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Test report

379022 - 1TRFWL

Date of issue: August 15, 2019

Applicant:

Residential Control Systems (RCS)

Product:

Thermostat Sensing Device

Models: VS-ELEM02-001

FCC ID: WIBTZW025 IC Registration number: 9374A-W025

Specifications:

FCC 47 CFR Part 15.249

Operation within the bands 902–928 MHz, 2400–2483.5 MHz, 5725–5875 MHZ, and 24.0–24.25 GHz.

RSS-210 Issue 9, August 2016 Annex B.10

License-Exempt Radio Apparatus: Category 1 Equipment

Test location

Company name	Nemko USA, Inc.
Address	2210 Faraday Ave, Suite 150
City	Carlsbad
Province	California
Postal code	92008
Country	USA
Telephone	+1 760 444 3500
Weite	www.nemko.com
Site number	FCC: US5058; IC: 2040B-3

Tested by	Martha Espinoza, Wireless Test Engineer.
Tester Signature	
Reviewed by	Juan Manuel Gonzalez
Date	August 15, 2019
Reviewer Signature	

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.
This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this report are within Nemko USA's ISO/IEC 17025 accreditation. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Government.

Copyright notification

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Section 1. Report summary

1.1 Applicant

Company name	Residential Control System (RCS)
Address	12625 Danielson Ct. Suite 102
City	Poway
Province/State	CA
Postal/Zip code	92064
Country	U.S.A.

1.2 Manufacturer

Company name	Residential Control System (RCS)
Address	11481 Sunrise Gold Circle Suite 1
City	Rancho Cordova
State	CA
Postal/Zip code	92742
Country	U.S.A.

1.3 Test specifications

FCC 47 CFR Part 15, Subpart C, Clause 15.249	Operation within the bands 902–928 MHz, 2400–2483.5 MHz, 5725–5875 MHz, and 24.0–24.25 GHz.
RSS-210 Issue 9, August 2016, Annex B.10	Devices operating in 902–928, 2400–2483.5 and 5725–5875 MHz

1.4 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was completed against all relevant requirements of the test standard. Results obtained indicate that the product under test complies in full with the requirements. The test results relate only to the items tested.

See “Summary of test results” for full details.

1.5 Exclusions

None

1.6 Test report revision history

Revision #	Details of changes made to test report
379022-1TRFWL	Original report issued

Section 2. Summary of test results

2.1 FCC Part 15 Subpart C, general requirements test results

Part	Test description	Verdict
§15.207(a)	Conducted limits	Pass
§15.31(e)	Variation of power source	Not applicable[1]
§15.203	Antenna requirement	Not applicable[2]
§15.215(c)	20 dB bandwidth	Pass

Notes: [1] Measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, was performed with the supply voltage varied between 85 % and 115 % of the nominal rated supply voltage. No noticeable output power variation was oerved

[2] The Antennas are located within the enclosure of EUT and not user accessible.

2.2 FCC Part 15 Subpart C, intentional radiators test results

Part	Test description	Verdict
§15.249(a)	Radiated emissions not in restricted bands	Pass
§15.249(b)	Fixed Point-to-Point operation in the 24.0–24.25 GHz band	Not applicable
§15.249(d)	Spurious emissions (except harmonics)	Pass

Notes: None

2.3 IC RSS-GEN, Issue 4, test results

Part	Test description	Verdict
6.7	Occupied bandwidth	Pass
7.3	Receiver radiated emission limits	Pass
7.4	Receiver conducted emission limits	Not applicable
8.8	Power Line Conducted Emissions Limits for Licence-Exempt Radio Apparatus	Pass

Notes: [1] According to sections 5.2 and 5.3 of RSS-Gen, Issue 4 the EUT does not have a stand-alone receiver neither scanner receiver, therefore exempt from receiver requirements.

2.4 IC RSS-210, Issue 9, test results

Part	Test description	Verdict
§B.10(a)	Field strength: Fundamental and Harmonics	Pass
§B.10(b)	Radiated emissions except Harmonic emissions	Pass

Notes: None

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	July 29, 2019
Nemko sample ID number	379022

3.2 EUT information

Product name	Thermostat Sensor Device
Model	VS-ELEM02-001
Model variant	N/A
Serial number	Engineering Sample
Software details	Z-Wave MicroRF firmware

3.3 Technical information

Operating band	ISM Band
Operating frequencies	908.42 MHZ & 916.00 MHZ
Occupied bandwidth (99 %)	217.94 KHz
Power requirements	24 VAC, 1 A or 4 AA Batteries
Antenna information	The EUT uses a unique antenna non-detachable like intentional radiator (PCB printed).

3.4 Product description and theory of operation

EUT was a RCS Thermostat Sensor Device with a 908.42 to 916.00MHz transmitter.

3.5 EUT exercise details

EUT was set to fixed two channels (low band: 908.42 MHZ and high band: 916.00 MHZ) test mode and transmitting a modulated signal. The output power was fixed with a serial port and a support computer according to manufacturer test pan. For all testing the Amplifier setting was set to “34”.

3.6 EUT setup diagram

Figure 3.6-1: Setup diagram

3.7 EUT Support Equipment

Table 3.7-1: EUT Support Equipment

Description	Brand name	Model/Part number	Serial number
Laptop Computer	Dell	Inspiron 15	HDGV512
Wireless to serial adapter	NA	N/A	N/A
Power Supply	MC Electronics	MGT2420	N/A

Table 3.7-2: Inter-connection cables

Cable description	From	To	Length (m)

Section 4. Engineering considerations

4.1 Modifications incorporated in the EUT

There were no modifications performed to the EUT during this assessment.

4.2 Technical judgment

None

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 5. Test conditions

5.1 Atmospheric conditions

Temperature	15–30 °C
Relative humidity	20–75 %
Air pressure	860–1060 mbar

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

5.2 Power supply range

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages ±5 %, for which the equipment was designed.

Section 6. Measurement uncertainty

6.1 Uncertainty of measurement

Measurement uncertainty budgets for the tests are detailed below. Measurement uncertainty calculations assume a coverage factor of K = 2 with 95% certainty.

Test name	Measurement uncertainty, dB
All antenna port measurements	0.55
Conducted spurious emissions	1.13
Radiated spurious emissions	3.78
AC power line conducted emissions	1.38

Section 7. Test equipment

7.1 Test equipment list

Table 7.1-1: Equipment list (Radiated measurements)

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
EMI Test Receiver	Rohde & Schwarz	ESU40	E1121	1 yr	05/25/2020
System Controller	Sunoc Sciences	SC104V	E1129	NCR	NCR
Bilog Antenna	Schaffner	CBL 6111D	1763	2 yr	01/17/2021
DRG Horn	ETS-Lindgren	3117-PA	E1139	1 yr	03/21/2020
Pre Amp as part of DRG Horn	ETS-Lindgren	3117-PA	Part of E1139	1 yr	03/21/2020

Note: None

Table 7.1.2: Software details (Radiated measurements)

Manufacturer of Software	Details
Rohde-Schwarz	EMC32 V10.00.00

Notes: None

Table 7.1-3: Conducted disturbance equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
LISN	Rohde & Schwarz	ENV216	E1020	1 year	8-22-2019
EMI Receiver	Rohde & Schwarz	ESCI	1767	2 years	3-25-2021

Notes: None

Table 7.1-4: Software details (Conducted measurements)

Manufacturer of Software	Details
Rohde-Schwarz	EMC32 V10.00.00

Notes: None

Section 8. Testing data

8.1 FCC 15.207(a) and RSS-Gen 8.8 AC power line conducted emissions limits

8.1.1 Definitions and limits

FCC:
Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 µH/50 Ω 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 boundary between the frequency ranges.

IC:
A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which 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 table below.

Unless the requirements applicable to a given device state otherwise, for any radio apparatus equipped to operate from the public utility AC power supply either directly or indirectly (such as with a battery charger), the radio frequency voltage of emissions conducted back onto the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in table below. The more stringent limit applies at the frequency range boundaries.

Table 8.1-1: Conducted emissions limit

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

Note: * - The level decreases linearly with the logarithm of the frequency.
** - A linear average detector is required.

