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Report Reference ID:	332205-4TRFFCC

Test specification:	Title 47-Telecommunication Chapter I - Federal Communications Commission Subchapter A - General Part 15 - Radio Frequency Devices Subpart C - Intentional Radiators **§15.231 Periodic operation in the band 40.66–40.70 MHz and above 70 MHz**

Applicant:	ZADI Spa – Via C.Marx, 138 – 41012 Carpi (MO) – Italy
Apparatus:	RSS Active key/remote control
FCC ID:	VFZKLGKZADI02
Model:	K0349-0

Testing laboratory:	Nemko Spa Via del Carroccio, 4 – 20853 Biassono (MB) – Italy Telephone: +039 039 2201201 Facsimile: +39 039 220 1221

	Name and title	**Date**
Tested by:	P. Barbieri, Wireless/EMC Specialist	2017-07-04
Reviewed by:	G. Curioni, Wireless/EMC Specialist	2017-07-04

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Section 1: Report summary

1.1 Test specification

Specifications	**FCC Part 15 Subpart C, 15.231** Periodic operation in the band 40.66–40.70 MHz and above 70 MHz

1.2 Statement of compliance

Compliance	In the configuration tested the EUT was found compliant Yes ☒ No ☐ This report contains an assessment of apparatus against specifications based upon tests carried out on samples submitted at Nemko Canada Inc. These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15; Subpart C. Radiated tests were conducted in accordance with ANSI C63.10-2013.

1.3 Exclusions

Exclusions	None

1.4 Registration number

Test site FCC ID number	Test Firm Registration Number FCC: 481407

1.5 Test report revision history

Revision #	Details of changes made to test report
332205-4TRFFCC	Original report issued

1.6 Limits of responsibility

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.

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Section 2: Summary of test results

2.1 FCC Part 15 Subpart C – Intentional Radiators, test results

General requirements for FCC Part 15		
Part	Test description	Verdict
§15.31(e)	Variation of power source	P
§15.31(m)	Number of operating frequencies	P
§15.203	Antenna requirement	P
§15.207(a)	Conducted limits	N/A
Specific requirements for FCC Part 15 Subpart C, 15.231		
Part	Test description	Verdict
§15.231(a)	Conditions for intentional radiators to comply with periodic operation	P
§15.231(b)	Field strength of emissions	P
§15.231(c)	Emission bandwidth	P
§15.231(d)	Requirements for devices operating within 40.66–40.70 MHz band	N/A
§15.231(e)	Conditions for intentional radiators to comply with periodic operation	N/A

Notes:
Possible test case verdicts:
test case does not apply to the test object: N/A (Not applicable)
test object does meet the requirement: P (Pass)
test object does not meet the requirement: F (Fail)

Section 3: Equipment under test (EUT) and application details

3.1 Applicant details

Applicant complete business name	Name:	ZADI S.P.A.
	Grantee code	VFZKLGKZADI02
Mailing address	Address:	Via C.Marx, 138
	City:	Carpi
	Province/State:	Modena
	Post code:	41012
	Country:	Italy

3.2 Modular equipment

a) Single modular approval	Single modular approval Yes ☐ No ☒
b) Limited single modular approval	Limited single modular approval Yes ☐ No ☒

3.3 Product details

FCC ID	Grantee code:	--
	Product code:	--
Equipment class	DSC – Part 15 Remote Control/Security Device Transmitter 15.231	
Description of product as it is marketed	RSS Active key/remote control	
	Model name/number:	K0349-0
	Serial number:	3/9 and 8/9 (number assigned by Nemko Spa)

3.4 Application purpose

Type of application	☒ Original certification ☐ Change in identification of presently authorized equipment Original FCC ID: Grant date: ☐ Class II permissive change or modification of presently authorized equipment

3.5 Composite/related equipment	
a) Composite equipment	The EUT is a composite device subject to an additional equipment authorization Yes ☐ No ☒
b) Related equipment	The EUT is part of a system that operates with, or is marketed with, another device that requires an equipment authorization Yes ☒ No ☐
c) Related FCC ID	If either of the above is "yes": ☐ has been granted under the FCC ID(s) listed below: ☒ is in the process of being filled under the FCC ID(s) listed below: ☐ is pending with the FCC ID(s) listed below: ☐ has a mix of pending and granted statues under the FCC ID(s) listed below: i FCC ID: -- ii FCC ID:

3.6 Sample information	
Receipt date:	2017-06-26
Nemko sample ID number:	332205

3.7 EUT technical specifications	
Operating band:	-
Operating frequency:	433.92 MHz
Modulation type:	FSK
Occupied bandwidth:	234 kHz
Channel spacing:	Single channel
Emission designator:	234KF1D
Antenna type:	Integral printed on board
Power source:	3 V CR2032 battery

3.8 Operation of the EUT during testing	
Details:	Constant transmitting at maximum power

3.9 EUT setup diagram
None (EUT composed by a single unit battery supply)

Section 4: Engineering considerations

4.1 Modifications incorporated in the EUT

Modifications	Modifications performed to the EUT during this assessment None ☒ Yes ☐, performed by Client ☐ or Nemko ☐ Details:

4.2 Deviations from laboratory tests procedures

Deviations	Deviations from laboratory test procedures None ☒ Yes ☐ - details are listed below: Details:

4.3 Technical judgment

Judgment	None

Section 5: Test conditions

5.1 Power source and ambient temperatures	
Normal temperature, humidity and air pressure test conditions	Temperature: 15–30 °C Relative humidity: 20–75 % Air pressure: 86–106 kPa 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.
Power supply range:	The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages ±5 %, for which the equipment was designed. The declared voltage is 3 Vdc nominal (2.50 – 3.16 voltage working range)

Section 6: Measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report according to CISPR 16-4-2 “Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements“ and is documented in the Nemko Spa Technical Procedure WML1002. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device

Section 7: Test equipment

7.1 Test equipment list

Equipment	Manufacturer	Model No.	Asset/Serial No.	Next cal.
Trilog Broad Band Antenna 25 MHz÷2 GHz	Schwarzbeck	VULB 9162	9162-025	07/2017
Bilog antenna 1 ÷18 GHz	Schwarzbeck	STLP 9148	9148-123	06/2018
Broadband preamplifier 1 ÷18 GHz	Schwarzbeck	BBV 9718	9718-137	12/2017
EMI receiver 20 Hz ÷ 8 GHz	R&S	ESU8	100202	09/2017
Semi-anechoic chamber	Nemko	10m semi-anechoic chamber	530	10/2018
Shielded room	Siemens	10m control room	1947	NCR

Note: N/A = Not applicable, NCR = No cal required, COU = Cal on use

Section 8: Testing data

8.1 Clause 15.31(e) Variation of power source

§ 15.31 Measurement standards.

(e) For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85 % and 115 % of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

Special notes
None

Test data
New battery was used during the tests

8.2 Clause 15.31(m) Number of operating frequencies

§ 15.31 Measurement standards.

(m) Measurements on intentional radiators or receivers, other than TV broadcast receivers, shall be performed and, if required, reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in the following table:

Frequency range over which device operates	Number of frequencies	Location in the range of operation
1 MHz and less	1	Middle
1 to 10 MHz	2	1 near top and 1 near bottom
More than 10 MHz	3	1 near top, 1 near middle and 1 near bottom

Special notes
None

Test data	
The EUT has only one channel at 433.92 MHz	
Low frequency / channel	NA
Mid frequency / channel	NA
High frequency / channel	NA

8.3 Clause 15.203 Antenna requirement

§ 15.203 Antenna requirement.

