to relevant parts of the following standards:

ANSI 63.10-2013
eCFR 47, part 15 C, November 2019
RSS-247, Issue 2
RSS-Gen Issue 5
KDB 558074 D01 DTS Meas Guidance v05r02 (2019-04)
KDB 996369 D04 Module Integration Guide v01 (2019-02)

Uncertainties

Measurement and test instrument uncertainties are described in the quality assurance documentation ”SP-QD 10885”. The uncertainties are calculated with a coverage factor k=2 (95% level of confidence). The measurement uncertainties can be found in the table below:

Method	**Uncertainty**
Radiated emission, 9 kHz - 30 MHz	5.3 dB
Radiated emission, 30 – 1000 MHz	6.3 dB
Radiated emission, 1 – 6 GHz	5.2 dB
Radiated emission, 6-40 GHz	5.6 dB

Compliancy evaluation is based on a shared risk principle with respect to the measurement uncertainty.

The test results apply to the tested items only
The test results in this report apply only to the particular Equipment Under Test (EUT) as declared in the report.

Test participant

Fredrik Moll, Husqvarna AB (partly present)

Test results

Restricted bands of operation measurements according to FCC 47 CFR part 15.247 (d) / RSS-247 5.5

Date	Temperature	Humidity
2019-11-20	22 °C ± 3 °C	35 % ± 5 %
2019-11-21	22 °C ± 3 °C	37 % ± 5 %
2019-11-22	21 °C ± 3 °C	37 % ± 5 %
2019-11-22: Asphalt surface	8 °C ± 3 °C	82 % ± 5 %

Test setup and procedure

The measurements were performed according to ANSI C63.10, clause 11.12.

The test was performed with continuous transmission (100% duty cycle) and with normal modulation.

The test of radiated emission was performed in a semi anechoic chamber.
The EUT height was 0.8 m for frequencies below 1GHz and 1.5 m height above 1 GHz.

Measurements below 30 MHz:
The measurements were performed with three perpendicular antenna positions.
The pre-measurement of radiated emission was performed in a semi anechoic chamber at 3 m distance.
The final measurement of radiated emission was performed on an asphalt surface at 10 m distance, if needed.

1. A pre-measurement is performed with peak detector. The test object is scanned 360 degrees with max hold peak detector.
2. If the emission is close or above the limit during the pre-measurement a final measurement is performed on an asphalt surface at 10 m distance. The test object is scanned 360 degrees for maximum response with peak detector. Then the emission is measured with the quasi-peak detector according to 15.209(d).

Measurements above 30 MHz:
The measurements were performed with both horizontal and vertical polarizations of the antenna. The antenna distance was 3.0 m in the frequency range 30 MHz-18 GHz and 1.0 m in the frequency range 18-26 GHz.

The measurement procedure is as follows:

1. A pre-measurement is performed with peak detector. For measurement < 1 GHz the test object is measured in eight directions with the antenna at three heights, 1.0 m, 1.5 m and 2.0 m. For measurement between 1 GHz – 26 GHz the test object is measured in seventeen directions with the antenna at three heights, 1.0 m, 1.5 m and 2.0 m.

2. For measurements in the frequency range 1 – 18 GHz, RF absorbers were covering an floor area to comply with site validation requirements according to CISPR 16-1-4:2010.

3. If the emission is close or above the limit during the pre-measurement, the test object is scanned 360 degrees and the antenna height scanned from 1 to 4 m for maximum response. Then the emission is measured with the quasi-peak detector on frequencies below 1 GHz and with the average detector above 1 GHz.

The measurement was first performed with peak detector.
The following RBW were used:
9kHz – 150 kHz: RBW = 200 Hz
150 KHz – 30 MHz: RBW= 9 kHz
30 MHz-1 GHz: RBW=120 kHz
1-26 GHz: RBW=1 MHz

Test set-up photos during the tests can be found in the photo section in the end of the report.

Measurement equipment	RISE number
Semi anechoic chamber, Edison	504114
Computer Lenovo ThinkCentre	-
Software R&S EMC32, ver.10.50.40	503889
EMI test receiver R&S ESU 26	902210
Emco 6502, Active loop antenna	502916
Antenna Schaffner CBL 6143	504079
Antenna ETS-Lindgren 3115	902212
Standard gain horn Flann 16240-20	503673
Standard gain horn Flann 18240-20	503673
Standard gain horn Flann 20240-20	BX92412
Coaxial cable	BX32218
Coaxial cable	504102
Coaxial cable	504103
Coaxial cable	504104
Coaxial cable	503697
Low Noise Amplifier Schwarzbeck BBV9742	504085
Low Noise Amplifier Miteq	504160
Low Noise Amplifier Miteq	503278
3 GHz High pass filter Wainwright WHNX	901502
Multimeter Fluke 83	501522
Temperature and humidity meter Testo 625	504117

Results

The pre-test emission spectra in semi anechoic chamber at 3 m with the active loop antenna below 30 MHz can be found in the diagrams below:

Diagram 1:	9 kHz-150 kHz, Ambient, antenna pos A
Diagram 2:	150 kHz-30 MHz, Ambient, antenna pos A
Diagram 3:	9 kHz-150 kHz, 2402 MHz, antenna pos A
Diagram 4:	150 kHz-30 MHz, 2480 MHz, antenna pos A
Diagram 5:	9 kHz-150 kHz, 2440 MHz, antenna pos B
Diagram 6:	150 kHz-30 MHz, 2402 MHz, antenna pos B
Diagram 7:	9 kHz-150 kHz, 2440 MHz, antenna pos C
Diagram 8:	150 kHz-30 MHz, 2440 MHz, antenna pos C

Note: Only worst-case plots are attached.

No unwanted emissions were detected in the frequency range 150 kHz – 30 MHz during the pre-test.

Free field measurements at asphalt surface were performed in antenna position A, B and C at the frequencies 18.02 kHz and 67.84 kHz at mid channel (worst case regarding 18.02 kHz and 67.84 kHz) at 10 m measurement distance, no unwanted emission from the EUT could be detected at these frequencies above the ambient emission level.

The emission spectra in semi anechoic chamber at 3m in the frequency range above 30 MHz can be found in the diagrams below:

Diagram 9:	30-1000 MHz, Ambient, vertical and horizontal polarization
Diagram 10:	30-1000 MHz, 2440 MHz, vertical and horizontal polarization
Diagram 11:	1-3 GHz, Ambient, vertical and horizontal polarization
Diagram 12:	1-3 GHz, 2402 MHz, vertical and horizontal polarization
Diagram 13:	3-8.2 GHz, Ambient, vertical and horizontal polarization
Diagram 14:	3-8.2 GHz, 2440 MHz, vertical and horizontal polarization
Diagram 15:	8.2-12.5 GHz, Ambient, vertical and horizontal polarization
Diagram 16:	8.2-12.5 GHz, 2440 MHz, vertical and horizontal polarization
Diagram 17:	12.5-18 GHz, Ambient, vertical and horizontal polarization
Diagram 18:	12.5-18 GHz, 2440 MHz, vertical and horizontal polarization
Diagram 19:	18-26 GHz, Ambient, vertical and horizontal polarization
Diagram 20:	18-26 GHz, 2440 MHz, vertical and horizontal polarization

Note: Only worst-case plots are attached.

The highest detected levels during the final measurement in the frequency range 30 MHz-26 GHz are listed in the tables below.

2402 MHz

Frequency (MHz)	QP level (dBµV/m)	CISPRAV level (dBµV/m)	Peak level (dBµV/m)	Corr (dB)	Limit (dBµV/m)	Height (cm)	Azimuth (deg)	Pol.
36.698	24.7	N/A	**33.7**	25.5	20 dBc **)	145	348	Vertical
37.165	23.4	N/A	**32.2**	25.3	20 dBc **)	127	64	Vertical
63.015	26.5	N/A	**31.9**	16.4	20 dBc **)	100	304	Vertical
77.470	25.5	N/A	**29.5**	14.4	20 dBc **)	185	78	Vertical
103.055	20.9	N/A	**28.2**	17.5	20 dBc **)	270	189	Horizontal
144.054	23.0	N/A	**28.3**	19.2	20 dBc **)	202	49	Horizontal
2273.759	N/A	**42.7**	**49.7**	9.1	53.9 (AV)	126	220	Horizontal
2295.161	N/A	**33.0**	**46.1**	9.1	53.9 (AV)	119	217	Horizontal
2314.619	N/A	**31.9**	**44.7**	9.1	53.9 (AV)	160	294	Horizontal
2401.762 *)	N/A	**93.3**	**95.2**	9.2	53.9 (AV)	118	88	Vertical
2530.184	N/A	N/A	**48.9**	9.1	20 dBc **)	107	83	Vertical
4804.125	N/A	**44.7**	**50.3**	-8.4	53.9 (AV)	277	183	Vertical
7206.705	N/A	N/A	**53.8**	-0.3	20 dBc **)	160	78	Horizontal
9609.000	N/A	N/A	**47.4**	-6.0	20 dBc **)	150	51	Horizontal

*) Fundamental. The fundamental was re-measured (pk det) with RBW=100 kHz for the 20 dBc limit, the peak level with RBW=100 kHz was 94.6 dBuV/m.

**) Not in a restricted band, the limit is 20 dBc.

2440 MHz

Frequency (MHz)	QP level (dBµV/m)	CISPRAV level (dBµV/m)	Peak level (dBµV/m)	Corr (dB)	Limit (dBµV/m)	Height (cm)	Azimuth (deg)	Pol.
36.445	25.2	N/A	**33.7**	25.6	20 dBc **)	122	29	Horizontal
36.860	25.5	N/A	**34.6**	25.5	20 dBc **)	139	0	Horizontal
63.628	27.8	N/A	**32.2**	16.3	20 dBc **)	106	248	Vertical
76.083	25.3	N/A	**30.7**	14.6	20 dBc **)	232	80	Vertical
101.774	21.9	N/A	**29.5**	17.3	20 dBc **)	277	204	Horizontal
144.092	22.8	N/A	**28.0**	19.2	20 dBc **)	189	300	Horizontal
2311.622	N/A	**43.3**	**50.6**	9.2	53.9 (AV)	121	83	Vertical
2333.514	N/A	**35.1**	**47.5**	9.2	53.9 (AV)	120	85	Vertical
2439.714 *)	N/A	**91.6**	**93.9**	9.2	53.9 (AV)	115	89	Vertical
2568.062	N/A	N/A	**48.0**	9.5	20 dBc **)	109	99	Vertical
4879.981	N/A	**46.1**	**51.4**	-8.3	53.9 (AV)	247	174	Vertical
7320.683	N/A	**42.9**	**52.4**	-0.1	53.9 (AV)	148	168	Horizontal
9759.009	N/A	N/A	**47.4**	-5.6	20 dBc **)	147	49	Horizontal

*) Fundamental. The fundamental was re-measured (pk det) with RBW=100 kHz for the 20 dBc limit, the peak level with RBW=100 kHz was 93.7 dBuV/m.