8.1.2 Test summary

Test date	July 30, 2019	Temperature	23 °C
Test engineer	Steven Newman, EMC Test Engineer	Air pressure	1003 mbar
Verdict	Pass	Relative humidity	254%

8.1.3 Oervations, settings and special notes

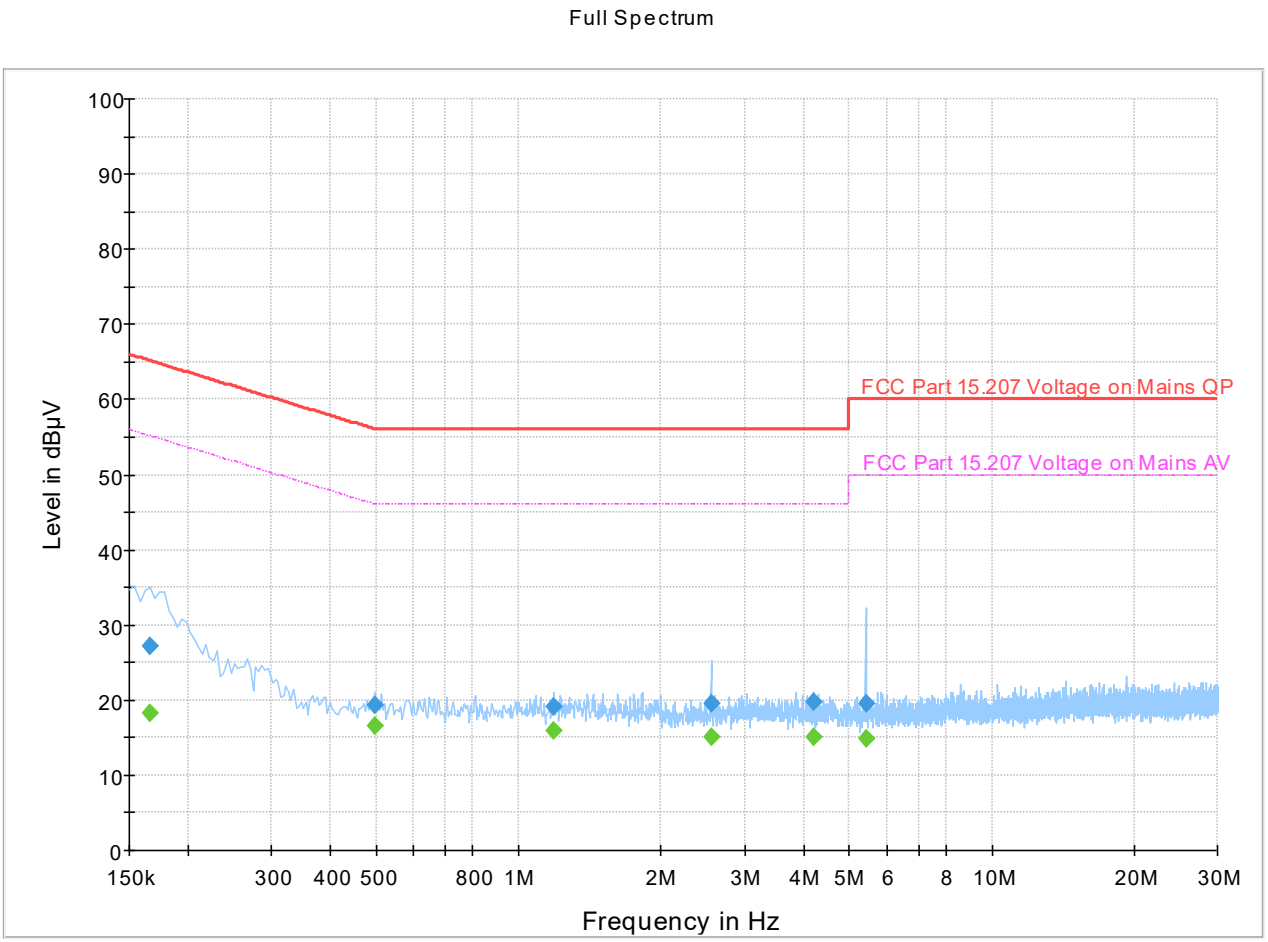
The EUT was set up as tabletop configuration.

The spectral scan has been corrected with transducer factors (i.e. cable loss, LISN factors, and attenuators) for determination of compliance.

Test receiver settings:

Frequency span	150 kHz to 30 MHz
Detector mode	Peak and Average (preview mode); Quasi-Peak and Average (final measurements)
Resolution bandwidth	9 kHz
Video bandwidth	30 kHz
Trace mode	Max Hold
Measurement time	1000 ms

8.1.4 Test data(EUT Tx at power 40 CH 908.42 MHz)



The spectral plot has been corrected with transducer factors. (i.e. cable loss, LISN factors, and attenuators)

Figure 8.1-1: Conducted emissions from 0.150 to 30 MHZ, transmitting mode, 120 V 60 Hz

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.166000	---	18.33	55.16	36.83	5000.0	9.000	N	ON	19.6
0.166000	27.20	---	65.16	37.96	5000.0	9.000	N	ON	19.6
0.498000	---	16.52	46.03	29.51	5000.0	9.000	N	ON	19.5
0.498000	19.41	---	56.03	36.63	5000.0	9.000	N	ON	19.5
1.186000	---	15.95	46.00	30.05	5000.0	9.000	L1	ON	19.4
1.186000	19.13	---	56.00	36.87	5000.0	9.000	L1	ON	19.4
2.554000	19.63	---	56.00	36.37	5000.0	9.000	L1	ON	19.5
2.554000	---	15.04	46.00	30.96	5000.0	9.000	L1	ON	19.5
4.214000	19.73	---	56.00	36.27	5000.0	9.000	L1	ON	19.5
4.214000	---	15.05	46.00	30.95	5000.0	9.000	L1	ON	19.5
5.410000	---	14.95	50.00	35.05	5000.0	9.000	N	ON	19.5
5.410000	19.49	---	60.00	40.51	5000.0	9.000	N	ON	19.5

Table 8.1-2: Quasi-Peak and Average conducted emissions results on both phases lines

8.2 FCC 15.215(c) and RSS-Gen 6.7 Occupied (Emission) bandwidth

8.2.1 Definitions and limits

FCC
Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80 % of the permitted band in order to minimize the possibility of out-of-band operation.

IC
The occupied bandwidth or the "99% emission bandwidth" is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

8.2.2 Test summary

Test date	August 1, 2019	Temperature	21 °C
Test engineer	Martha Espinoza, Wireless Test Engineer	Air pressure	1005 mbar
Verdict	Pass	Relative humidity	25%

8.2.3 Oervations, settings and special notes

Spectrum analyzer settings:

Detector mode	Peak
Resolution bandwidth	1 to 5% of Occupied Bandwidth
Video bandwidth	RBW × 3
Trace mode	Max Hold

8.2.4 Test data

Table 8.2-1: 99% dB and 20 dB bandwidth results

Fundamental frequency, MHz	99% bandwidth	20 dB bandwidth
908.42	217.94 KHz	248.39 KHz
916	206.73 KHz	240.38 KHz

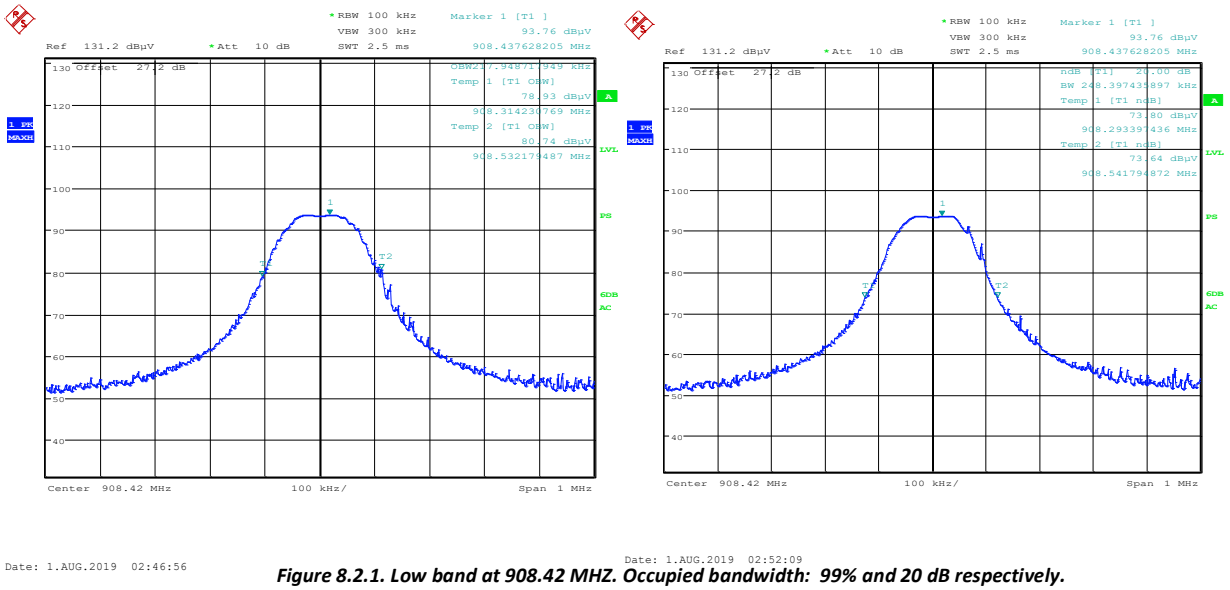


Figure 8.2.1. Low band at 908.42 MHZ. Occupied bandwidth: 99% and 20 dB respectively.