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

Special notes

None

Test data

Detailed photo of the antenna:

8.4 Clause 15.231(a) Conditions for intentional radiators to comply with periodic operation

§ 15.231 Periodic operation in the band 40.66–40.70 MHz and above 70 MHz.

(a) The provisions of this section are restricted to periodic operation within the band 40.66–40.70 MHz and above 70 MHz. Except as shown in paragraph (e) of this section, the intentional radiator is restricted to the transmission of a control signal such as those used with alarm systems, door openers, remote switches, etc. Continuous transmissions, voice, video and the radio control of toys are not permitted. Data is permitted to be sent with a control signal. The following conditions shall be met to comply with the provisions for this periodic operation:

(1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

(2) A transmitter activated automatically shall cease transmission within 5 seconds after activation.

(3) Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmissions, including data, to determine system integrity of transmitters used in security or safety applications are allowed if the total duration of transmissions does not exceed more than two seconds per hour for each transmitter. There is no limit on the number of individual transmissions, provided the total transmission time does not exceed two seconds per hour.

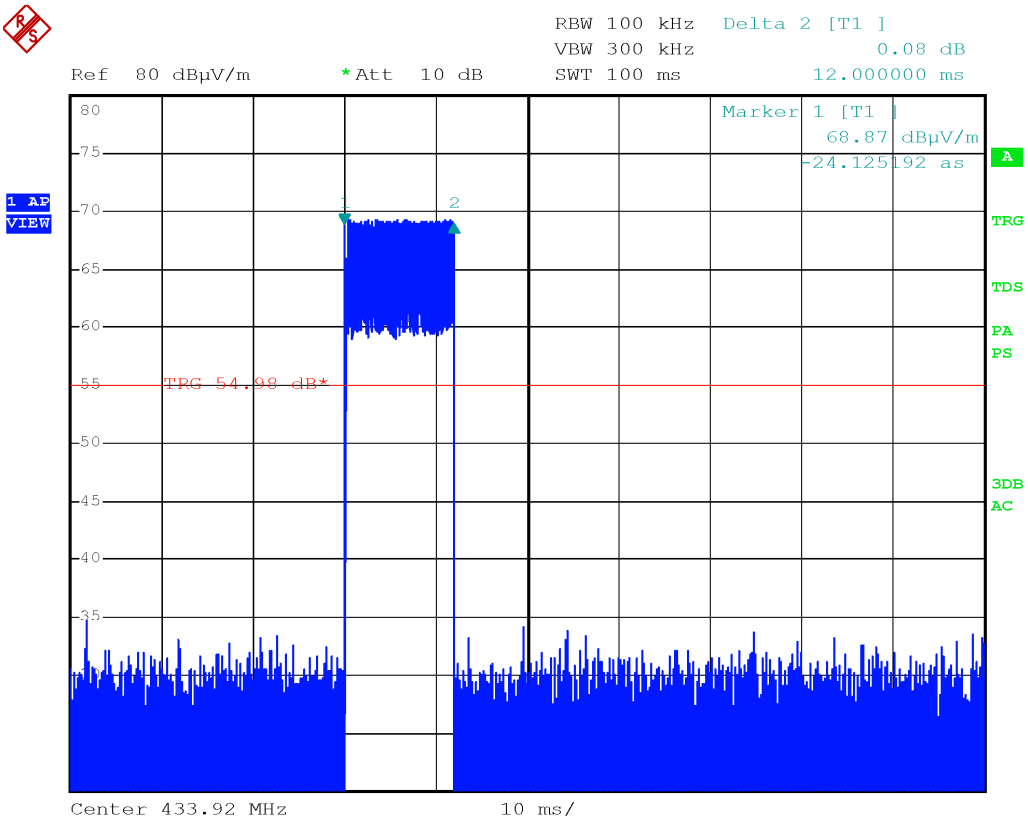
(4) Intentional radiators which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition

(5) Transmission of set-up information for security systems may exceed the transmission duration limits in paragraphs (a)(1) and (a)(2) of this section, provided such transmissions are under the control of a professional installer and do not exceed ten seconds after a manually operated switch is released or a transmitter is activated automatically. Such set-up information may include data.

Special notes
None

Test data

15.231(a)(1) Manually operated transmitter. Verify of the automatically deactivate of the transmission within 5 seconds:



Transmission time = 12.00 ms

8.5 Clause 15.231(b) Field strength of emissions

§ 15.231 Periodic operation in the band 40.66–40.70 MHz and above 70 MHz.

(b) In addition to the provisions of §15.205, the field strength of emissions from intentional radiators operated under this section shall not exceed the following:

Fundamental frequency (MHz)	Field strength of fundamental		Field strength of spurious emissions	
	(µV/m)	(dBµV/m)	(µV/m)	(dBµV/m)
40.66–40.70	2,250	67	225	47
70–130	1,250	61.9	125	41.9
130–174	1,250 to 3,750*	61.9 to 71.5*	125 to 375*	41.9 to 51.5*
174–260	3,750	71.5	375	51.5
260–470	3,750 to 12,500*	71.5 to 81.9*	375 to 1,250*	51.5 to 61.9*
Above 470	12,500	81.9	1,250	61.9

* Linear interpolations

(1) The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.

(2) Intentional radiators operating under the provisions of this section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector. The specific method of measurement employed shall be specified in the application for equipment authorization. If average emission measurements are employed, the provisions in §15.35 for averaging pulsed emissions and for limiting peak emissions apply. Further, compliance with the provisions of §15.205 shall be demonstrated using the measurement instrumentation specified in that section.

(3) The limits on the field strength of the spurious emissions in the above table are based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in §15.209, whichever limit permits a higher field strength.

Special notes

§15.209 – Radiated emission limits

Frequency (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance (m)
0.009–0.490	2400/F	67.6−20log(F)	300
0.490–1.705	24000/F	87.6−20log(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:
- F = fundamental frequency in kHz
- 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.