**) Not in a restricted band, the limit is 20 dBc.

2480 MHz

Frequency (MHz)	QP level (dBµV/m)	CISPRAV level (dBµV/m)	Peak level (dBµV/m)	Corr (dB)	Limit (dBµV/m)	Height (cm)	Azimuth (deg)	Pol.
36.240	24.9	N/A	**33.3**	25.6	20 dBc **)	146	220	Horizontal
37.113	25.1	N/A	**34.2**	25.5	20 dBc **)	156	133	Vertical
63.077	28.0	N/A	**33.3**	16.3	20 dBc **)	110	256	Vertical
75.040	24.9	N/A	**30.4**	14.6	20 dBc **)	205	53	Vertical
102.491	22.1	N/A	**29.7**	17.3	20 dBc **)	113	36	Vertical
146.529	22.5	N/A	**27.7**	19.2	20 dBc **)	176	23	Horizontal
2351.983	N/A	**45.4**	**51.5**	9.2	53.9 (AV)	118	88	Vertical
2479.690 *)	N/A	**90.0**	**95.2**	9.1	53.9 (AV)	115	92	Vertical
2607.907	N/A	N/A	**47.3**	9.9	20 dBc **)	194	46	Horizontal
4959.415	N/A	**41.6**	**50.1**	-8.3	53.9 (AV)	242	160	Vertical
7439.215	N/A	**41.7**	**52.0**	-0.2	53.9 (AV)	190	165	Horizontal
9918.915	N/A	N/A	**44.3**	-6.1	20 dBc **)	148	48	Horizontal

*) Fundamental. The fundamental was re-measured (pk det) with RBW=100 kHz for the 20 dBc limit, the peak level with RBW=100 kHz was 92.6 dBuV/m.

**) Not in a restricted band, the limit is 20 dBc.

Note: The calculation of the measured radiated E-field signal level is given by:

E (dBuV/m) = V (dBuV) + Cl_1 (dB) - PAG (dB) + HPF (dB)+ Cl_2 (dB) + AF (dB/m)

Where:

E (dBuV/m) = Measured E-field

Cl_1 (dB) = Loss in cable 1

PAG (dB) = PreAmplifier Gain

HPF (dB) = High Pass Filter

Cl_2 (dB) = Loss in cable 2

V (dBuV) = Spectrum analyser value

Limits

Below 30 MHz:
The limits below 30 MHz are given for different measurement distances, according to 47CFR 15.209 (a). The limits below are converted to 3 m by using the extrapolation factor 40 dB/decade (§15.31). Below 30 MHz the field strength is converted to magnetic field units, dBµA/m, by subtracting with 51.5 dB (20xLOG(377)) since it is measured with a magnetic loop antenna.

Frequency (MHz)	Field strength (dBµV/m)@3m	Field strength (dBµA/m)@3m	Field strength (dBµA/m)@10m
0.009-0.490	128.5-93.8	77.0-42.3	56.1-21.4
0.490-1.705	73.8-63.0	22.3-11.5	1.4- -9.4
1.705-30.0	69.5	18.0	-2.9
30-88	40.0		
88-216	43.5		
216-960	46.0		
960-1000	54.0		

Note: The FCC limit in the limit table above below 30 MHz is calculated with the extrapolation factor 40 dB/decade and converted to magnetic field (dBµA/m).

According to 47CFR 15.209 (d), the field strength limit is given for the quasi-peak value except that the average value is valid in the band 9-90 kHz and 110-490 kHz.

Above 30 MHz:
According to 47CFR 15.247(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.
Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a).

According to RSS-247 5.5, in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator 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 A8.4(4), 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.

According to 15.35(b) there is also a limit on the peak level of the radio frequency emission, the limit on the peak radio frequency emission is 20 dB above the maximum permitted average emission limit applicable to the equipment under test.

Test engineers: Maulo Rivera Avalos and Fredrik Isaksson

Complies?	Yes

Measuring distance: 3 m

Diagram 1

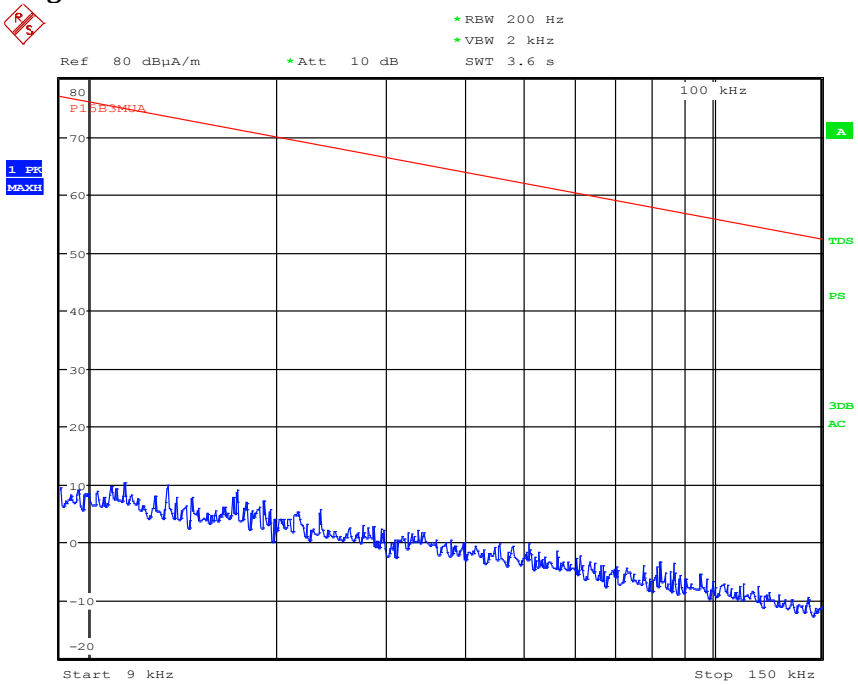

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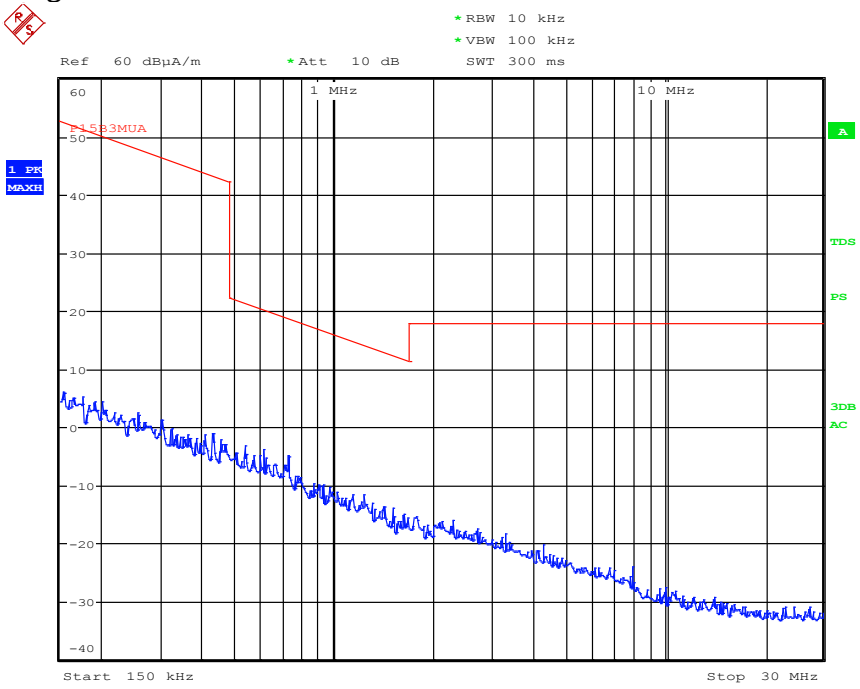
Diagram 2



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Measuring distance: 3 m

Diagram 3

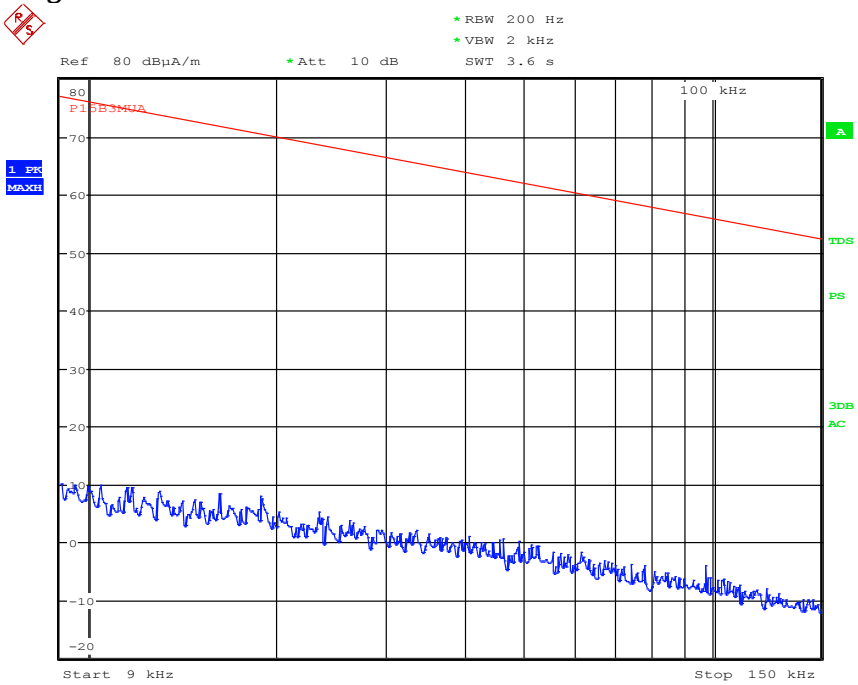

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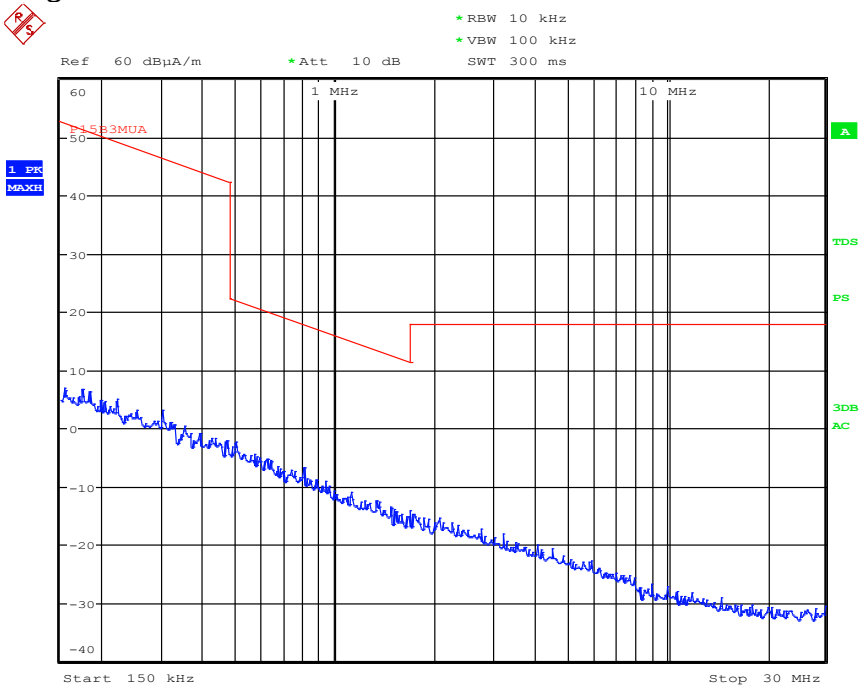
Diagram 4