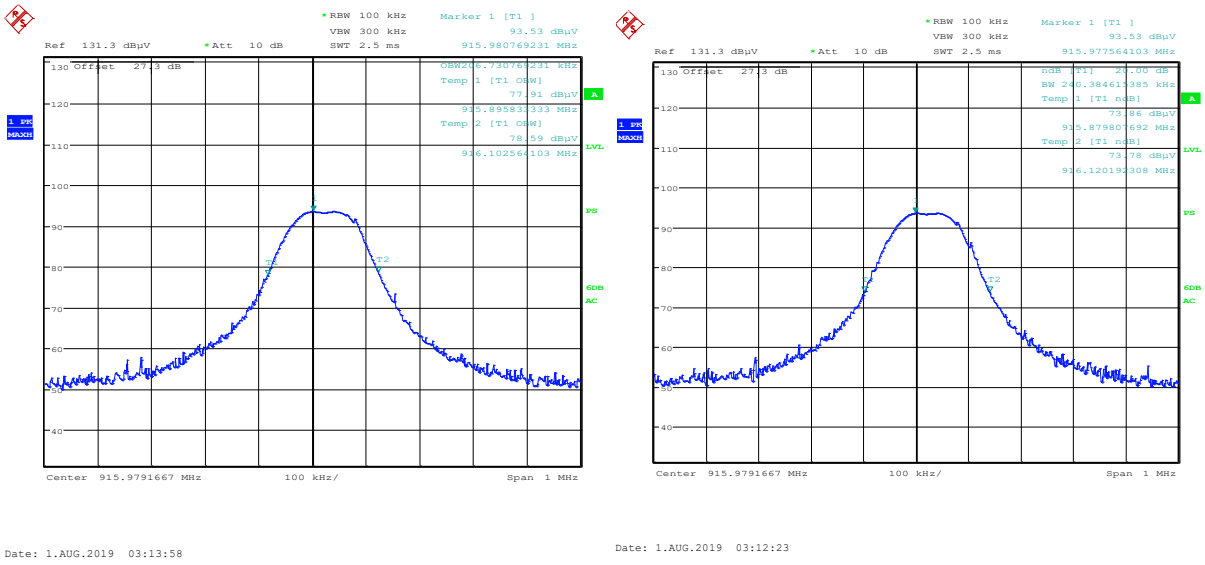


Figure 8.2.2. High band at 916 MHZ. Occupied bandwidth: 99% and 20 dB respectively.

8.3 FCC 15.249(a) RSS 210 B.10(a) and (b) Field strength of Fundamental, harmonics and spurious emissions

8.3.1 Definitions and limits

FCC:
The field strength of emissions from intentional radiators shall comply with the following table. Field strength limits are specified at 3 meters.
IC:
The field strength measured at 3 meters shall not exceed the limits in the following table.

Table 8.3-1: Field strength limits

Fundamental frequencies, MHz	Field strength of fundamental		Field strength of harmonics	
	mV/m	dBµV/m	µV/m	dBµV/m
902–928	50	94	500	54
2400–2483.5	50	94	500	54
5725–5875	50	94	500	54
24000–24250	250	108	2500	68

Notes: In the emission table above, the tighter limit applies at the band edges. For frequencies above 1 GHz the limit on peak RF emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test

8.3.2 Test summary

Test date	July 25, 30, 31 2019	Temperature	21 & 23 °C
Test engineer	Martha Espinoza, Steven Newman, Wireless/EMC Test Engineer	Air pressure	1004 & 1006 mbar
Verdict	Pass	Relative humidity	52 & 54 %

8.3.3 Oervations, settings and special notes

The spectrum was searched from 30 MHz to 10th harmonic of fundamental frequency. Radiated measurements were performed at 3m.
Three orthogonal positions were evaluated during pre-scans and only the worst-case position was used for final and formal testing.

Spectrum analyzer settings for frequencies below 1000 MHz:

Detector mode	Quasi-Peak
Resolution bandwidth	120 kHz
Video bandwidth	300 kHz
Trace mode	Max Hold

Spectrum analyzer settings for peak measurements at the frequencies above 1000 MHz:

Detector mode	Peak
Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Trace mode	Max Hold

Spectrum analyzer settings for average measurements at the frequencies above 1000 MHz:

Detector mode	Average
Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Trace mode	Max Hold

8.3.4 Test data

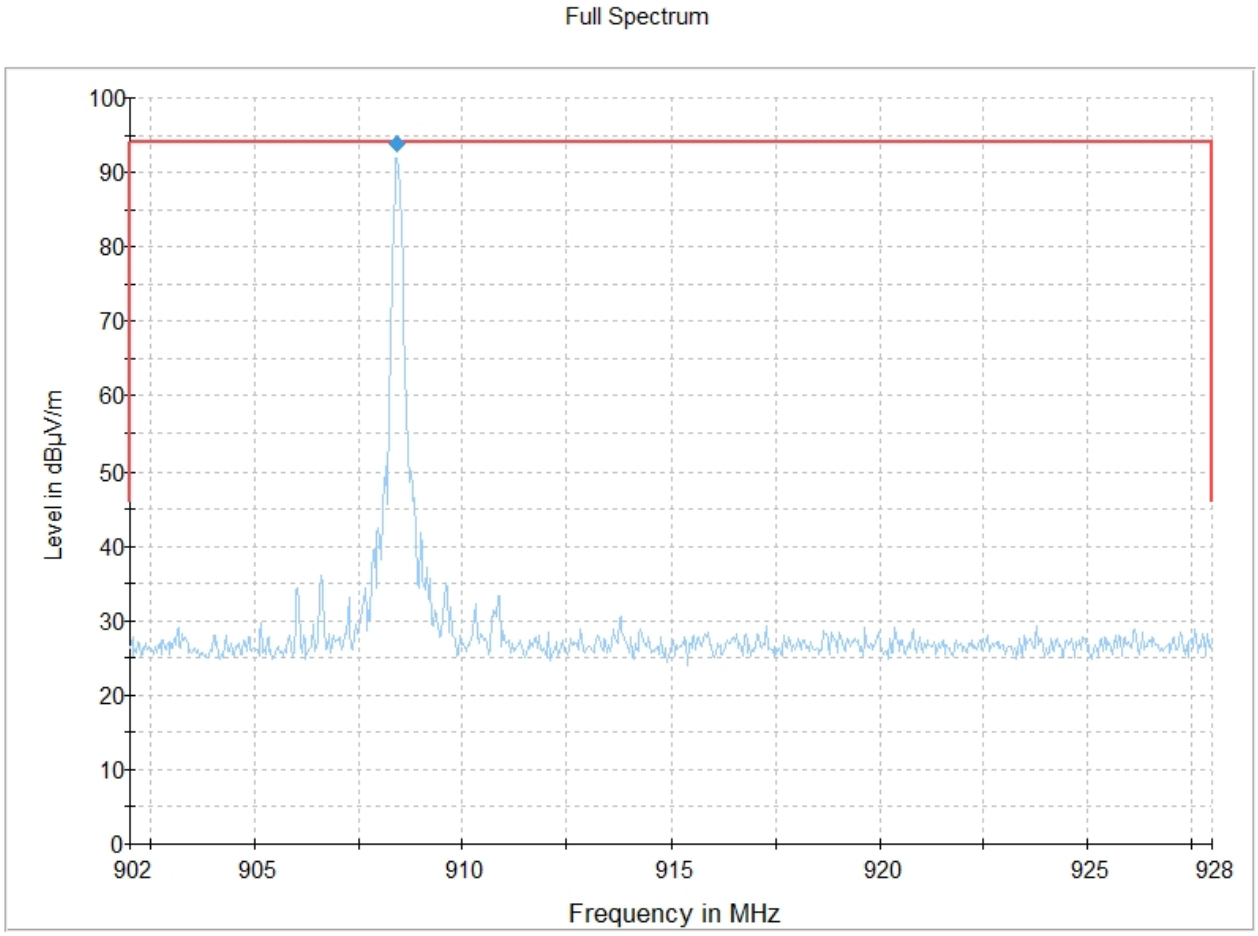


Figure 8.3-1: Field strength of Fundamental output power, low band (908.4 MHz)

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
908.432000	93.85	93.99	0.14	1000.0	120.000	116.0	V	264.0	27.2

Table 8.3-2: Field strength results, low band (908.42 MHZ)

Note: Three orientations were evaluated with pre-scans and the worst case was used for final testing. X axis was chosen like the worst case.