§15.205 – Restricted bands of operation

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

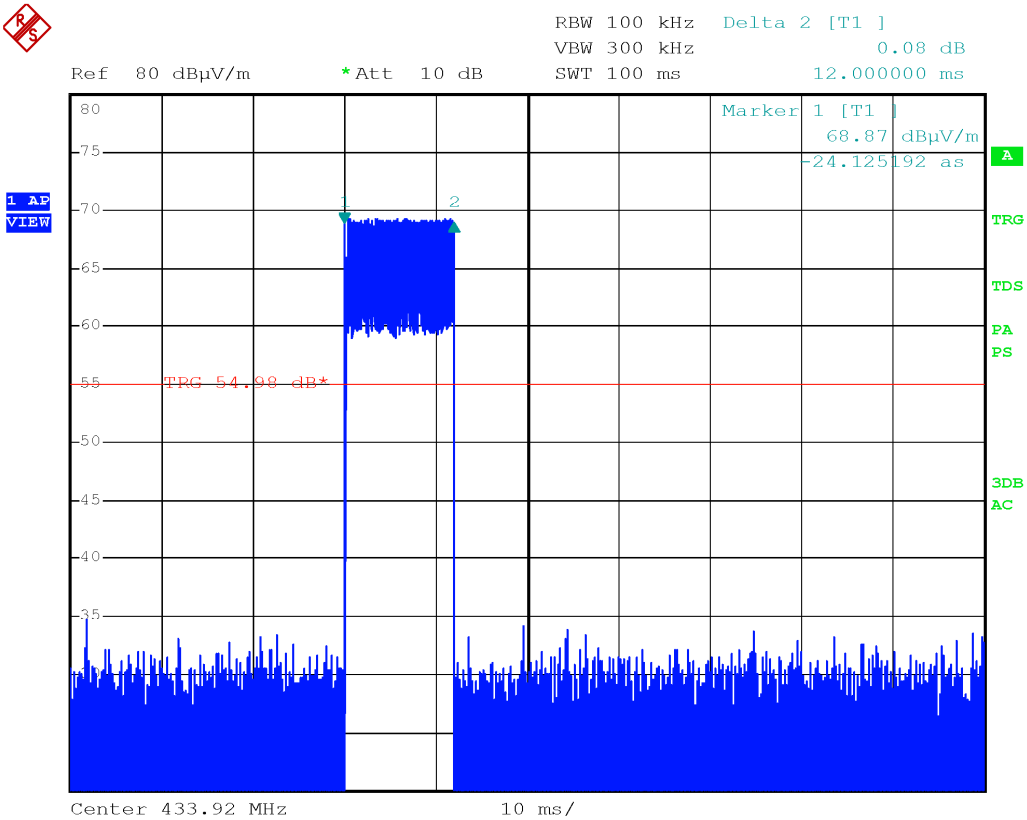
- The spectrum was searched from 30 MHz to the 10th harmonic.
- The EUT was measured on three orthogonal axis.
- All measurements were performed at a distance of 3 m.
- All measurements were performed:
  - below 30 MHz: using a quasi-peak detector with 9 kHz/30 kHz RBW/VBW,
  - within 30–1000 MHz range: using a quasi-peak detector with 120 kHz/300 kHz RBW/VBW,
  - within 30–1000 MHz range: using a peak detector with 100 kHz/300 kHz RBW/VBW,
  - above 1 GHz: using peak detector with 1 MHz/3 MHz RBW/VBW for peak results
    - and using peak detector with 1 MHz/10 Hz RBW/VBW for average results
    or using average detector with 1 MHz/3 MHz RBW/VBW for average results

Test data

Duty cycle/average factor calculations

§15.35(c) When the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds.

Duty cycle/average factor calculations:



$$Duty\,cycle/average\,factor = 20 \times \log_{10}\left(\frac{Tx_{100\,ms}}{100\,ms}\right)$$

Transmission time = 12.00 ms

Duty cycle correction = -18.41 dB

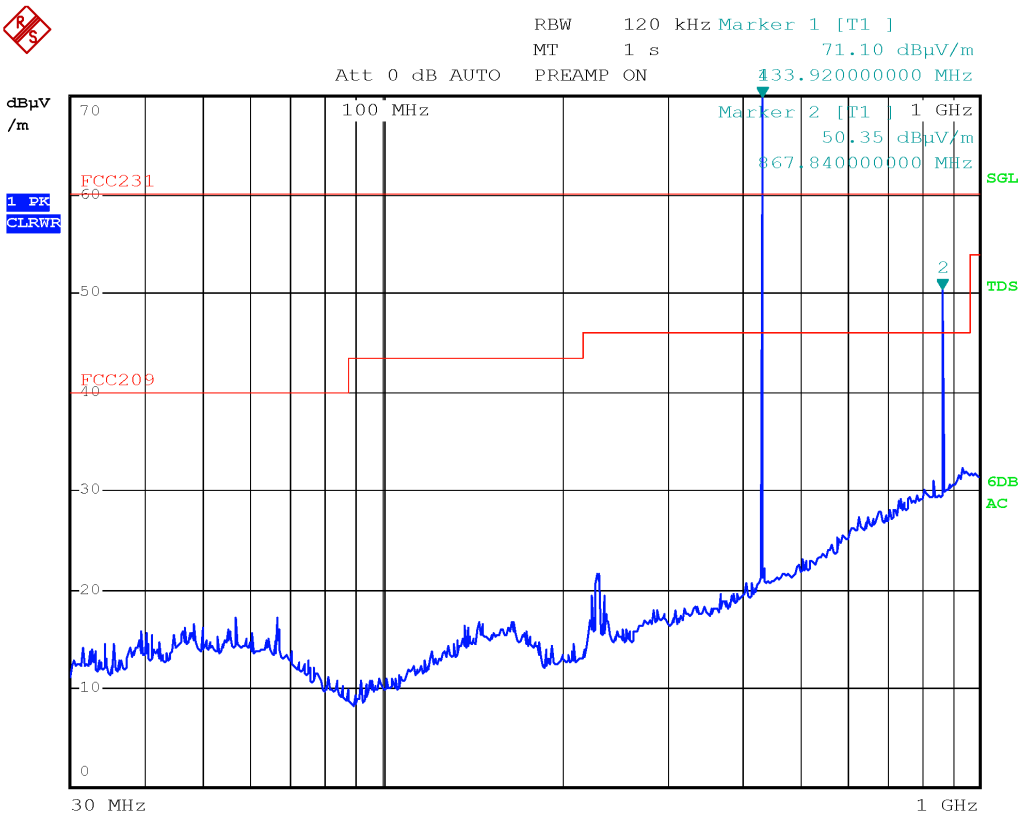
Test data, continued

Test facility	Measuring distance (m)	Antenna height variation (m)	Turn table position (°)
10m Semi anechoic chamber	3	1–4	0–360

Results

Refer to spectral plots and tables of this section.

Spectral plots



Antenna in horizontal polarization – EUT in horizontal position

Frequency (MHz)	Polarization V/H	Peak field strength (dBµV/m)	Duty cycle corr. (dB)	Avg field strength (dBµV/m)	Avg limit (dBµV/m)	Avg margin (dB)
433.92	H	71.1	-18.4	52.7	80.1	-27.4
867.84	H	50.4	-18.4	32.0	60.1	-28.1