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Measuring distance: 3 m

Diagram 5

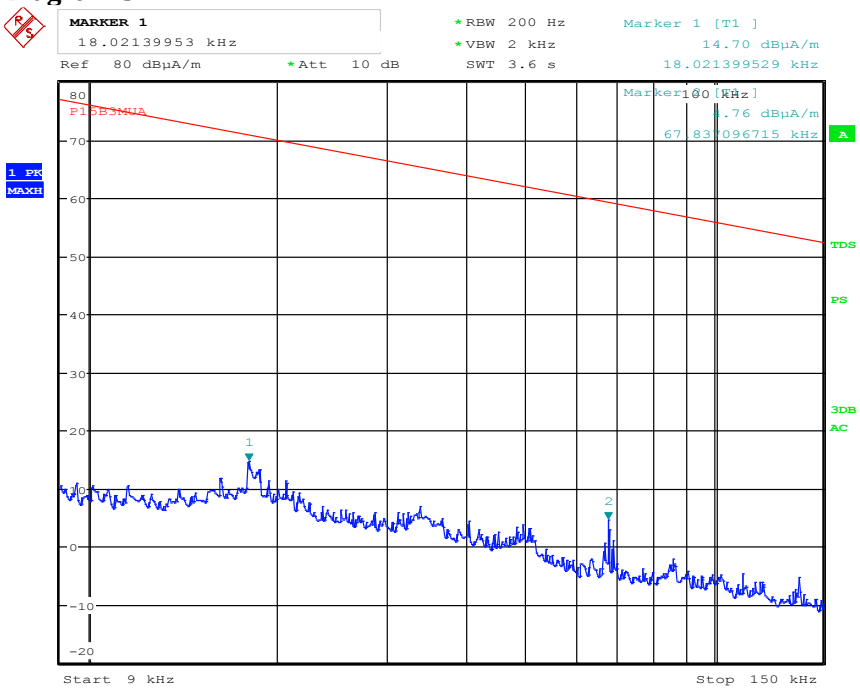

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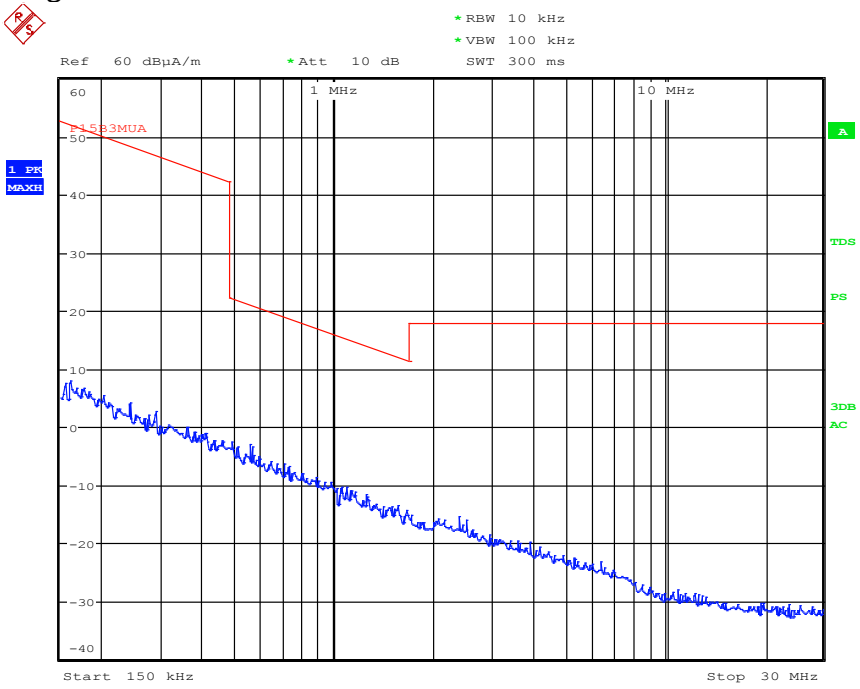
Diagram 6



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Measuring distance: 3 m

Diagram 7

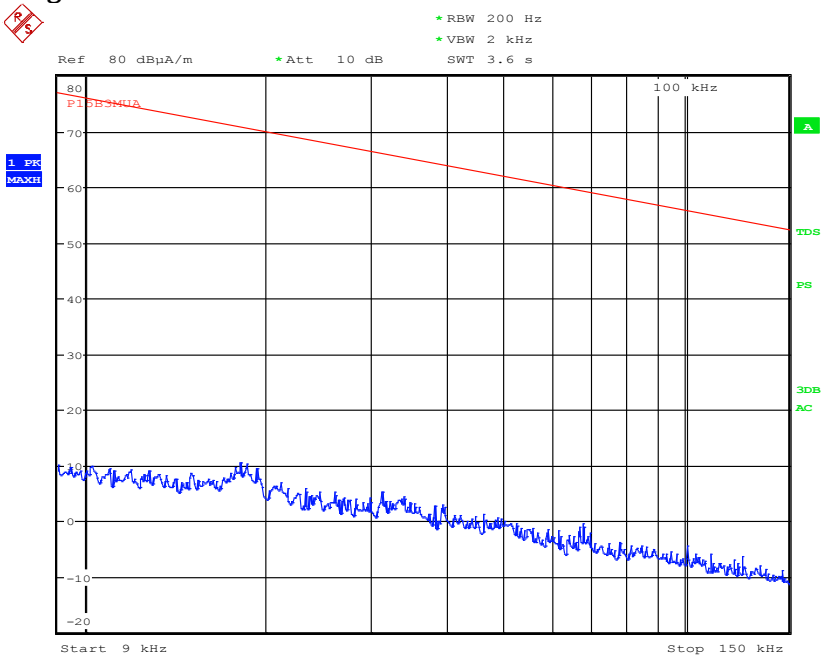

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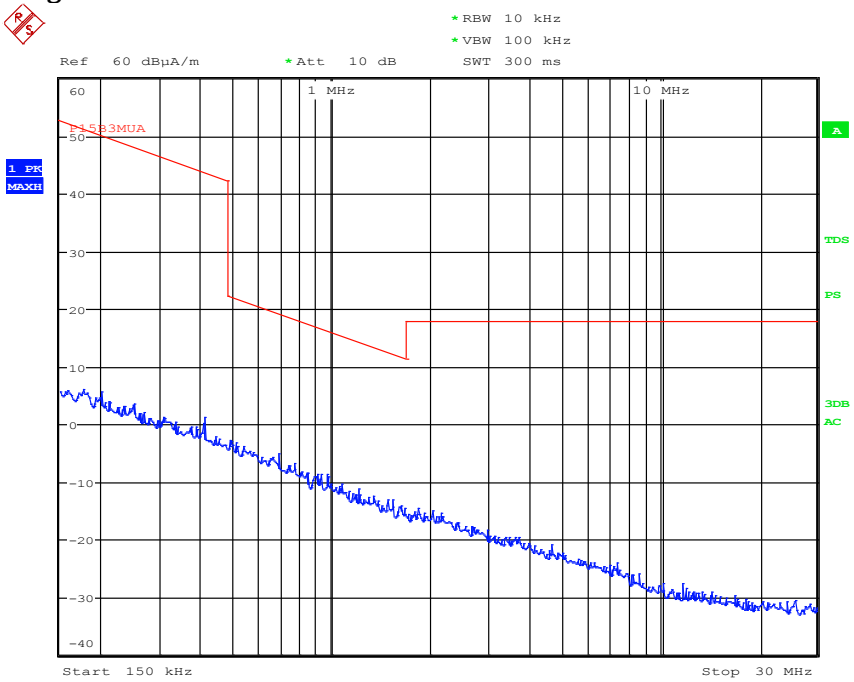
Diagram 8