8.3.5 Test data, continued

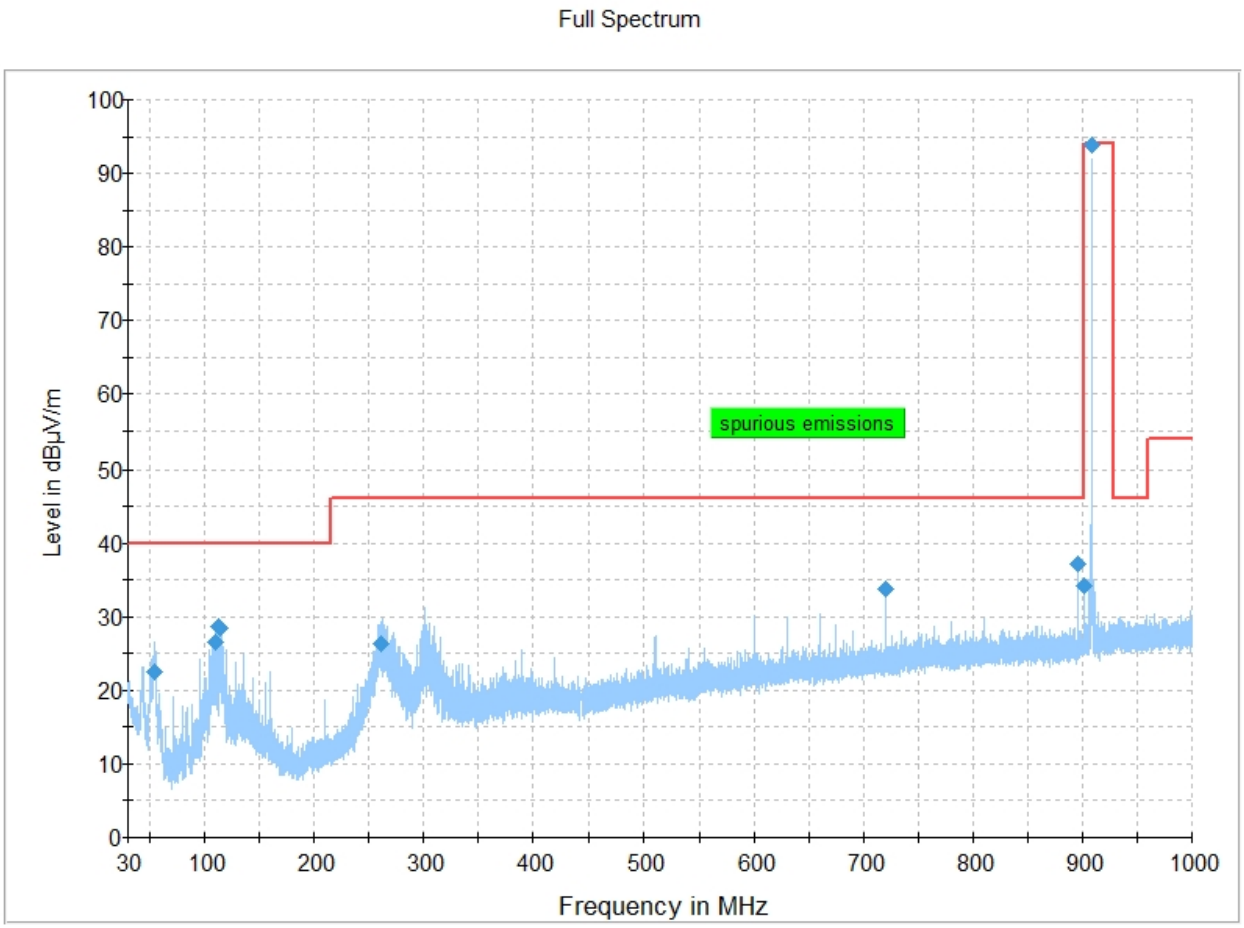


Figure 8.3-2: Field strength of spurious emissions 30MHz to 1GHz, low band (908.4 MHZ)

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
54.480667	22.55	40.00	17.45	1000.0	120.000	105.0	V	89.0	8.2
110.420667	26.60	40.00	13.40	1000.0	120.000	385.0	V	228.0	12.8
112.029667	28.65	40.00	11.35	1000.0	120.000	397.0	V	48.0	13.0
113.614000	28.48	40.00	11.52	1000.0	120.000	400.0	V	220.0	13.1
261.747333	26.32	46.00	19.68	1000.0	120.000	179.0	V	303.0	16.1
720.025667	33.74	46.00	12.26	1000.0	120.000	132.0	H	183.0	24.9
896.016000	37.24	46.00	8.76	1000.0	120.000	150.0	H	330.0	26.8
901.131333	34.17	46.00	11.83	1000.0	120.000	141.0	H	32.0	27.1

**Note: This value corresponding to the low band fundamental signal (908.42 MHz). This value is not part of the measurement limit and it is showed in this plot just for reference.*

Table 8.3-3: Field strength of spurious emissions from 30 MHz to 1000 MHz, low band (908.42 MHZ)

8.3.6 Test data, continued

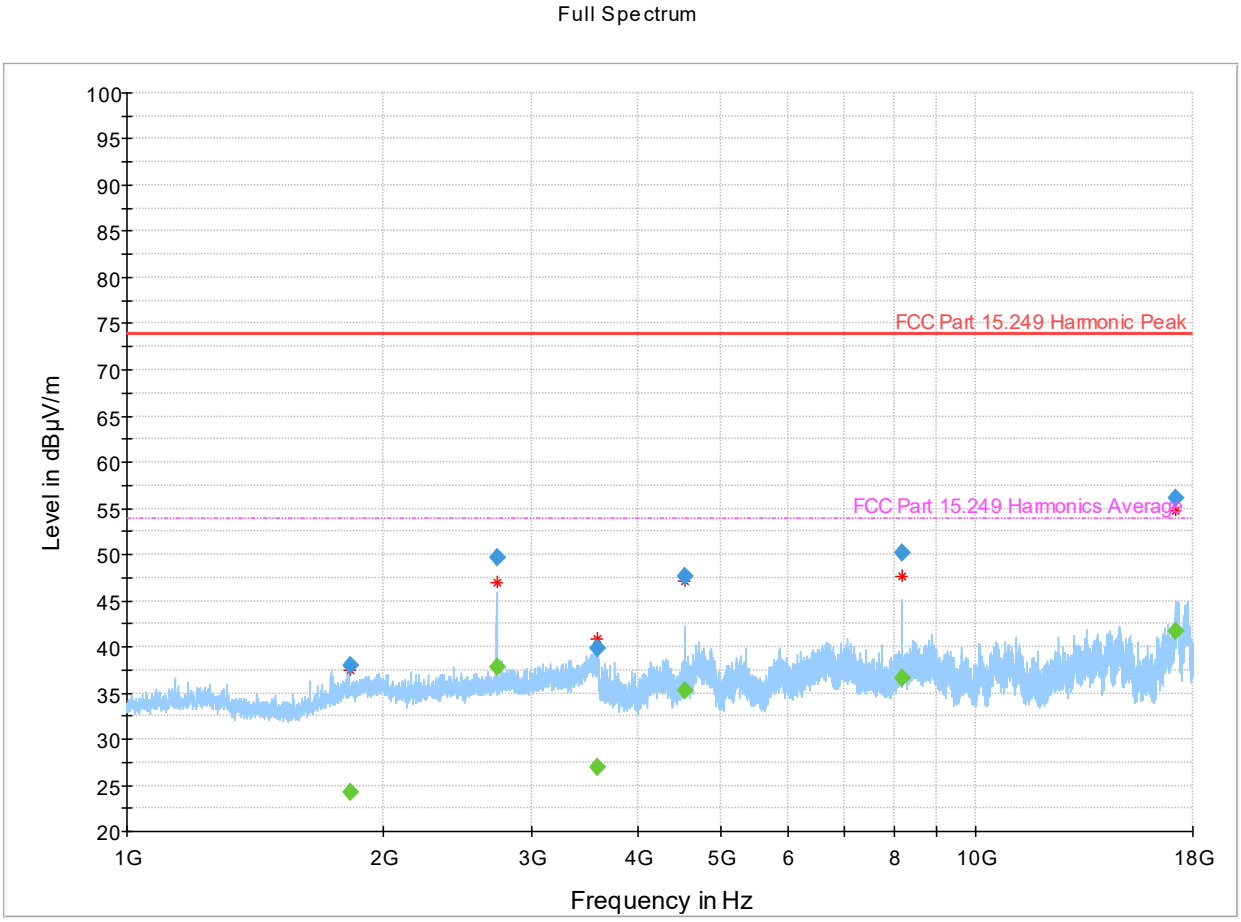


Figure 8.3-3: Field strength of spurious emissions from 1 to 10 GHz, low band (908.4 MHZ)

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1832.600000	37.92	---	73.90	35.98	5000.0	1000.000	128.8	V	357.0	-11.3
1832.600000	---	24.29	53.97	29.68	5000.0	1000.000	128.8	V	357.0	-11.3
2725.133333	---	37.83	53.97	16.14	5000.0	1000.000	115.1	V	26.0	-8.7
2725.133333	49.69	---	73.90	24.21	5000.0	1000.000	115.1	V	26.0	-8.7
3582.133333	39.90	---	73.90	34.00	5000.0	1000.000	191.5	V	155.0	-5.7
3582.133333	---	26.89	53.97	27.08	5000.0	1000.000	191.5	V	155.0	-5.7
4542.033333	47.63	---	73.90	26.27	5000.0	1000.000	217.5	V	345.0	-2.5
4542.033333	---	35.24	53.97	18.73	5000.0	1000.000	217.5	V	345.0	-2.5
8175.500000	---	36.67	53.97	17.30	5000.0	1000.000	192.0	V	343.0	1.1
8175.500000	50.15	---	73.90	23.75	5000.0	1000.000	192.0	V	343.0	1.1
17202.033333	56.10	---	73.90	17.80	5000.0	1000.000	370.7	H	72.0	12.3
17202.033333	---	41.71	53.97	12.26	5000.0	1000.000	370.7	H	72.0	12.3