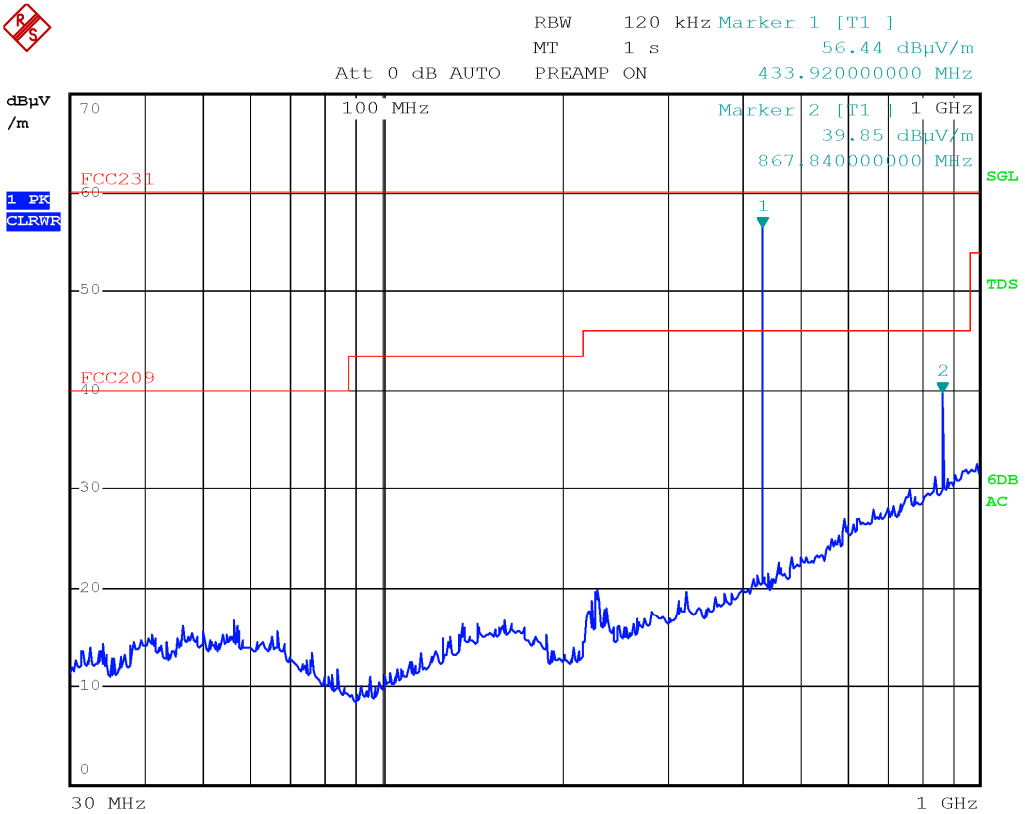
Test data, continued

Test facility	Measuring distance (m)	Antenna height variation (m)	Turn table position (°)
10m Semi anechoic chamber	3	1–4	0–360

Results

Refer to spectral plots and tables of this section.

Spectral plots



Antenna in vertical polarization – EUT in horizontal position

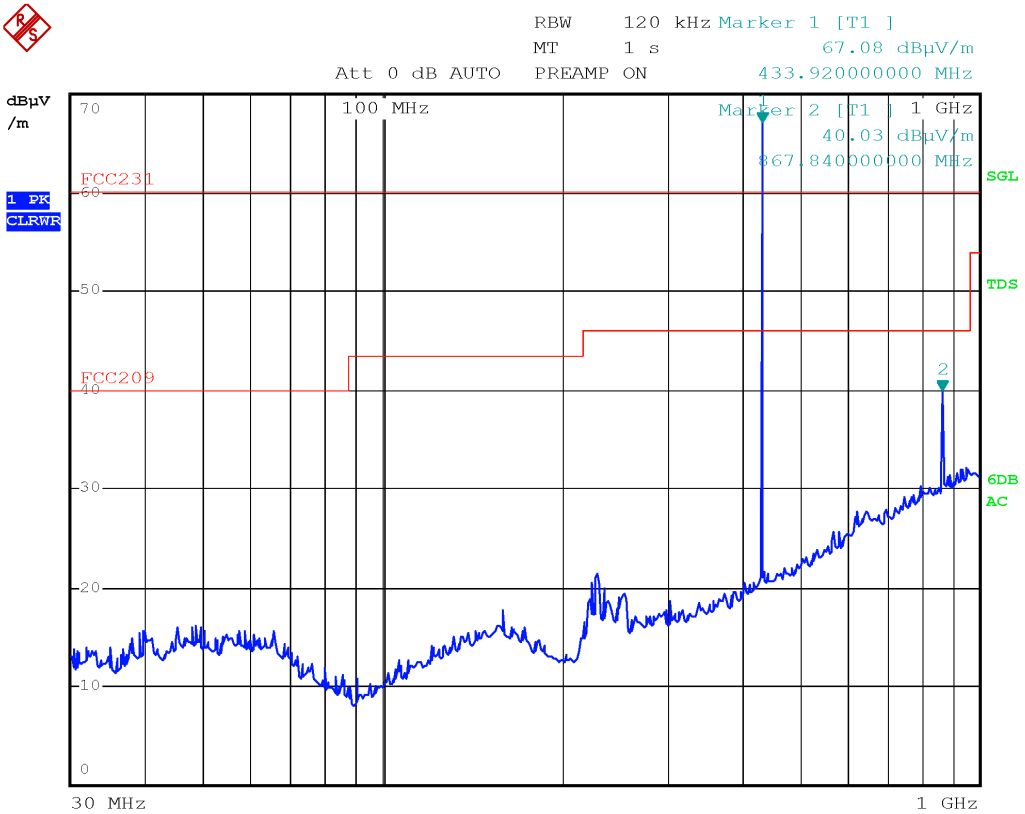
Frequency (MHz)	Polarization V/H	Peak field strength (dBµV/m)	Duty cycle corr. (dB)	Avg field strength (dBµV/m)	Avg limit (dBµV/m)	Avg margin (dB)
433.92	V	56.4	-18.4	38.0	80.1	-42.1
867.84	V	39.9	-18.4	21.5	60.1	-38.6

Test data, continued			
Test facility	Measuring distance (m)	Antenna height variation (m)	Turn table position (°)
10m Semi anechoic chamber	3	1–4	0–360

Results

Refer to spectral plots and tables of this section.

Spectral plots



Antenna in horizontal polarization – EUT in vertical position

Frequency (MHz)	Polarization V/H	Peak field strength (dBµV/m)	Duty cycle corr. (dB)	Avg field strength (dBµV/m)	Avg limit (dBµV/m)	Avg margin (dB)
433.92	H	67.1	-18.4	48.7	80.1	-31.4
867.84	H	40.0	-18.4	21.6	60.1	-38.5

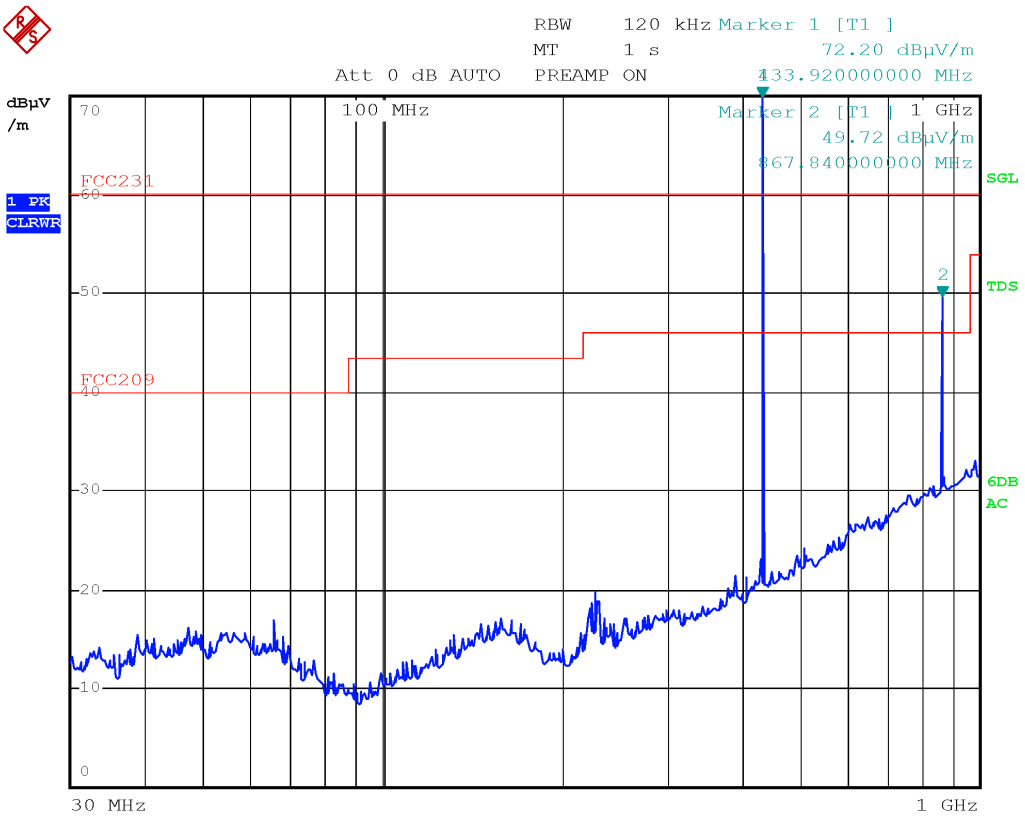
Test data, continued

Test facility	Measuring distance (m)	Antenna height variation (m)	Turn table position (°)
10m Semi anechoic chamber	3	1–4	0–360

Results

Refer to spectral plots and tables of this section.