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Measuring distance: 3 m

Diagram 9

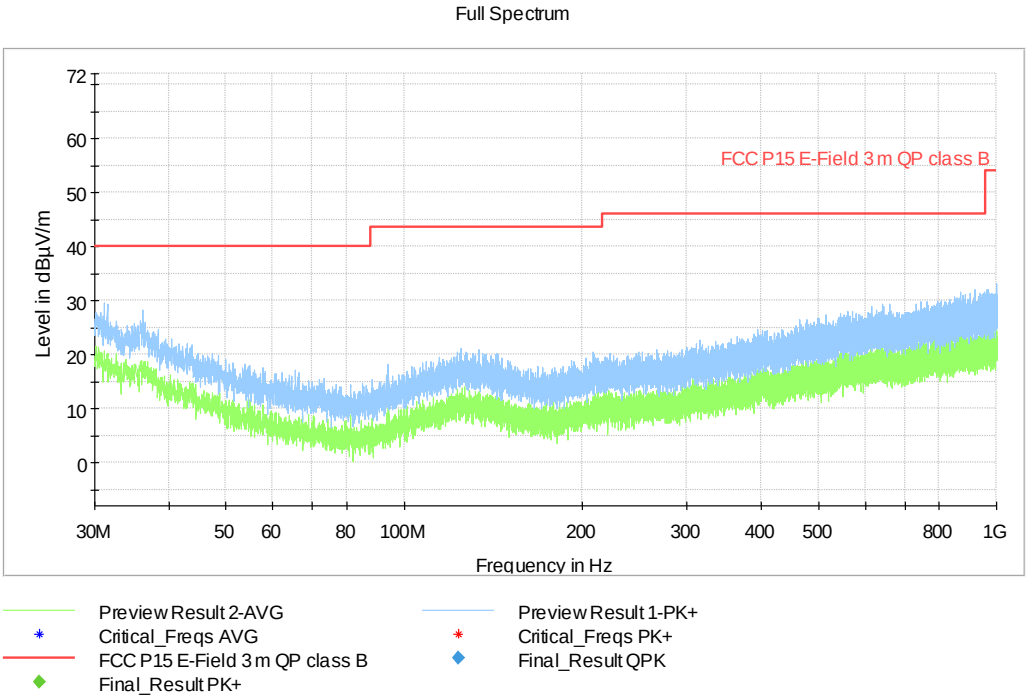
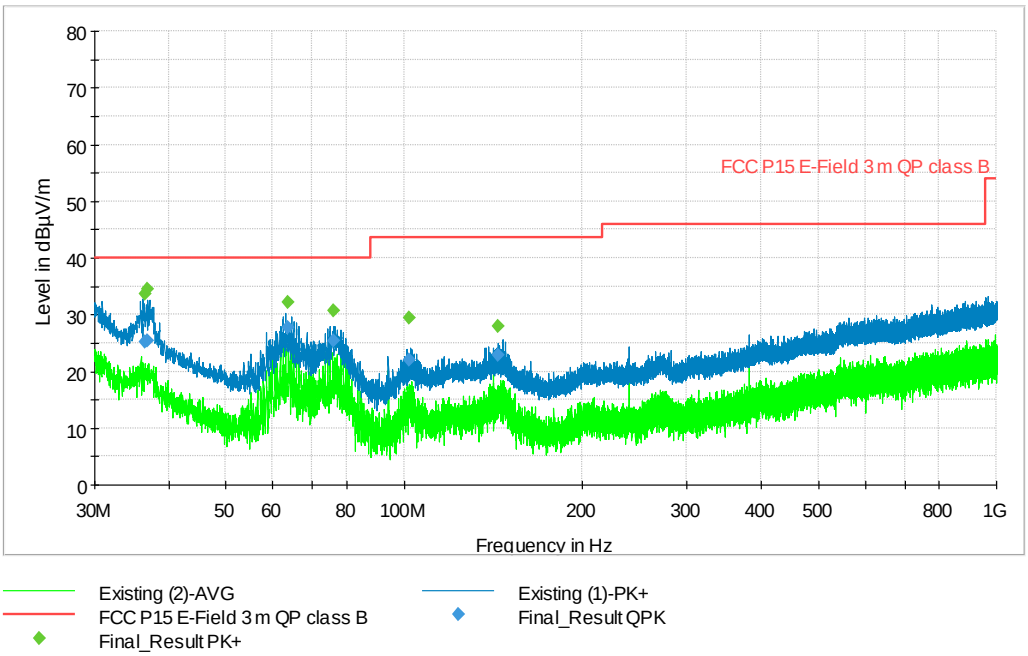


Diagram 10



Measuring distance: 3 m

Diagram 11

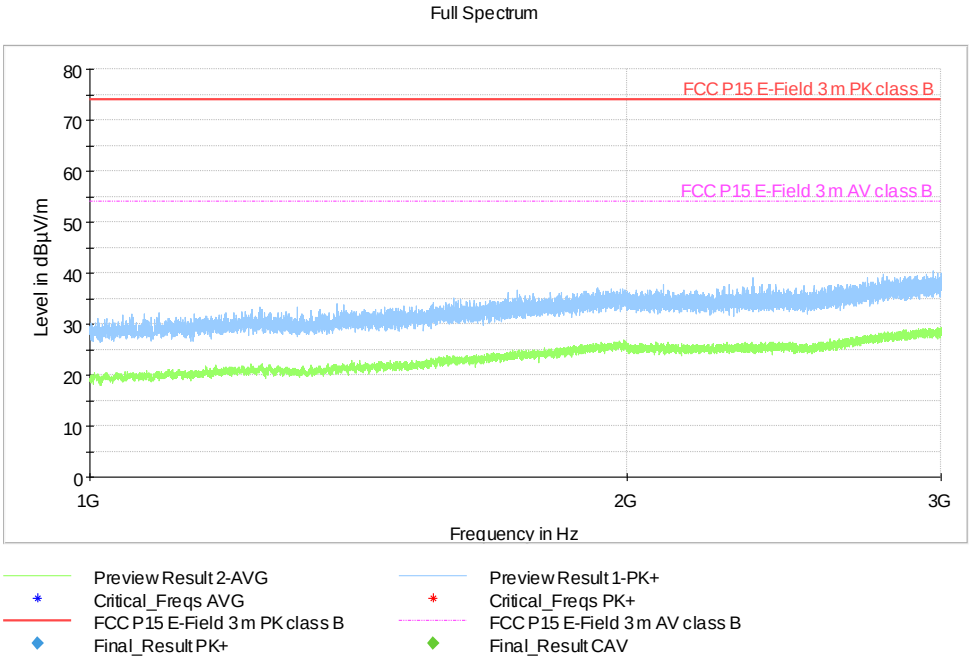
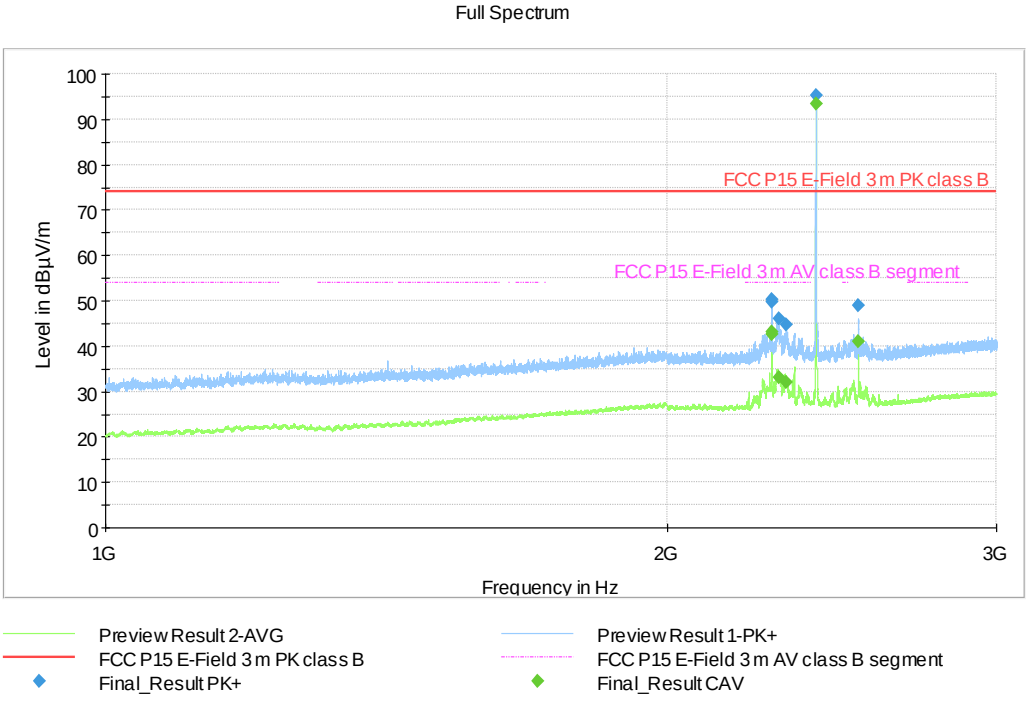


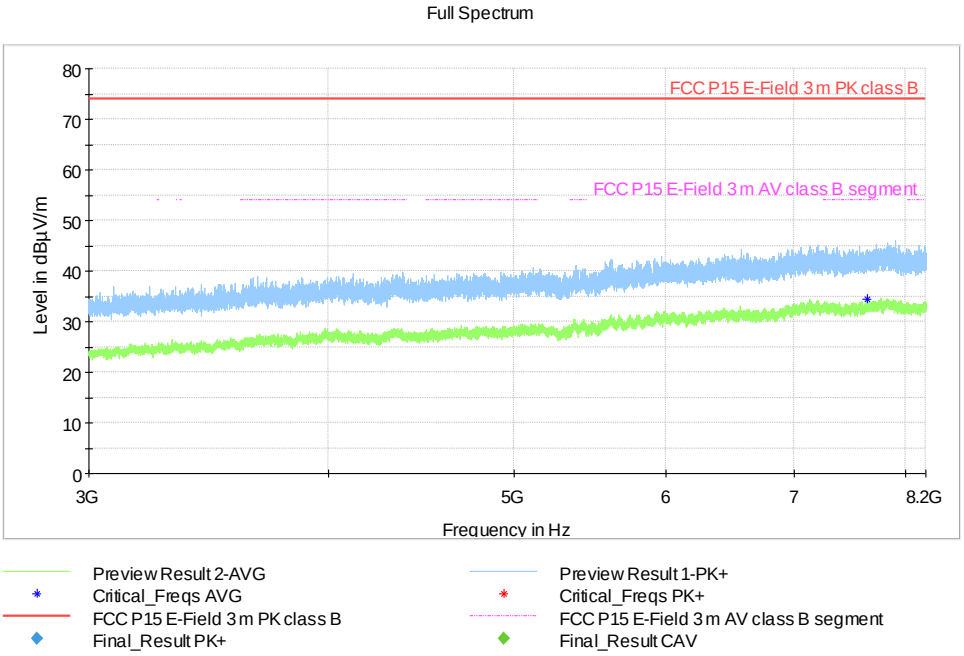
Diagram 12



Note: The purple limit FCC P15 E-field 3 m AV class B segment is the limit according to §15.247(d), where a limit is presented is the limit according to §15.205 and §15.209 and where no limit is presented the 20 dBc limit apply.

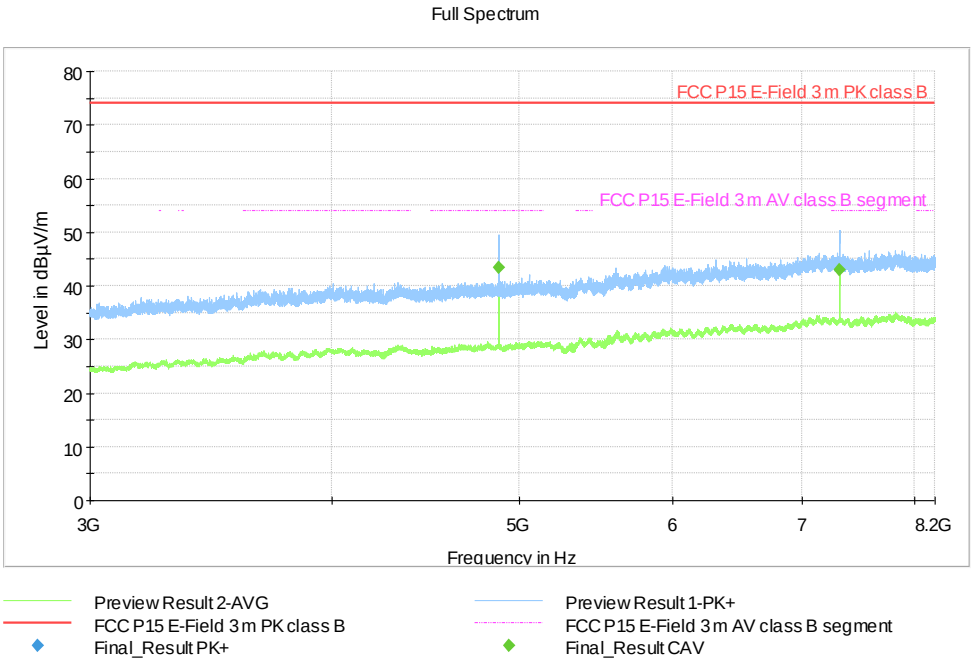
Measuring distance: 3 m

Diagram 13



Note: The purple limit FCC P15 E-field 3 m AV class B segment is the limit according to §15.247(d), where a limit is presented is the limit according to §15.205 and §15.209 and where no limit is presented the 20 dBc limit apply.