Table 8.3-4: Field strength of spurious emissions from 1 to 10 GHz, low band (908.42 MHz)

8.3.4 Test data

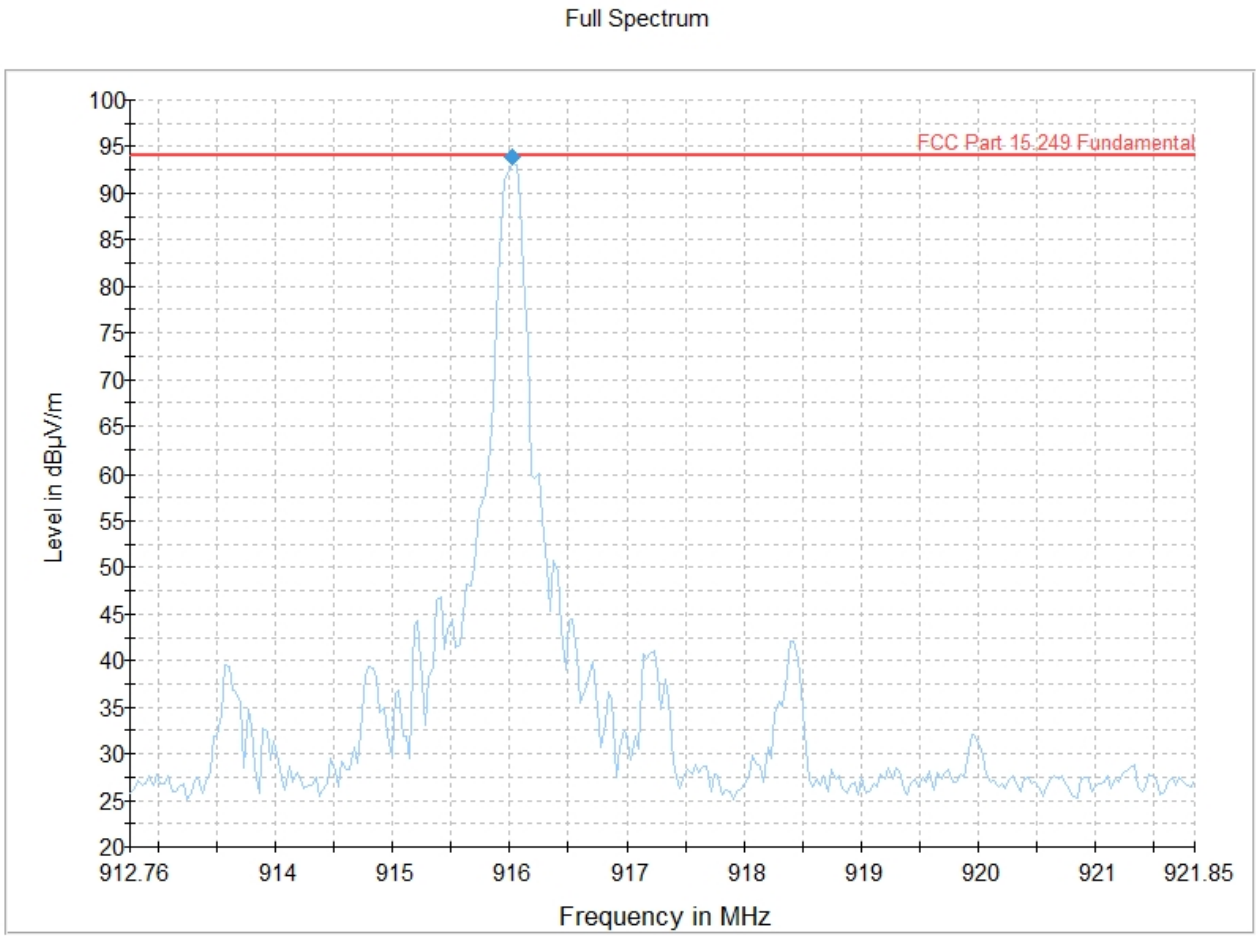


Figure 8.3-4: Field strength of Fundamental output power, high band (916 MHz)

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
916.030333	93.81	93.98	0.17	1000.0	120.000	112.0	V	313.0	27.3

Table 8.3-5: Field strength results, high band (916 MHz)

Note: Three orientations were evaluated with pre-scans and the worst case was used for final testing. X axis was chosen like the worst case.

8.3.4 Test data, continued

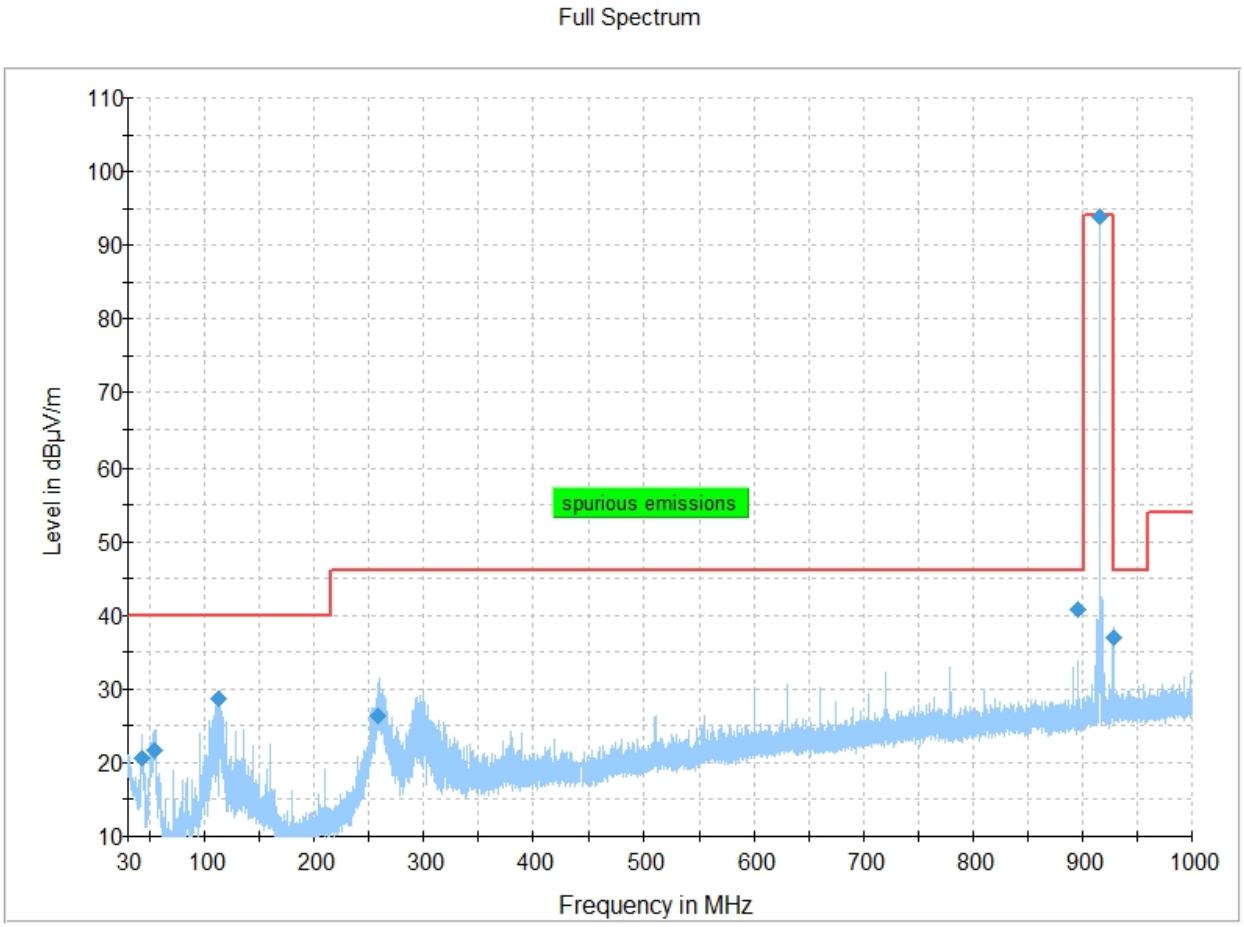


Figure 8.3-5: Field strength of spurious emissions 30MHz to 1GHz, high band (916 MHZ)

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
42.999667	20.68	40.00	19.32	1000.0	120.000	122.0	V	13.0	13.6
54.706000	21.70	40.00	18.30	1000.0	120.000	116.0	V	10.0	8.1
112.029667	28.67	40.00	11.33	1000.0	120.000	400.0	V	358.0	13.0
258.788000	26.45	46.00	19.55	1000.0	120.000	194.0	V	14.0	16.0
896.000667	40.70	46.00	5.30	1000.0	120.000	150.0	H	358.0	26.8
928.026000	37.06	46.00	8.94	1000.0	120.000	360.0	H	353.0	27.9