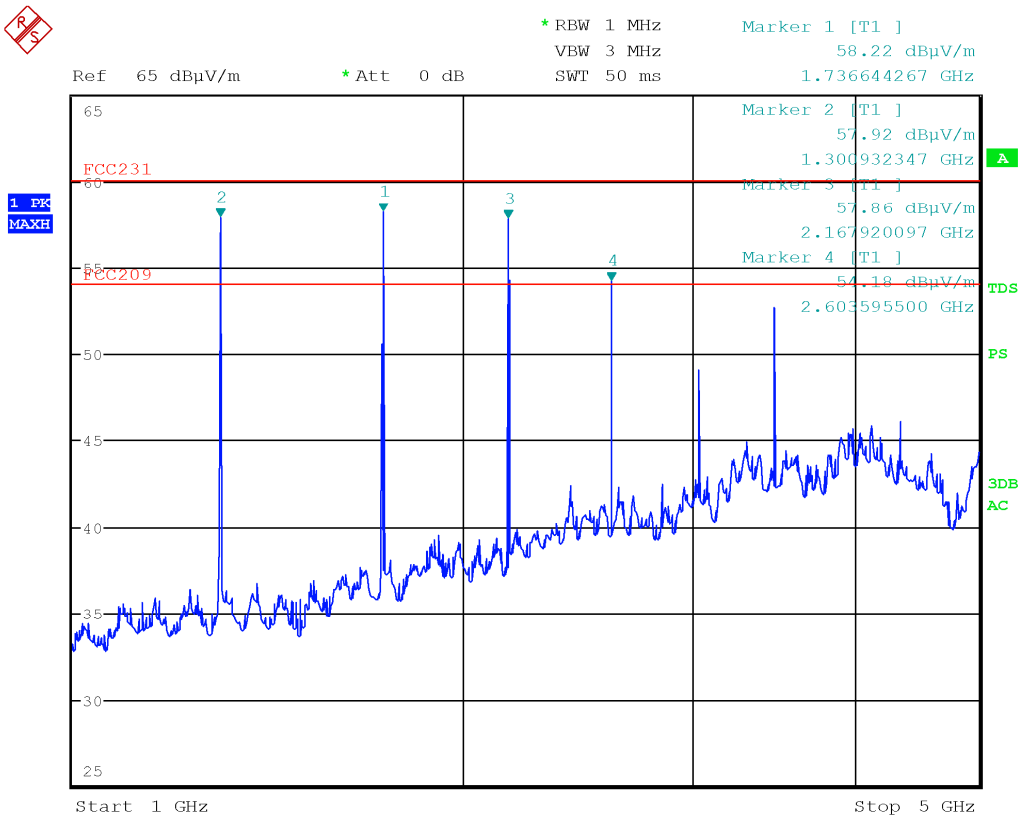
Spectral plots



Antenna in vertical polarization – EUT in vertical position

Frequency (MHz)	Polarization V/H	Peak field strength (dBµV/m)	Duty cycle corr. (dB)	Avg field strength (dBµV/m)	Avg limit (dBµV/m)	Avg margin (dB)
433.92	V	72.2	-18.4	53.8	80.1	-26.3
867.84	V	49.7	-18.4	31.3	60.1	-28.8

Test data, continued			
Test facility	Measuring distance (m)	Antenna height variation (m)	Turn table position (°)
10m Semi anechoic chamber	3	1–4	0–360
Results			
Refer to spectral plots and tables of this section.			
Spectral plots			



Antenna in horizontal polarization – EUT in horizontal position

Frequency (GHz)	Polarization V/H	Peak field strength (dBµV/m)	Duty cycle corr. (dB)	Avg field strength (dBµV/m)	Avg limit (dBµV/m)	Avg margin (dB)
1.30	H	57.9	-18.4	39.5	54.0	-14.5
1.74	H	58.2	-18.4	39.8	60.1	-20.3
2.17	H	57.9	-18.4	39.5	60.1	-20.6
2.60	H	54.2	-18.4	35.8	60.1	-24.3

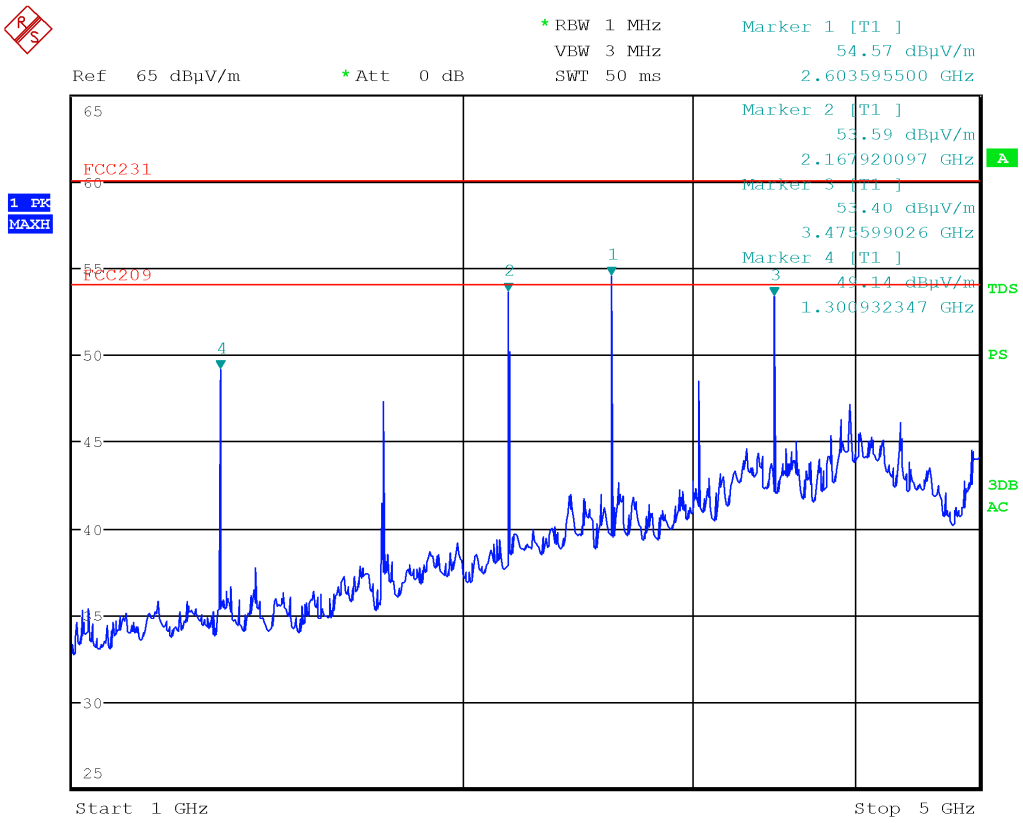
Test data, continued

Test facility	Measuring distance (m)	Antenna height variation (m)	Turn table position (°)
10m Semi anechoic chamber	3	1–4	0–360

Results

Refer to spectral plots and tables of this section.