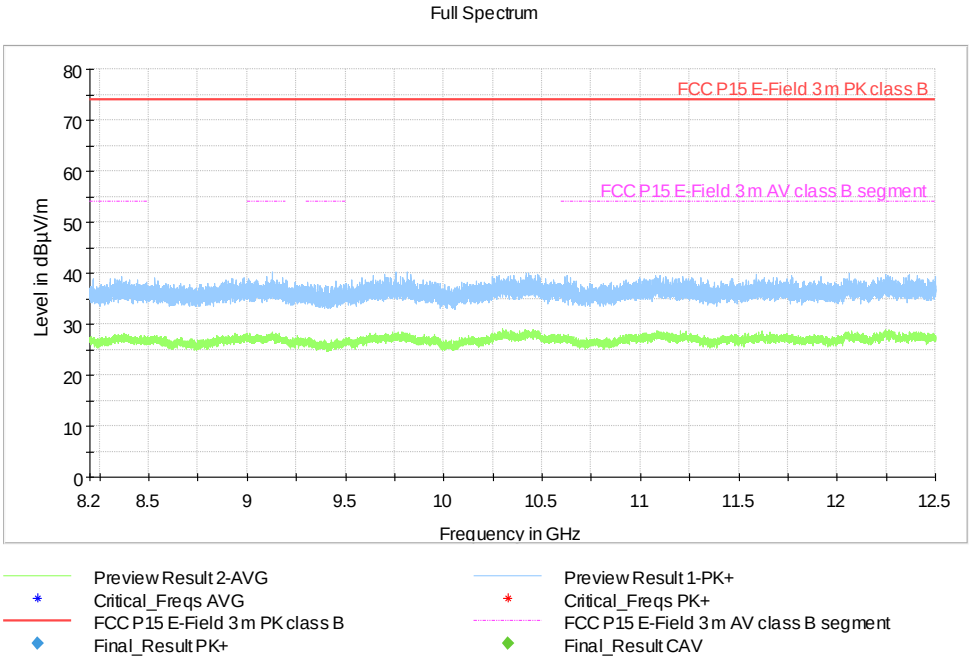
Diagram 14



Note: The purple limit FCC P15 E-field 3 m AV class B segment is the limit according to §15.247(d), where a limit is presented is the limit according to §15.205 and §15.209 and where no limit is presented the 20 dBc limit apply.

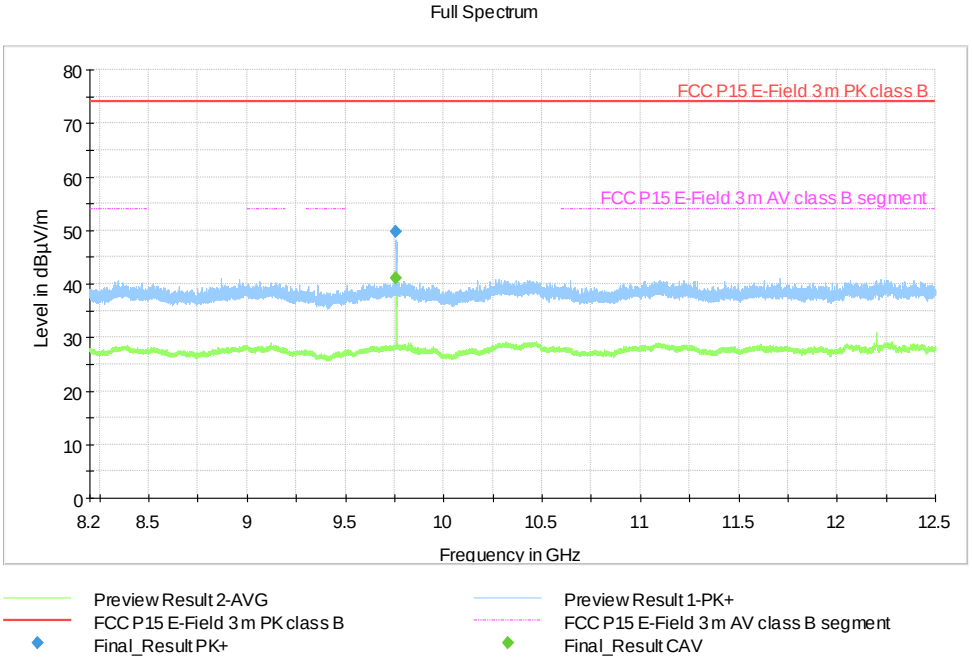
Measuring distance: 3 m

Diagram 15



Note: The purple limit FCC P15 E-field 3 m AV class B segment is the limit according to §15.247(d), where a limit is presented is the limit according to §15.205 and §15.209 and where no limit is presented the 20 dBc limit apply.

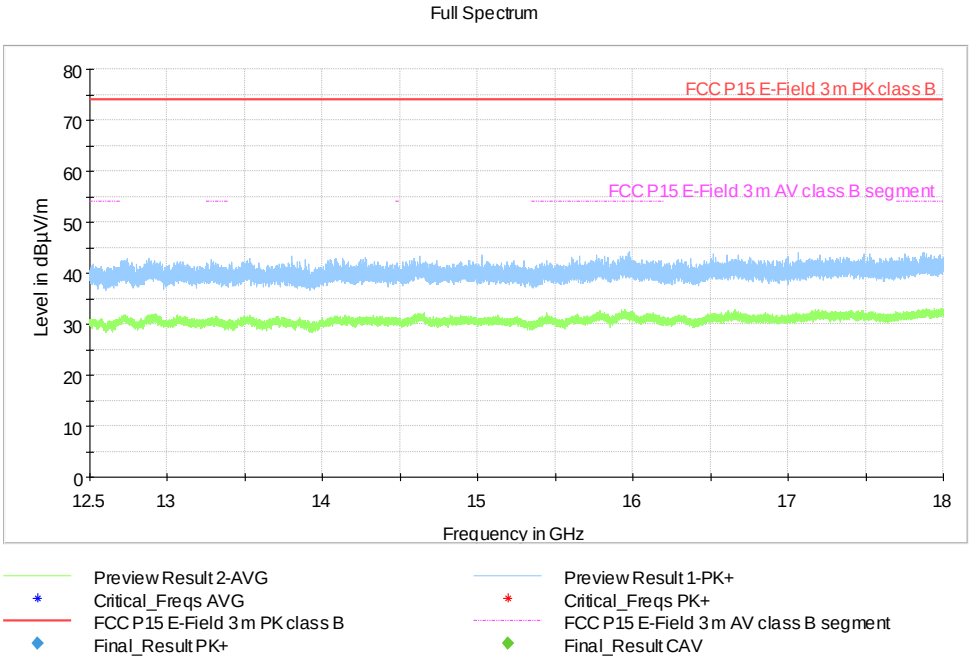
Diagram 16



Note: The purple limit FCC P15 E-field 3 m AV class B segment is the limit according to §15.247(d), where a limit is presented is the limit according to §15.205 and §15.209 and where no limit is presented the 20 dBc limit apply.

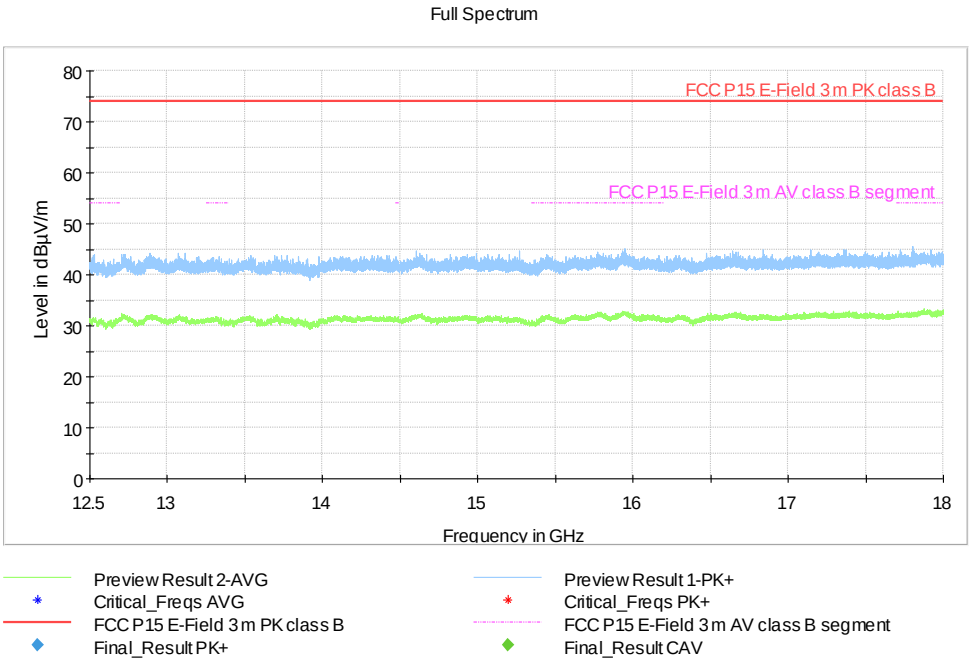
Measuring distance: 3 m

Diagram 17



Note: The purple limit FCC P15 E-field 3 m AV class B segment is the limit according to §15.247(d), where a limit is presented is the limit according to §15.205 and §15.209 and where no limit is presented the 20 dBc limit apply.

Diagram 18



Note: The purple limit FCC P15 E-field 3 m AV class B segment is the limit according to §15.247(d), where a limit is presented is the limit according to §15.205 and §15.209 and where no limit is presented the 20 dBc limit apply.