**Note: This value corresponding to the high band fundamental signal (916 MHz). This value is not part of the measurement limit and it is showed in this plot just for reference.*

Table 8.3-6: Field strength of spurious emissions from 30 MHz to 1000 MHz, high band (916 MHz)

8.3.4 Test data, continued

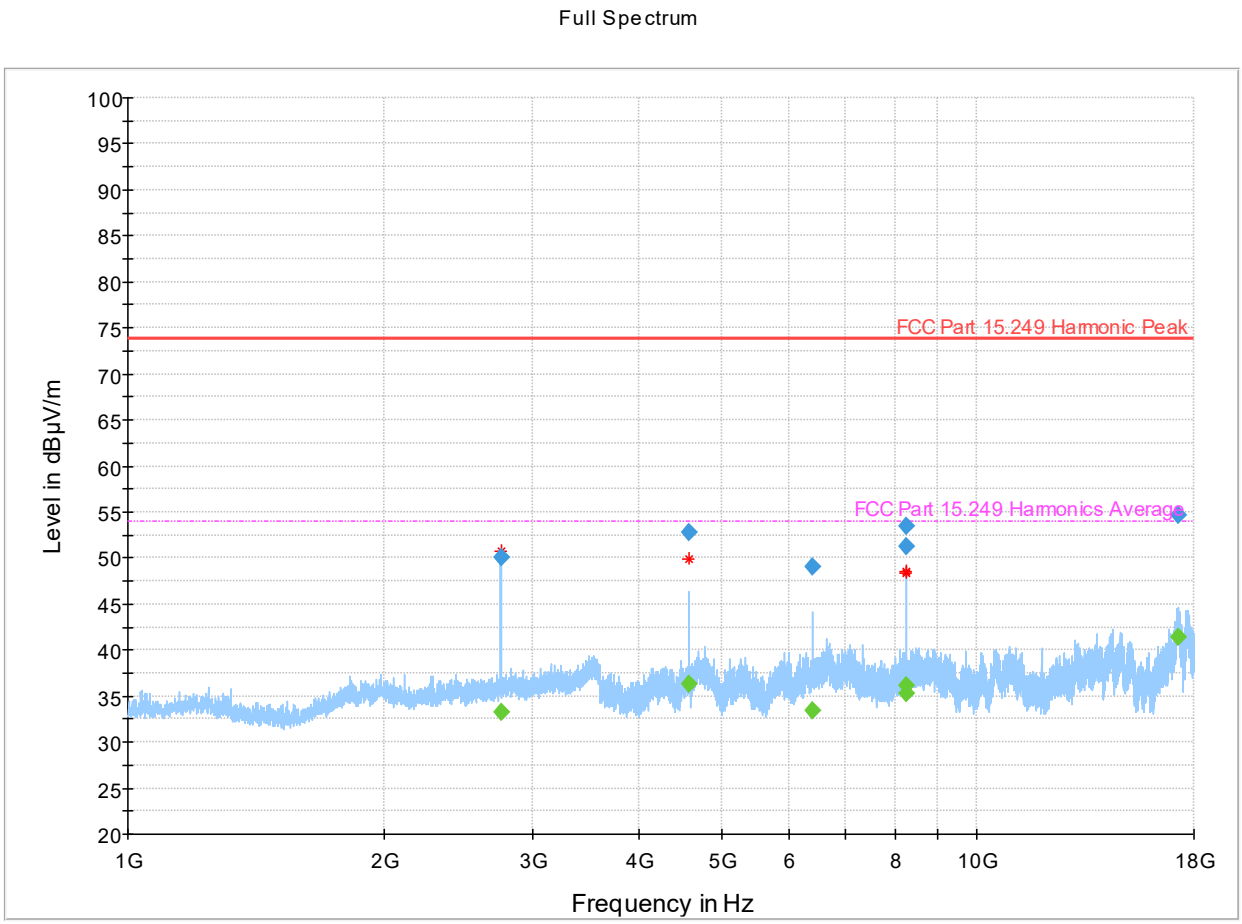


Figure 8.3-6: Field strength of spurious emissions from 1 to 10 GHz, high band (916 MHZ)

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2748.200000	49.98	---	73.90	23.92	5000.0	1000.000	111.2	V	333.0	-8.5
2748.200000	---	33.20	53.97	20.77	5000.0	1000.000	111.2	V	333.0	-8.5
4579.833333	---	36.26	53.97	17.71	5000.0	1000.000	157.0	V	0.0	-2.3
4579.833333	52.78	---	73.90	21.12	5000.0	1000.000	157.0	V	0.0	-2.3
6412.266667	49.12	---	73.90	24.78	5000.0	1000.000	145.8	V	355.0	-0.3
6412.266667	---	33.50	53.97	20.47	5000.0	1000.000	145.8	V	355.0	-0.3
8243.900000	51.17	---	73.90	22.73	5000.0	1000.000	137.6	V	307.0	1.3
8243.900000	---	35.21	53.97	18.76	5000.0	1000.000	137.6	V	307.0	1.3
8244.300000	53.47	---	73.90	20.43	5000.0	1000.000	112.7	V	341.0	1.3
8244.300000	---	36.18	53.97	17.79	5000.0	1000.000	112.7	V	341.0	1.3
17277.266667	---	41.37	53.97	12.60	5000.0	1000.000	356.9	H	1.0	12.0
17277.266667	54.71	---	73.90	19.19	5000.0	1000.000	356.9	H	1.0	12.0

Table 8.3-7: Field strength of spurious emissions from 1 to 10 GHz, high band (916 MHz)

8.4 FCC 15.249(d) and RSS-210 B10 (b) Emissions at the Band Edges

8.4.1 Definitions and limits

FCC
Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.
IC
Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general field strength limits listed in RSS-Gen, whichever is less stringent.

Table 8.4-1: 15.209 and RSS-Gen emissions field strength limits

Frequency, MHz	Field strength of emissions µV/m	dBµV/m	Measurement distance, m
0.009–0.490	2400/F	$67.6 - 20 \times \log_{10}(F)$	300
0.490–1.705	24000/F	$87.6 - 20 \times \log_{10}(F)$	30
1.705–30.0	30	29.5	30
30–88	100	40.0	3
88–216	150	43.5	3
216–960	200	46.0	3
above 960	500	54.0	3

Notes: In the emission table above, the tighter limit applies at the band edges. For frequencies above 1 GHz the limit on peak RF emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test

Table 8.4-2: IC restricted frequency bands

MHz	MHz	MHz	GHz
0.090–0.110	12.51975–12.52025	399.9–410	5.35–5.46
2.1735–2.1905	12.57675–12.57725	608–614	7.25–7.75
3.020–3.026	13.36–13.41	960–1427	8.025–8.5
4.125–4.128	16.42–16.423	1435–1626.5	9.0–9.2
4.17725–4.17775	16.69475–16.69525	1645.5–1646.5	9.3–9.5
4.20725–4.20775	16.80425–16.80475	1660–1710	10.6–12.7
5.677-5.683	25.5–25.67	1718.8–1722.2	13.25–13.4
6.215–6.218	37.5–38.25	2200–2300	14.47–14.5
6.26775–6.26825	73–74.6	2310–2390	15.35–16.2
6.31175–6.31225	74.8–75.2	2655–2900	17.7–21.4
8.291–8.294	108–138	3260–3267	22.01–23.12
8.362–8.366	156.52475–156.52525	3332–3339	23.6–24.0
8.37625–8.38675	156.7–156.9	3345.8–3358	31.2–31.8
8.41425–8.41475	240–285	3500–4400	36.43–36.5
12.29–12.293	322–335.4	4500–5150	Above 38.6

Note: Certain frequency bands listed in table above and above 38.6 GHz are designated for low-power license-exempt applications. These frequency bands and the requirements that apply to the devices are set out in this Standard

8.4.1 Definitions and limits, continued

Table 8.4-3: FCC restricted frequency bands

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2690–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	Above 38.6
13.36–13.41			

8.4.2 Test summary

Test date	July 25, 30, 31 2019	Temperature	21 & 23 °C
Test engineer	Martha Espinoza, Steven Newman, Wireless/EMC Test Engineer	Air pressure	1004 & 1006 mbar
Verdict	Pass	Relative humidity	52 & 54 %

8.4.3 Oervations, settings and special notes

The spectrum was searched in the band edge from 902 MHz (for low channel) and 928 MHz (for high channel) for fundamental measurement and from 30 to 1 GHz for restrictive bands. The 15.209 limit correspond to the restricted band limit. Radiated measurements were performed at 3 m.