Spectral plots



Antenna in vertical polarization – EUT in horizontal position

Frequency (MHz)	Polarization V/H	Peak field strength (dBµV/m)	Duty cycle corr. (dB)	Avg field strength (dBµV/m)	Avg limit (dBµV/m)	Avg margin (dB)
1.30	V	58.97	-18.4	30.7	54.0	-23.3
2.17	V	59.60	-18.4	35.2	60.1	-24.9
2.60	V	51.67	-18.4	36.2	60.1	-23.9
3.47	V	54.46	-18.4	35.0	54.0	-19.0

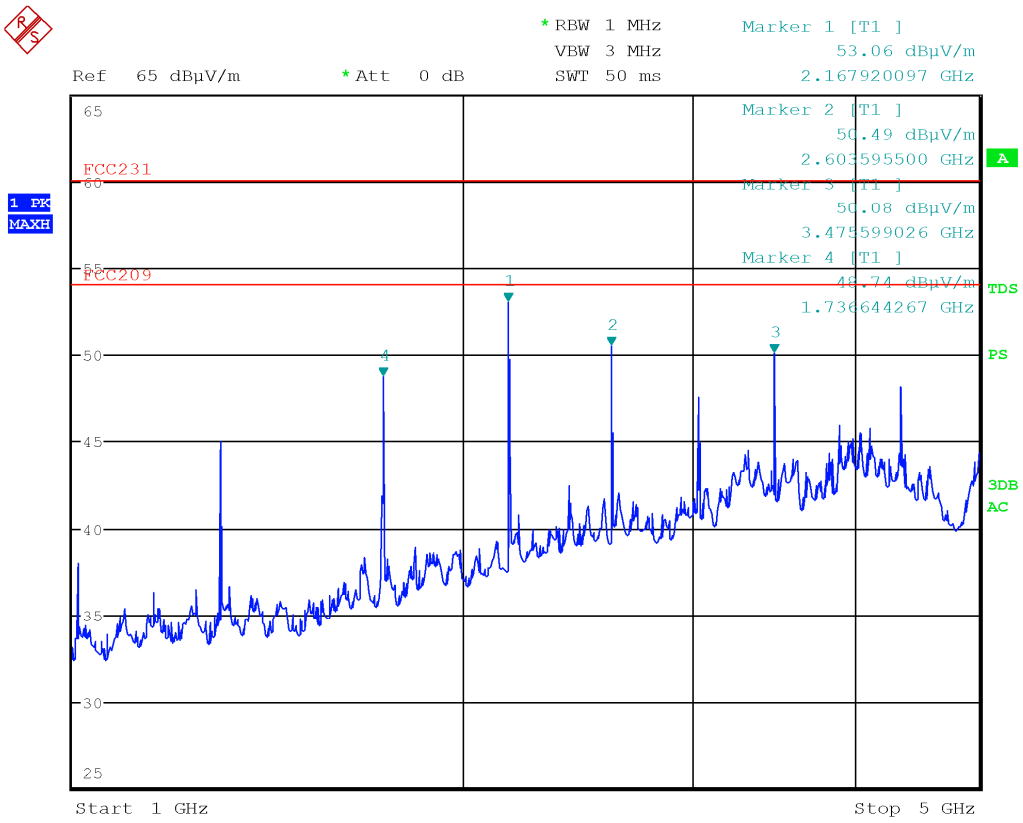
Test data, continued

Test facility	Measuring distance (m)	Antenna height variation (m)	Turn table position (°)
10m Semi anechoic chamber	3	1–4	0–360

Results

Refer to spectral plots and tables of this section.

Spectral plots



Antenna in horizontal polarization – EUT in vertical position

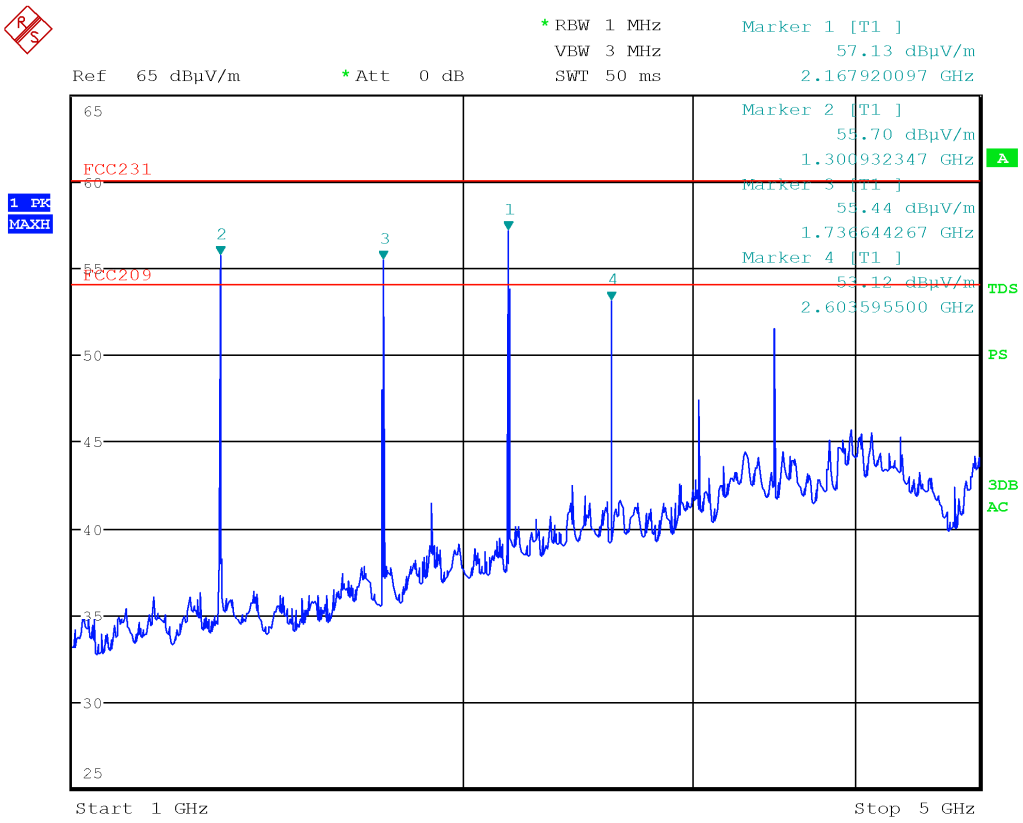
Frequency (MHz)	Polarization V/H	Peak field strength (dBµV/m)	Duty cycle corr. (dB)	Avg field strength (dBµV/m)	Avg limit (dBµV/m)	Avg margin (dB)
1.74	H	48.7	-18.4	30.3	60.1	-29.8
2.17	H	53.1	-18.4	34.7	60.1	-25.4
2.60	H	50.5	-18.4	32.1	60.1	-28.0
3.47	H	50.1	-18.4	31.7	54.0	-22.3

Test data, continued			
Test facility	Measuring distance (m)	Antenna height variation (m)	Turn table position (°)
10m Semi anechoic chamber	3	1–4	0–360

Results

Refer to spectral plots and tables of this section.