Measuring distance: 1 m

Diagram 19

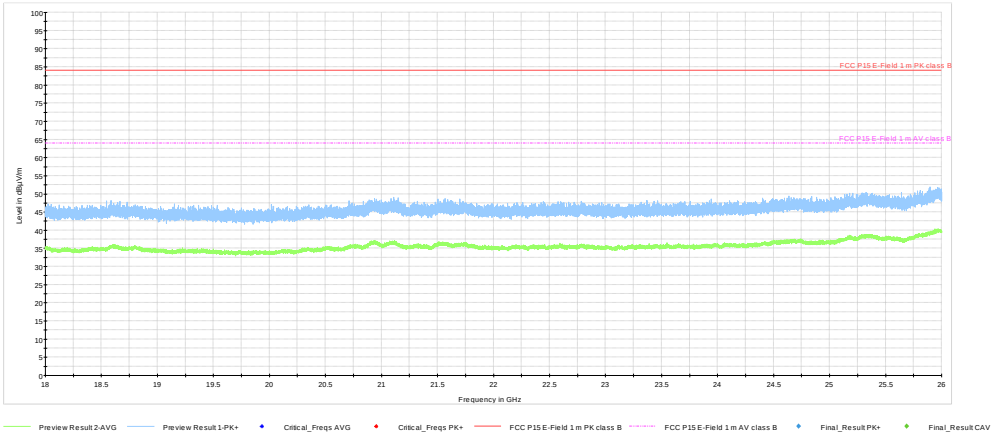
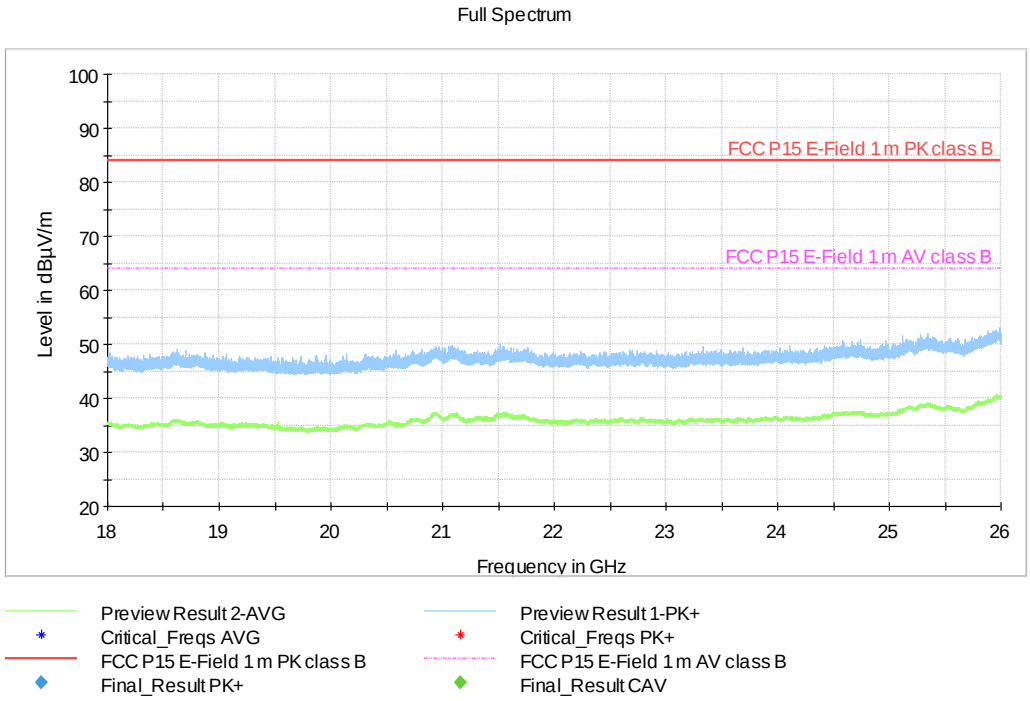


Diagram 20



Band edge measurements according to 47CFR 2.1049 / RSS-247 5.5

Date	Temperature	Humidity
2019-11-20	22 °C ± 3 °C	35 % ± 5 %

Test setup and procedure

The measurements were performed according to ANSI C63.10, see below which clauses that have been used.

The test was performed with continuous transmission (100% duty cycle) and with normal modulation.

The radiated measurements were performed in a semi anechoic chamber. The measurements were performed with the antenna position, polarization and the turntable in the position giving the highest level at the fundamental. The antenna distance was 3.0 m.
Both peak and average levels were measured during the test.

Test set-up photos during the tests can be found in the photo section in the end of the report.

Measurement equipment	RISE number
Semi anechoic chamber, Edison	504114
Computer Lenovo ThinkCentre	-
Software R&S EMC32, ver.10.50.40	503889
EMI test receiver R&S ESU 26	902210
Low Noise Amplifier Schwarzbeck BBV9742	504085
Antenna ETS-Lindgren 3115	902212
Coaxial cable	BX32218
Coaxial cable	504102
Coaxial cable	504103
Coaxial cable	504104
Multimeter Fluke 83	501522
Temperature and humidity meter Testo 625	504117

Results

Operation band 2400-2483.5 MHz

The measurement diagrams with peak and average detector can be found in the diagrams below.

	2402 MHz	"Band edge" at 2390 MHz (limit=54.0 dBµV/m (Average)) (Restricted band)
Diagram 1		Average level at 2390 MHz =32.0 dBµV/m (noise floor)
Diagram 2		Peak level at 2390 MHz =38.9 dBµV/m (noise floor) Note 1
	2402 MHz	Band edge at 2400 MHz (20 dBc limit)
Diagram 3		Peak level at fundamental
Diagram 4		Peak level at 2400 MHz dBc at 2400 MHz = 54.1 dBc Note 2
	2480 MHz	Band edge at 2483.5 MHz (limit=54.0 dBµV/m (Average)) (Restricted band)
Diagram 5		Average level at 2483.5 MHz =34.8 dBµV/m (noise floor)
Diagram 6		Peak level at 2483.5 MHz =52.5 dBµV/m Note 1

Note : The calculation of the measured radiated E-field signal level is given by:
E (dBuV/m) = V (dBuV) + Cl_1 (dB) + AF (dB/m)
Where:
E (dBuV/m) = Measured E-field
Cl_1 (dB) = Loss in cable 1
V (dBuV) = Spectrum analyser value
The diagrams 1-2 and 5-6 (absolute measurements) are with corrections (absolute levels).
The diagrams 3-4 (relative measurements) below are without any correction, the total correction factor was 9.2 dB for 2400 to 2402 MHz.

Note 1: .For average level method according to clause 11.13.3.3 (band edge) was used, applicable according to KDB 558074 D01 v05r02 clause 8.1 c) 1).
According to KDB 558074 D01 v05r02 clause 8.1 c) 2), the peak integrated band power methods of 11.13.3.2 of ANSI is not applicable for FCC compliance testing purposes.
For peak level clause 11.12.2.4 (emissions in restricted frequency bands) was used instead.

Note 2: In clause 11.13, Band edge, in ANSI C63.10 was not used as no relative measurement are described, thus clause 11.11.3 was (emissions in non restricted frequency bands) used instead.

Limits

Band edge at 2400 MHz:
According to 47CFR 15.247(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.

According to RSS-247 5.5, in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator 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 A8.4(4), 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.

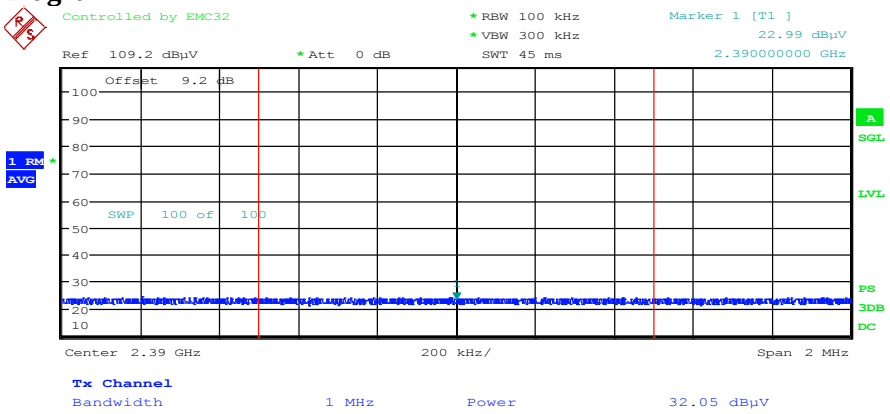
Band edge at 2390 MHz and 2483.5 MHz:
In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section15.209(a).

According to RSS-247 5.5, in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator 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 A8.4(4), 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.