Spectrum analyzer settings for frequencies below 1000 MHz:

Detector mode	Peak or Quasi-Peak
Resolution bandwidth	100 kHz
Video bandwidth	300 kHz
Trace mode	Max Hold

Spectrum analyzer settings for peak measurements at the frequencies above 1000 MHz:

Detector mode	Peak
Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Trace mode	Max Hold

Spectrum analyzer settings for average measurements at the frequencies above 1000 MHz:

Detector mode	Average
Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Trace mode	Max Hold

8.4.4 Test data

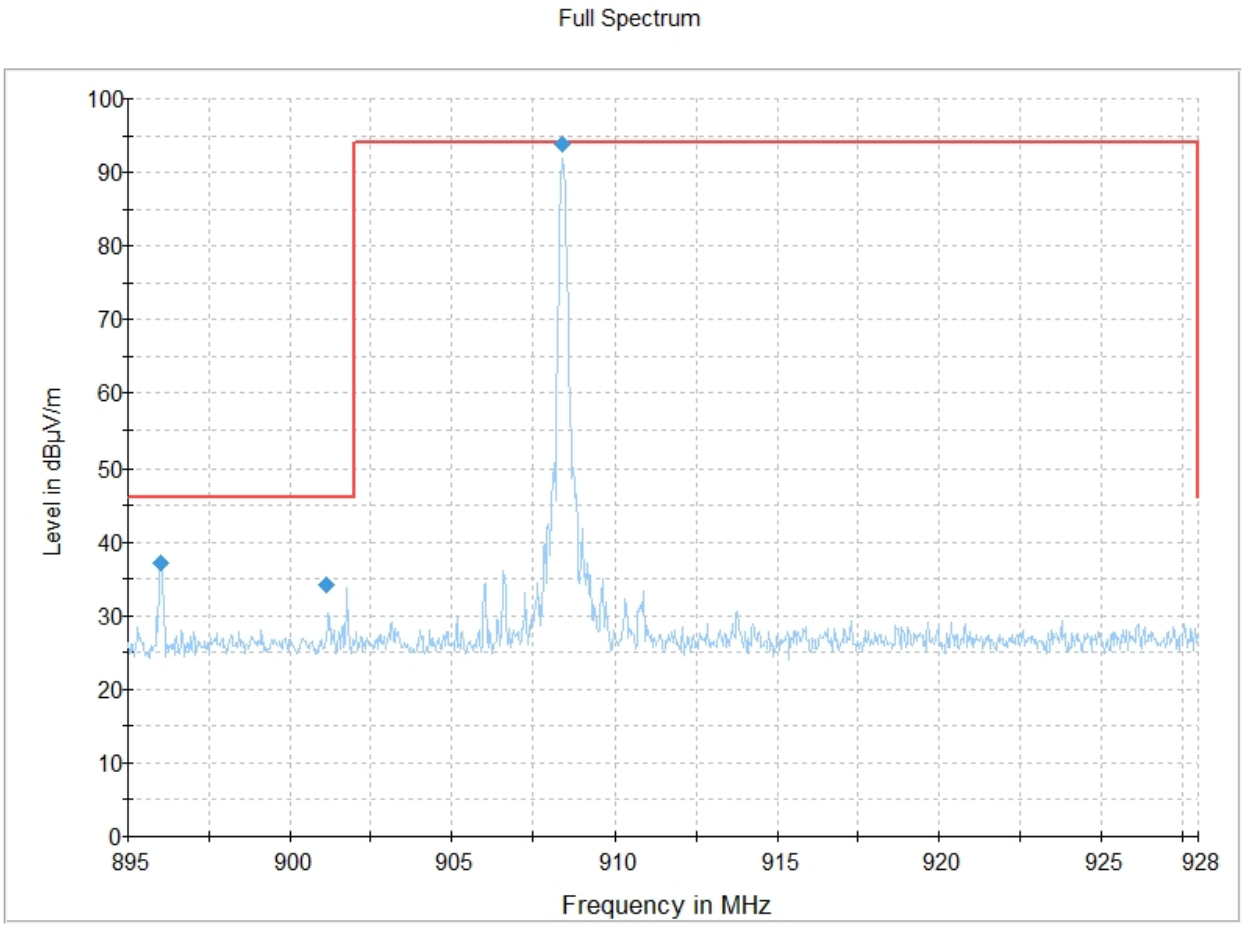


Figure 8.4-1: Field strength of emissions near band edges (low band: 908.42 MHz)

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
896.016000	37.24	46.00	8.76	1000.0	120.000	150.0	H	330.0	26.8
901.131333	34.17	46.00	11.83	1000.0	120.000	141.0	H	32.0	27.1

Figure 8.4-4: Field strength of emissions near band edges

8.4.4 Test data, continued

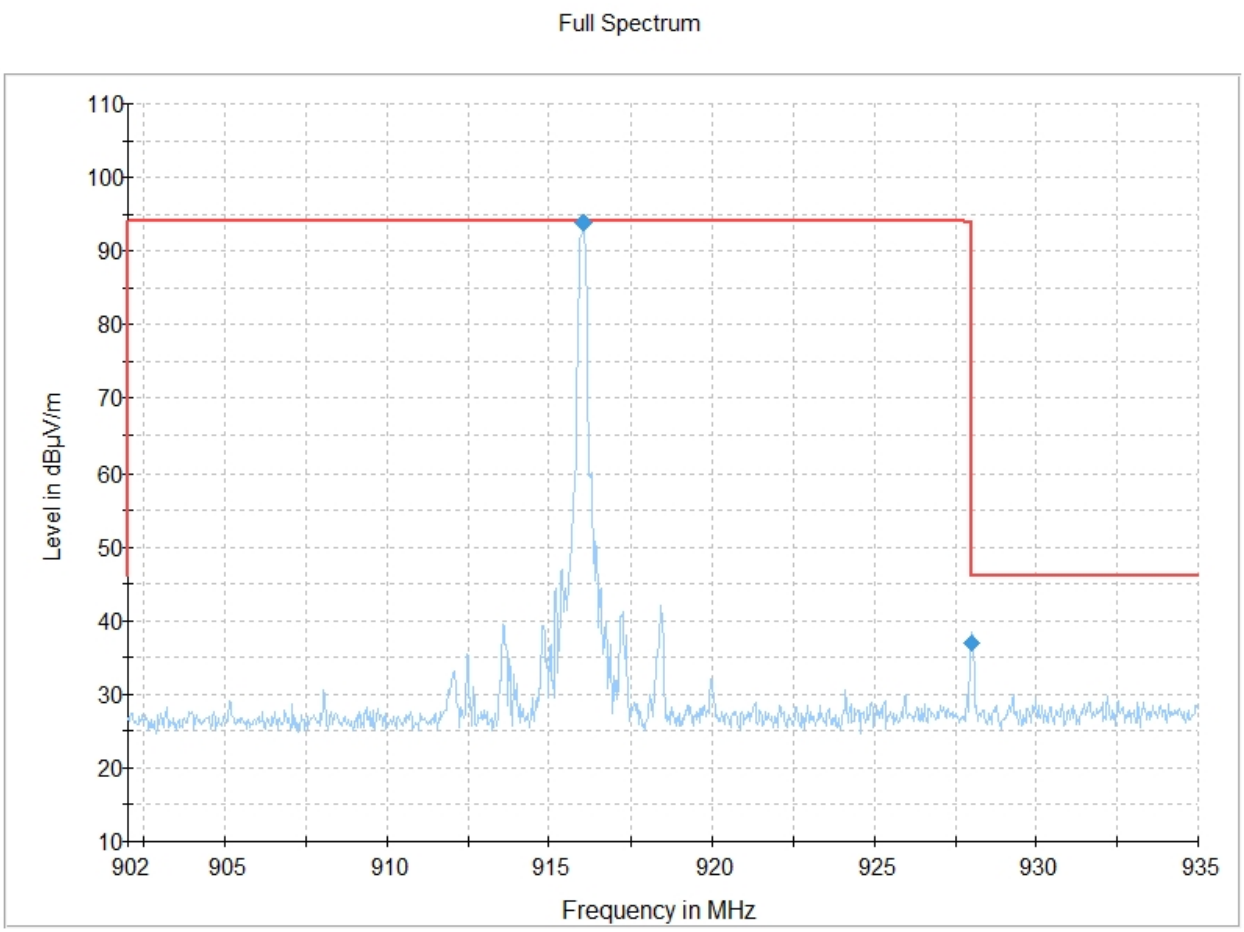


Figure 8.4-2: Field strength of emissions near band edges (high band: 916 MHz)

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
928.026000	37.06	46.00	8.94	1000.0	120.000	360.0	H	353.0	27.9

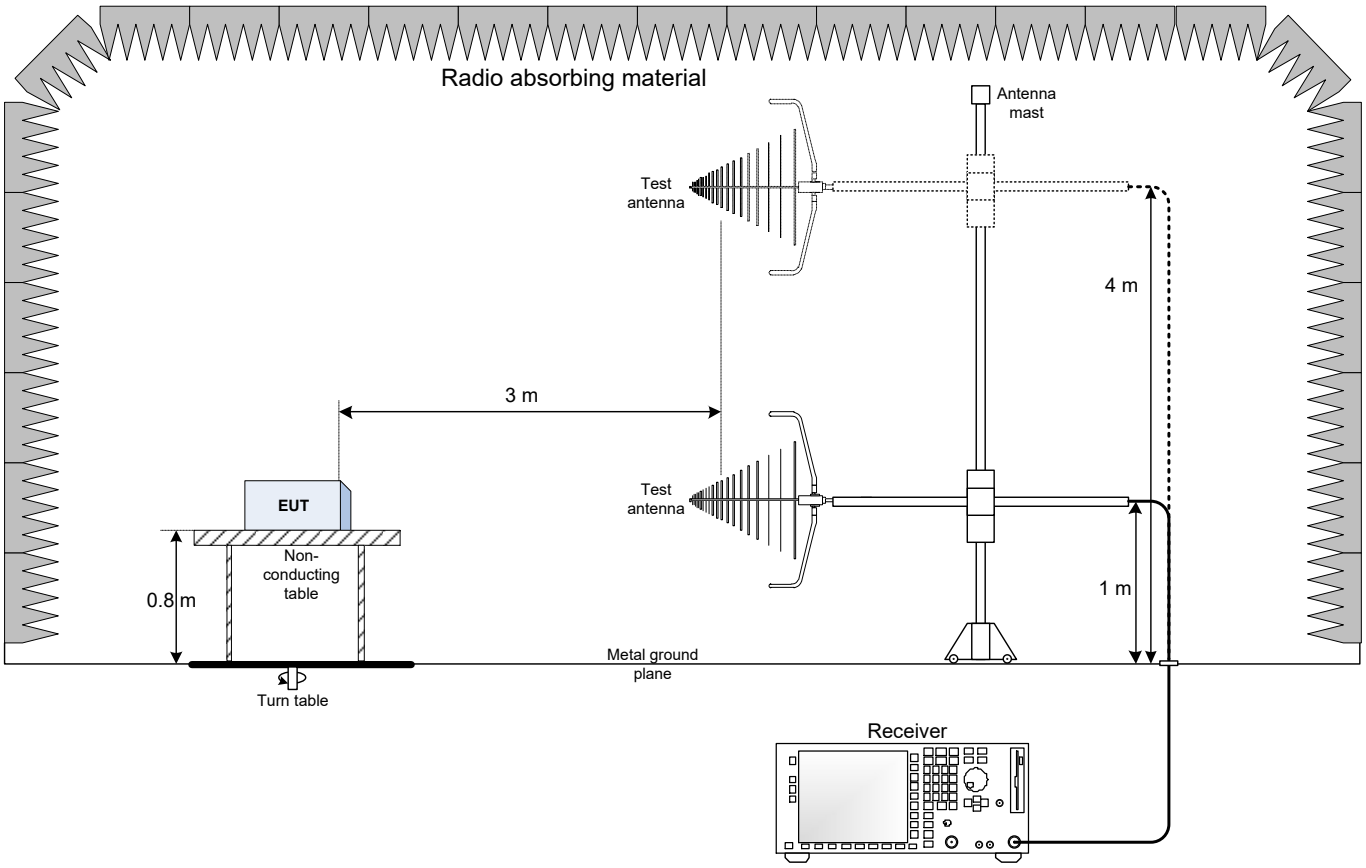
Figure 8.4-5: Field strength of emissions near band edges

Note: all measurement results indicated in the plot were taken with a peak detector, which is more stringent measurement, and still comply with quasi-peak limit.

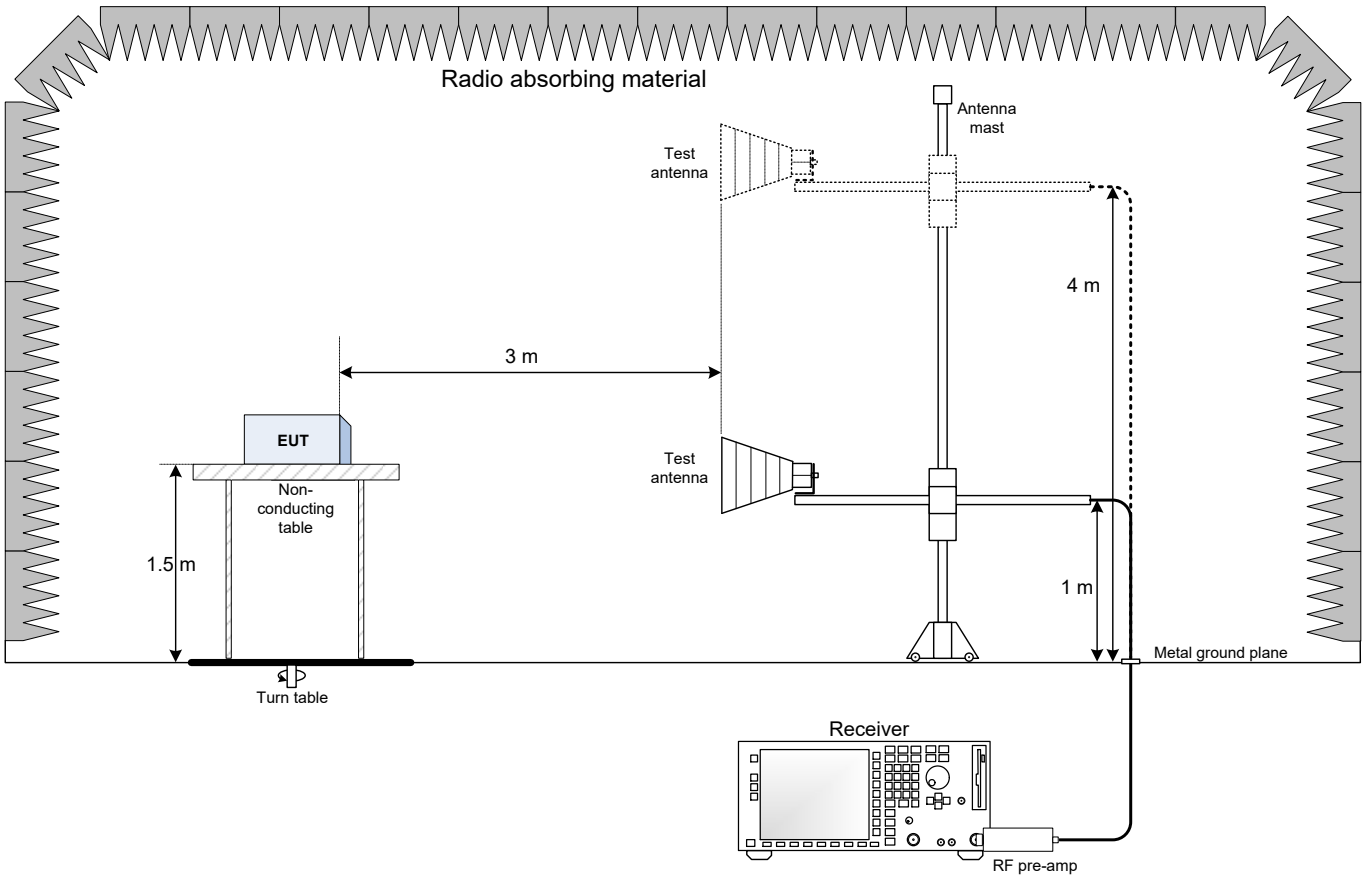
8.4.4 Test data, continued

Section 9. Block diagrams of test set-ups

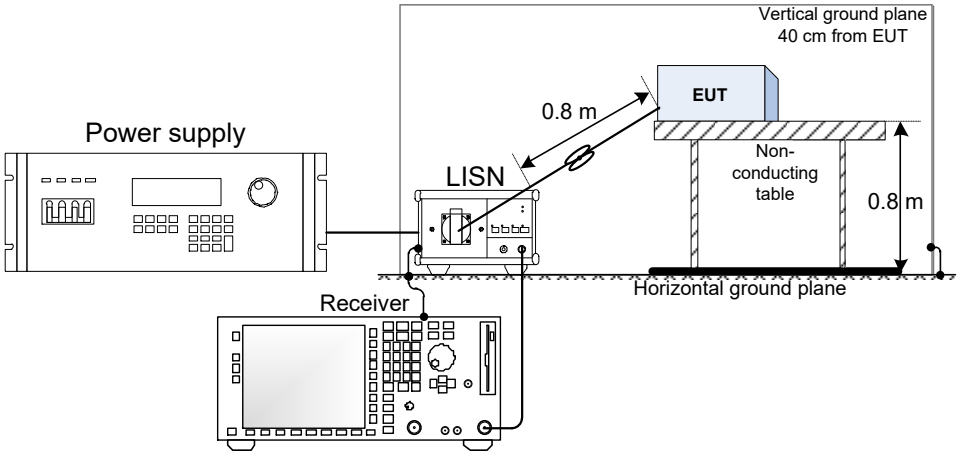
9.1 Radiated emissions set-up for frequencies below 1 GHz



9.2 Radiated emissions set-up for frequencies above 1 GHz



9.3 Conducted emissions set-up



Thank you for choosing