Spectral plots



Antenna in vertical polarization – EUT in vertical position

Frequency (MHz)	Polarization V/H	Peak field strength (dBµV/m)	Duty cycle corr. (dB)	Avg field strength (dBµV/m)	Avg limit (dBµV/m)	Avg margin (dB)
1.30	V	55.7	-18.4	37.3	54.0	-16.7
1.74	V	55.4	-18.4	37.0	60.1	-23.1
2.17	V	57.1	-18.4	38.7	60.1	-21.4
2.60	V	53.1	-18.4	34.7	60.1	-25.4

8.6 Clause 15.231(c) Emission bandwidth

§ 15.231 Periodic operation in the band 40.66–40.70 MHz and above 70 MHz.

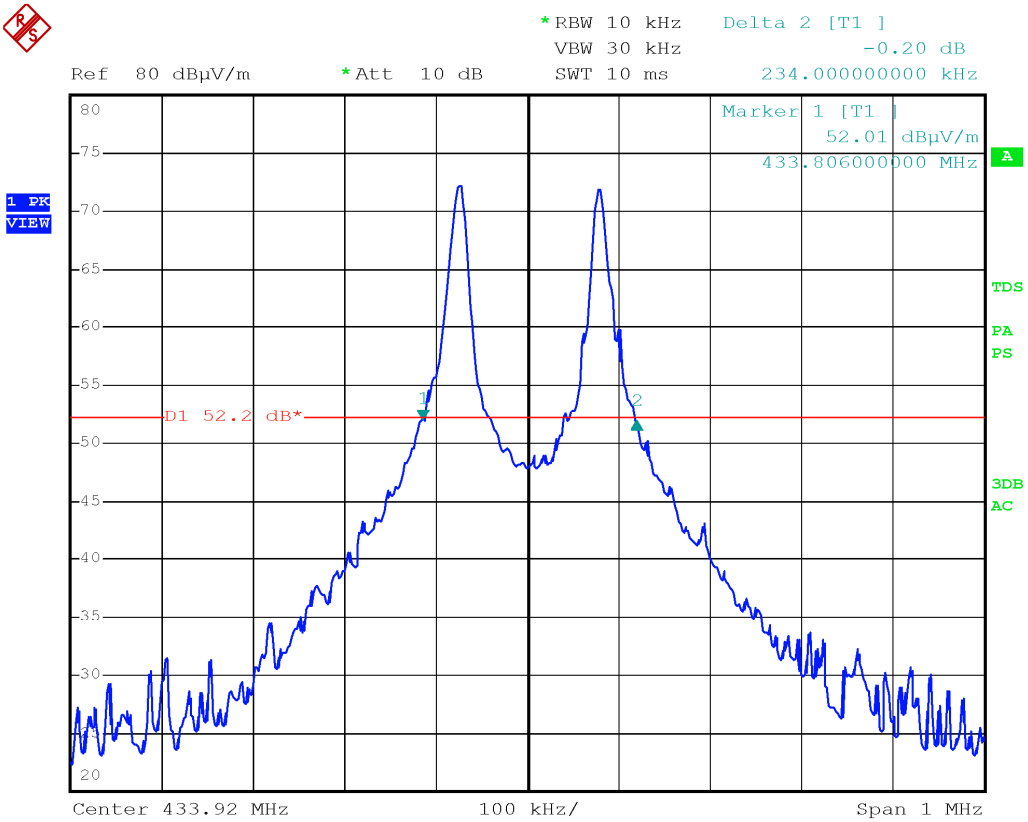
(c) The bandwidth of the emission shall be no wider than 0.25 % of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5 % of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

Special notes

The test was performed using peak detector of the spectrum analyzer with RBW no narrower than 1 % of the emission bandwidth.

Test data

Limits
0.25 % of 433.92 MHz is 1.08 MHz



20 dB bandwidth (kHz)	Limit (kHz)	Margin (kHz)
234	1084	850

8.7 Clause 15.231(d) Requirements for devices operating within 40.66–40.70 MHz band

§ 15.231 Periodic operation in the band 40.66–40.70 MHz and above 70 MHz.

(d) For devices operating within the frequency band 40.66–40.70 MHz, the bandwidth of the emission shall be confined within the band edges and the frequency tolerance of the carrier shall be ±0.01 %. This frequency tolerance shall be maintained for a temperature variation of −20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85 % to 115 % of the rated supply voltage at a temperature of 20 degrees C. For battery-operated equipment, the equipment tests shall be performed using a new battery.

Special notes
None

Test data
N/A

8.8 Clause 15.231(e) Field strength of emissions for periodic radiators

§ 15.231 Periodic operation in the band 40.66–40.70 MHz and above 70 MHz.

(e) Intentional radiators may operate at a periodic rate exceeding that specified in paragraph (a) of this section and may be employed for any type of operation, including operation prohibited in paragraph (a) of this section, provided the intentional radiator complies with the provisions of paragraphs (b) through (d) of this section, except the field strength table in paragraph (b) of this section is replaced by the following:

Fundamental frequency (MHz)	Field strength of fundamental		Field strength of spurious emissions	
	(µV/m)	(dBµV/m)	(µV/m)	(dBµV/m)
40.66–40.70	1,000	60	100	40
70–130	500	53.9	50	33.9
130–174	500 to 1,500*	53.9 to 63.5*	50 to 150*	33.9 to 43.5*
174–260	1,500	63.5	150	43.5
260–470	1,500 to 5,000*	63.5 to 73.9*	150 to 500*	43.5 to 53.9*
Above 470	5,000	73.9	500	53.9

– * Linear interpolations.
– The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.