Test engineers: Maulo Rivera Avalos and Fredrik Isaksson

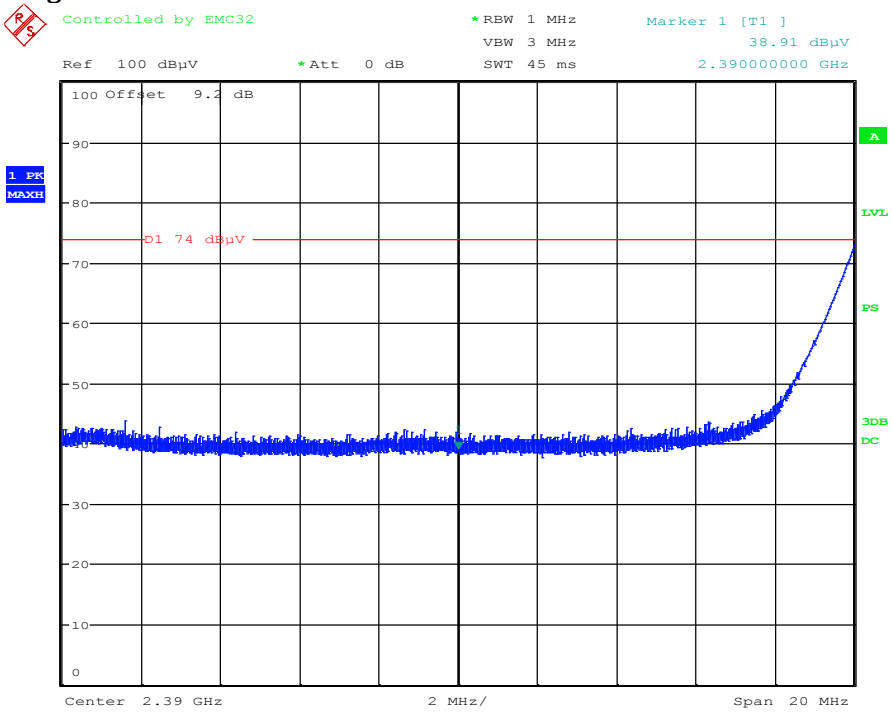
Complies?	Yes

Diagram 1



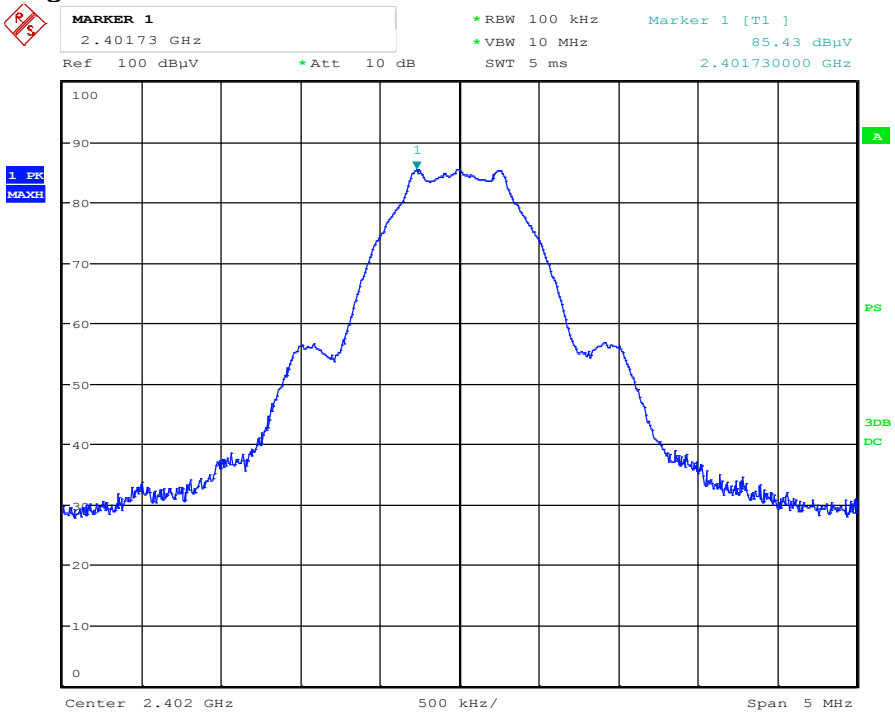
Date: 20.NOV.2019 13:05:13

Diagram 2



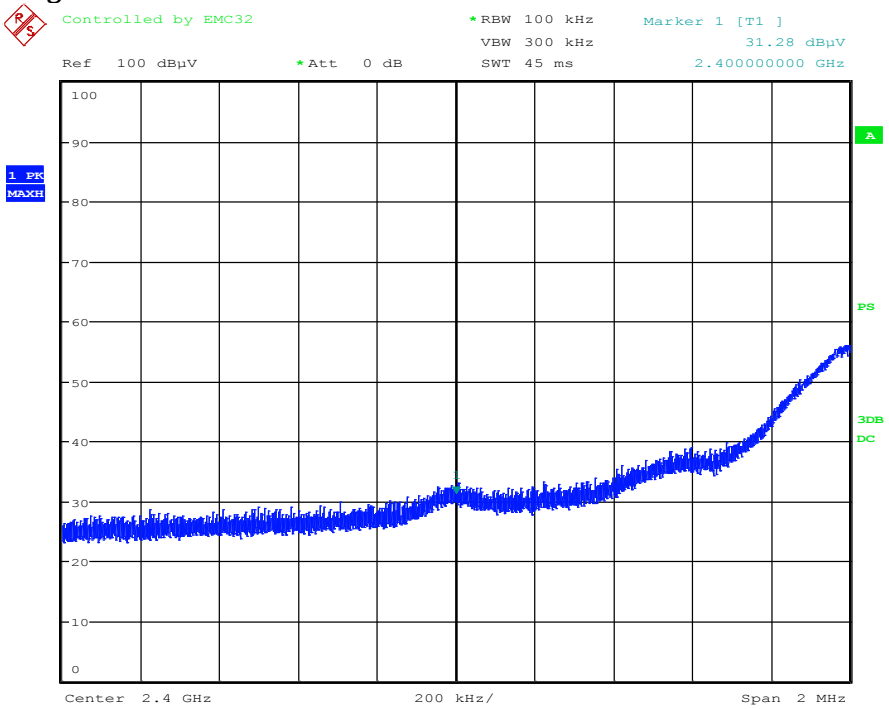
Date: 20.NOV.2019 12:43:08

Diagram 3



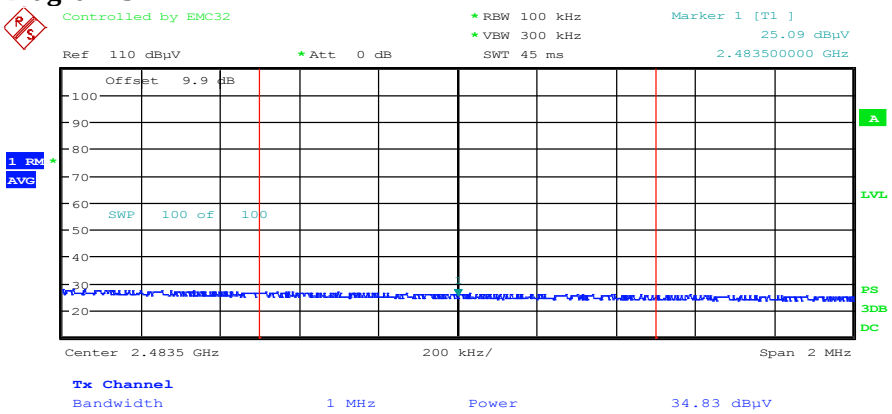
Date: 20.NOV.2019 12:21:58

Diagram 4



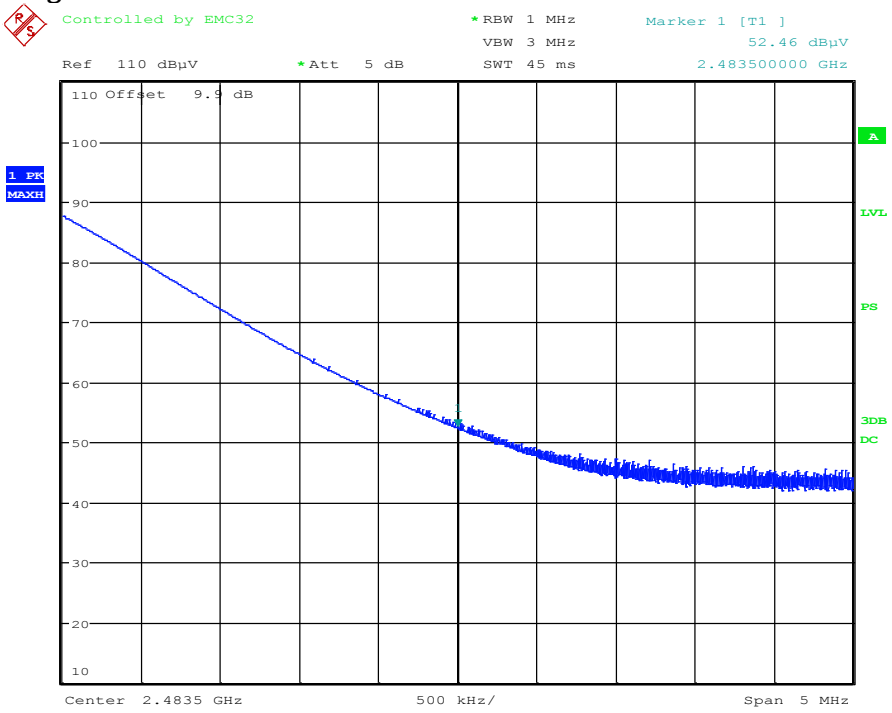
Date: 20.NOV.2019 12:54:59

Diagram 5



Date: 20.NOV.2019 14:36:59

Diagram 6



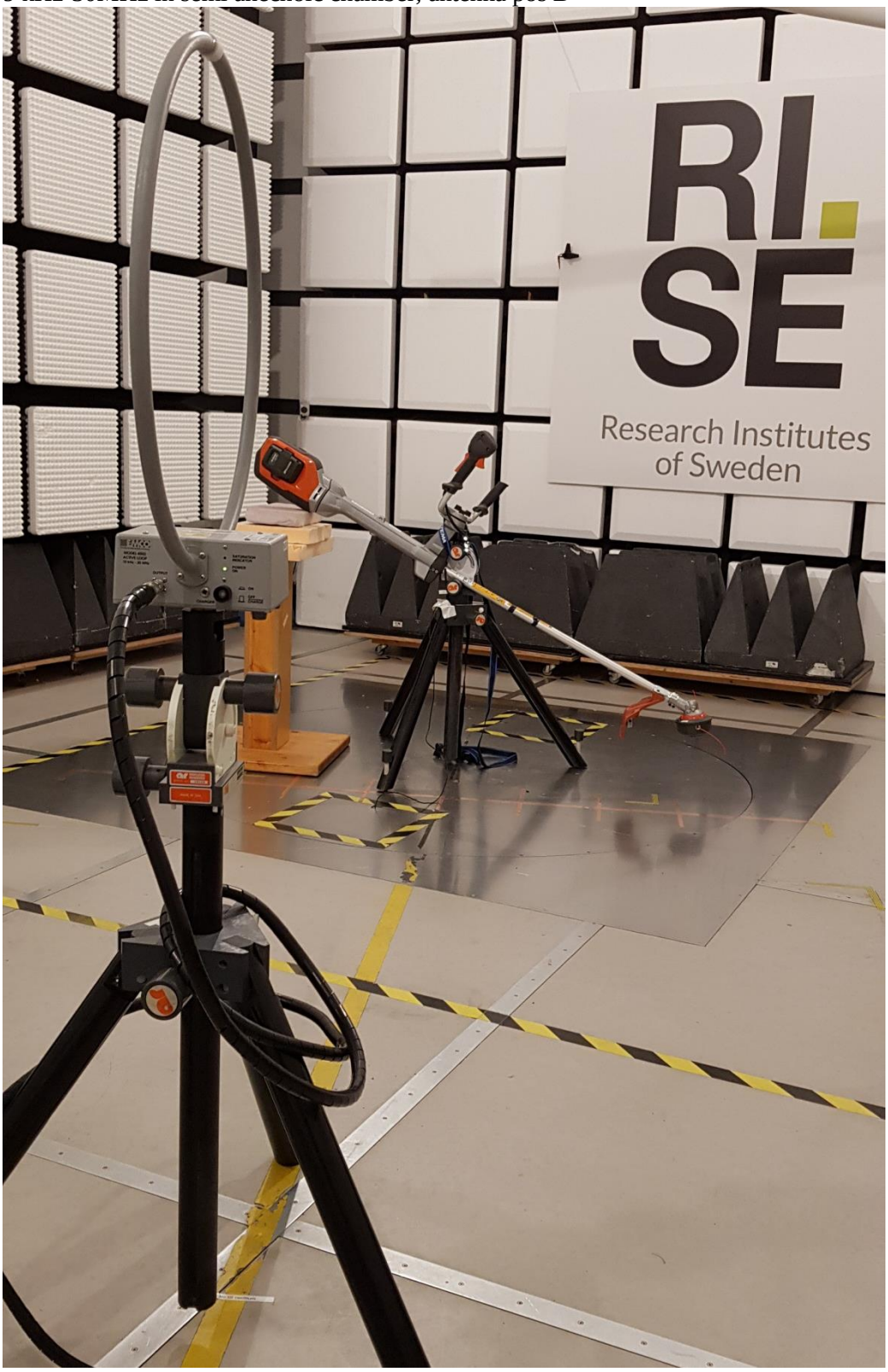
Date: 20.NOV.2019 14:34:06

Photos

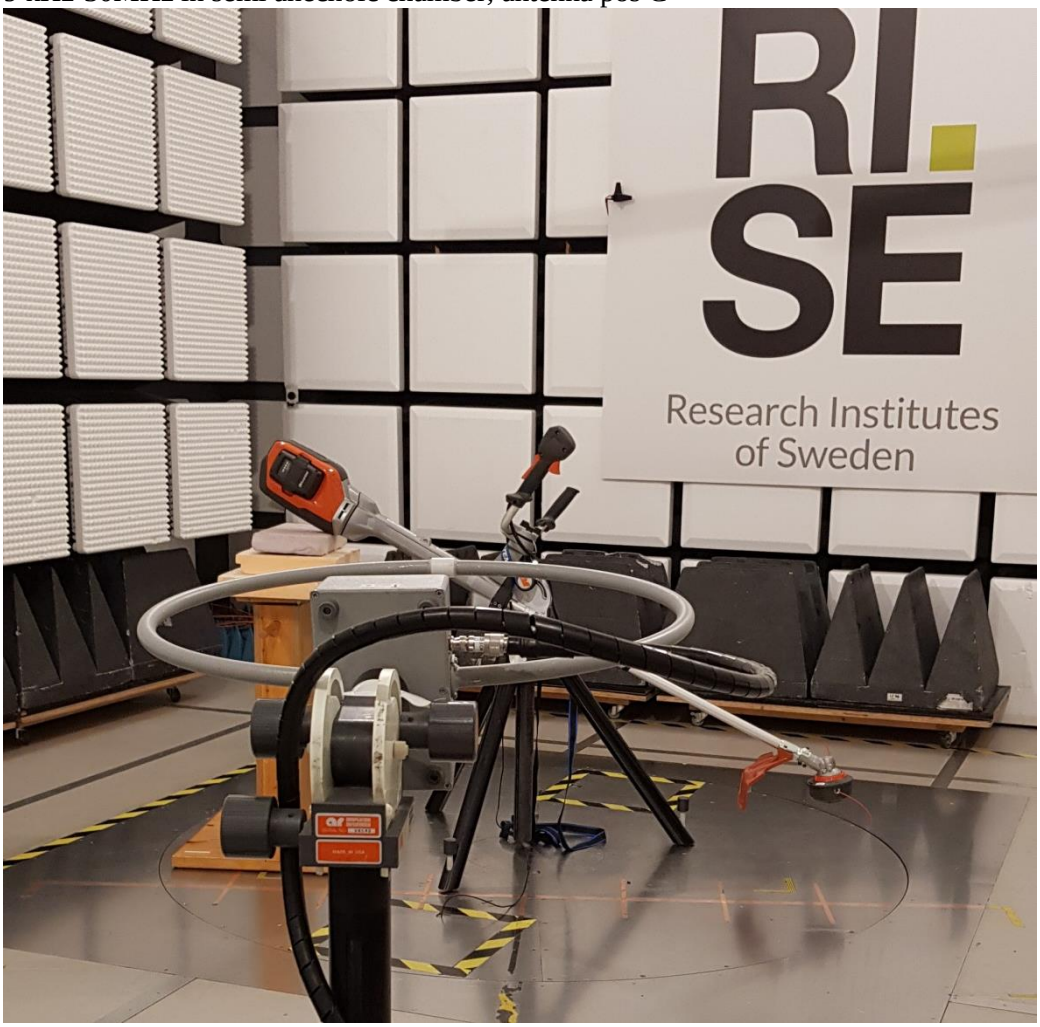