In addition, devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

Special Notes

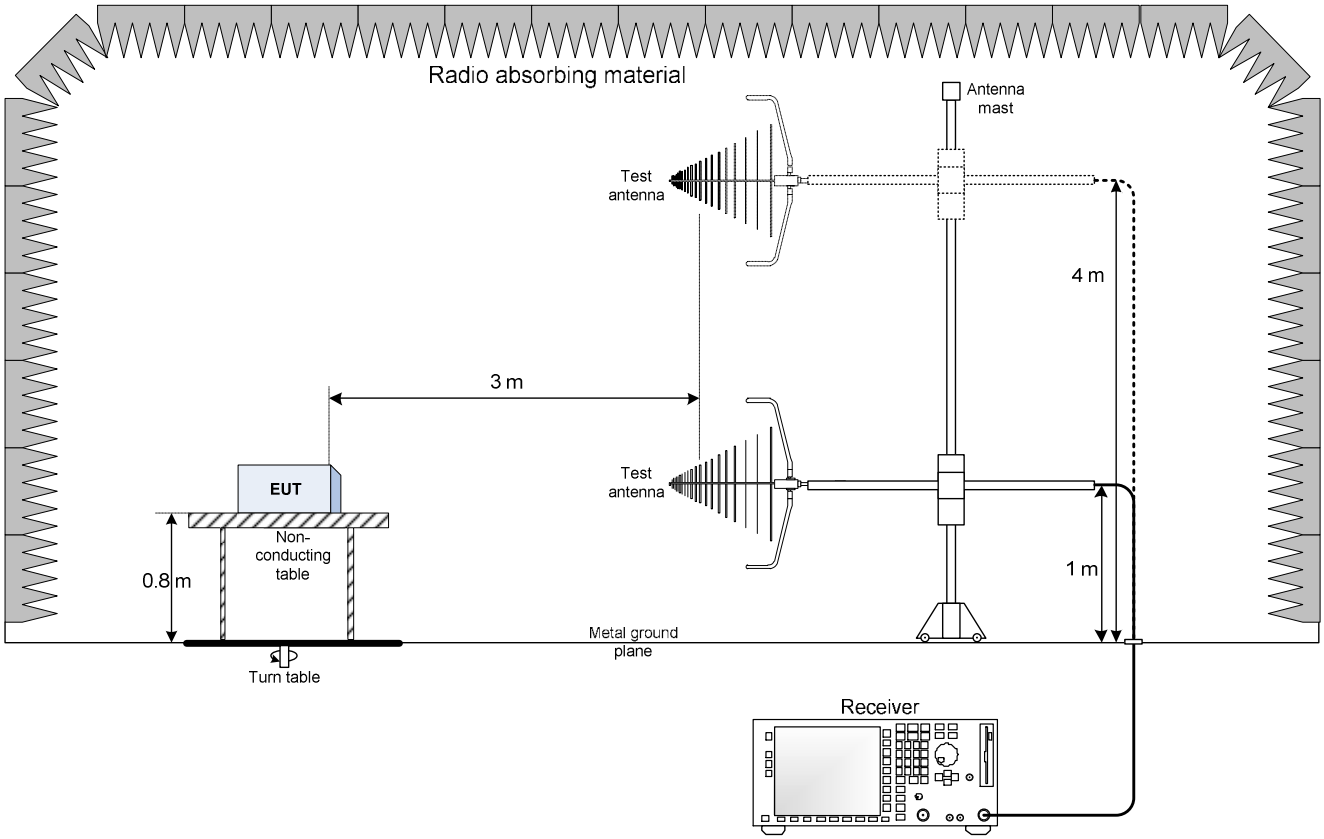
None

Test data

N/A

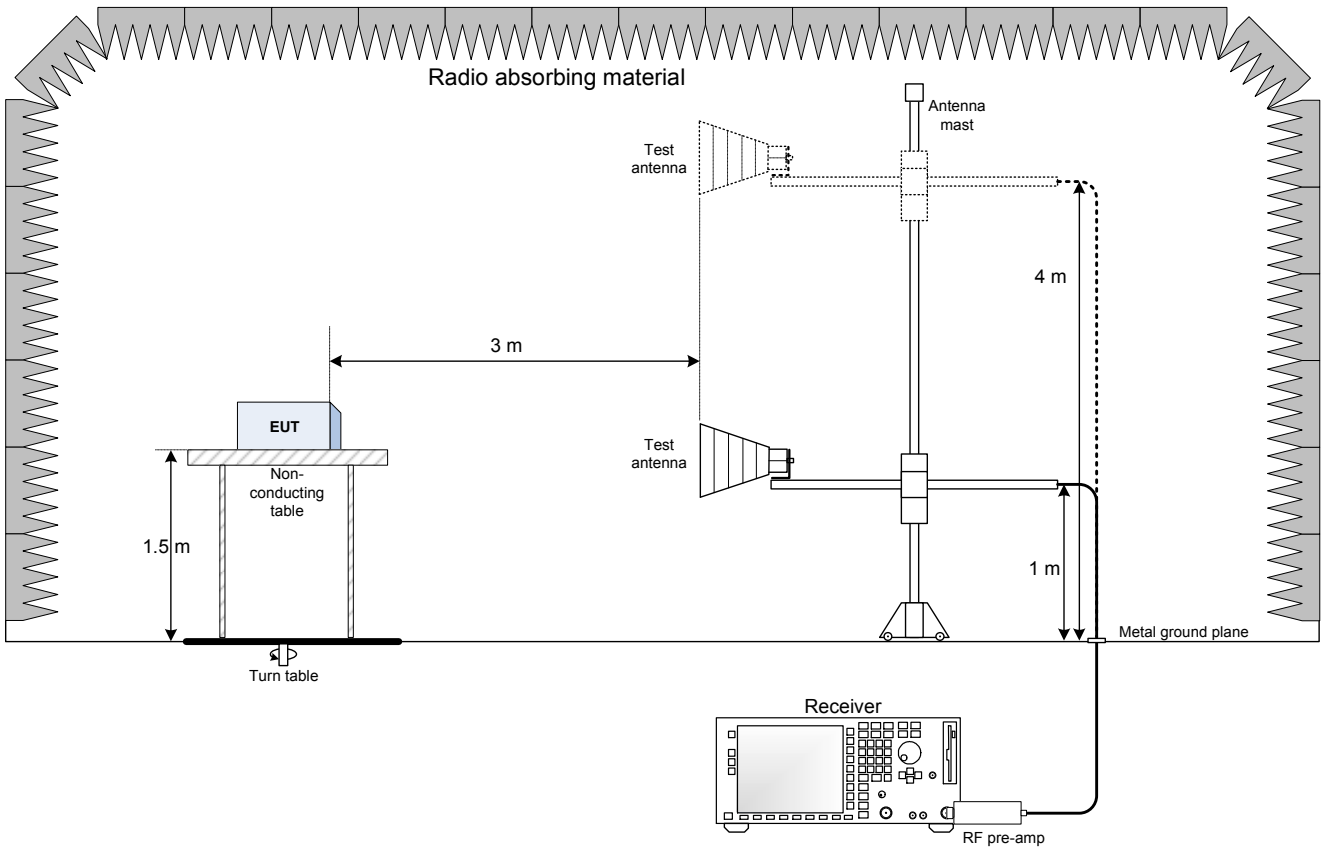
Section 9: Block diagrams of test set-ups

Radiated emissions set-up above 30 MHz

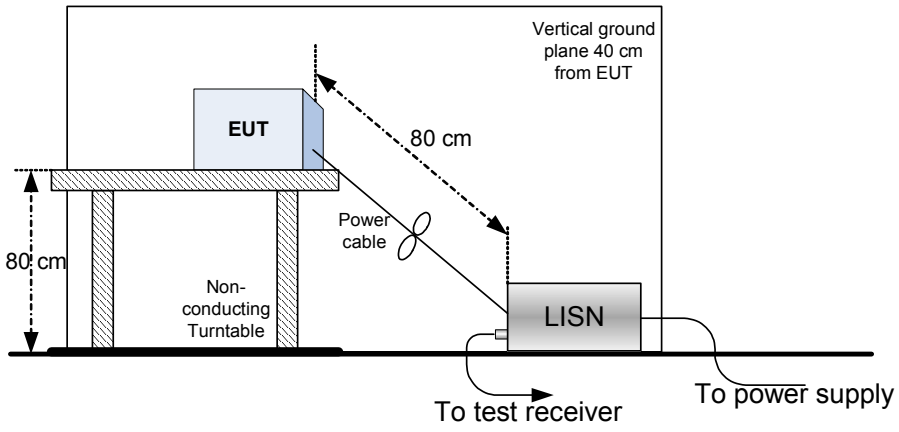


Block diagram, continued

Radiated emissions set-up above 1 GHz



Conducted emissions set-up



Section 10: EUT photos

EUT

Set up photo

End of report