The test set-up during the radiated tests can be seen in the pictures below.

9 kHz-30MHz in semi anechoic chamber, antenna pos A

9 kHz-30MHz in semi anechoic chamber, antenna pos B

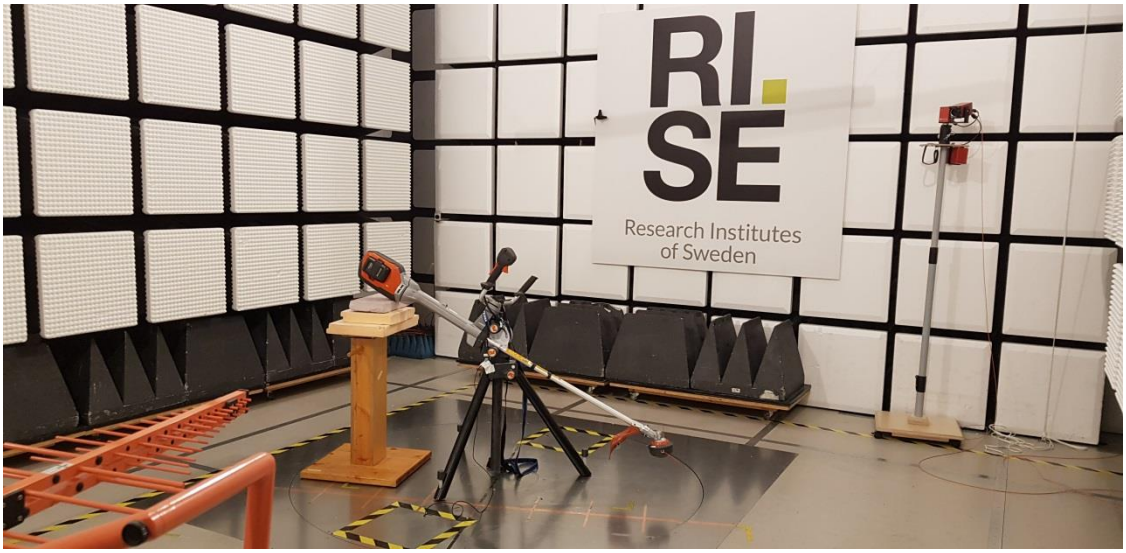


9 kHz-30MHz in semi anechoic chamber, antenna pos C

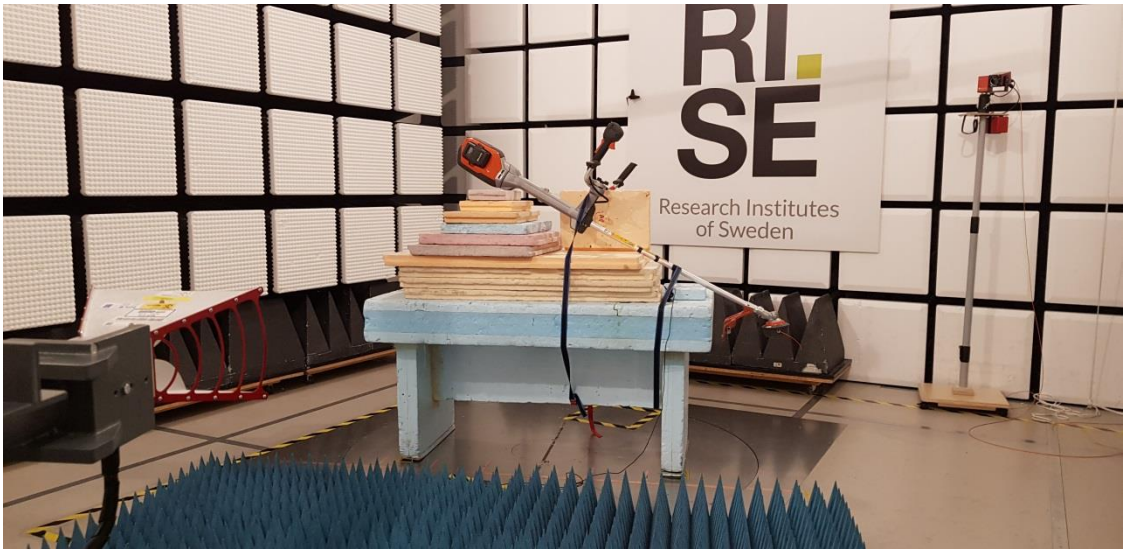


Final measurement at 18.02 kHz and 67.84 kHz at asphalt surface at 10 m, antenna pos B

30-1000 MHz:

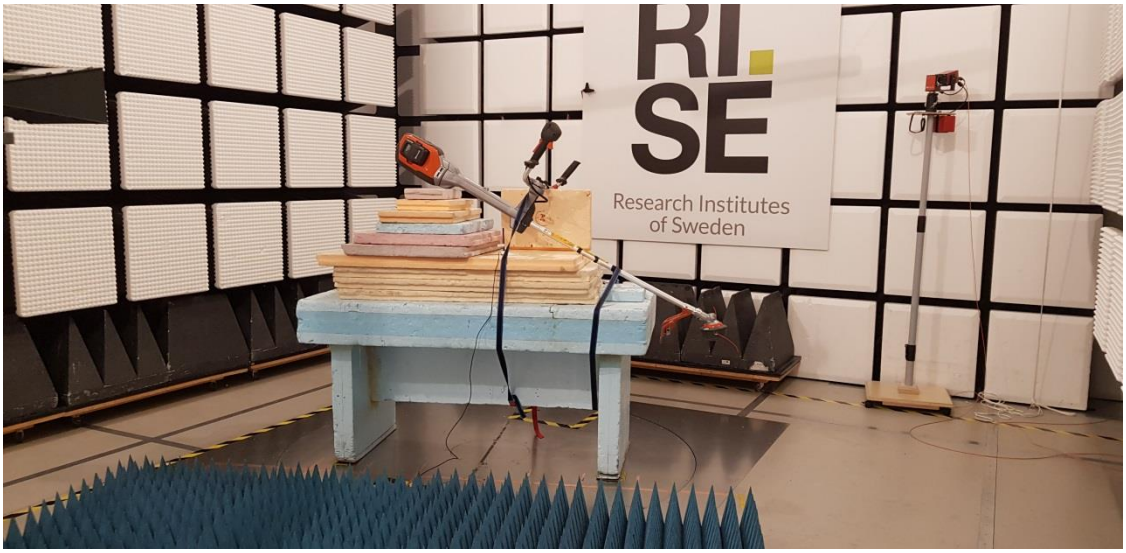


1-8.2 GHz:


RI.
SE
Research Institutes
of Sweden


Research Institute
of Sweden

8.2-18 GHz:



18-26 GHz: