

Report on the Radio Testing

For

Semtech Neuchatel SARL

on

Corecell

Report no. TRA-046892-45-01B

23 September 2019

RF907 3.0



Report Number: TRA-046892-45-01B
Issue: A

REPORT ON THE RADIO TESTING OF A
Semtech Neuchatel SARL
Corecell
WITH RESPECT TO SPECIFICATION
ETSI EN 300 220-2 V3.1.1 (2017-02)
(Limited testing)

TEST DATE: 2019-07-2019 to 2019-08-28

Written by:

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Date: 23 September 2019

Disclaimers:

- [1] THIS DOCUMENT MAY BE REPRODUCED ONLY IN ITS ENTIRETY AND WITHOUT CHANGE
- [2] THE RESULTS CONTAINED IN THIS DOCUMENT RELATE ONLY TO THE ITEM(S) TESTED

1 Revision Record

<i>Issue Number</i>	<i>Issue Date</i>	<i>Revision History</i>
A	18 September 2019	Original
B	23 September 2019	

2 Summary

TEST REPORT NUMBER: TRA-046892-45-01B

WORKS ORDER NUMBER: TRA-046892-01

PURPOSE OF TEST: Testing of radio equipment construction per article 3.2 of the RE-Directive 2014/53/EU

TEST SPECIFICATION: EN 300 220-2 V3.1.1 (Limited testing)

EQUIPMENT UNDER TEST (EUT): Corecell

MANUFACTURER/AGENT: Semtech Neuchatel SARL

ADDRESS: 40 Rue Gouttes d'Or
Neuchâtel
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CLIENT CONTACT: Tim Cooper
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ORDER NUMBER: 6000058546

TEST DATE: 2019-07-2019 to 2019-08-28

TESTED BY: Ian Broadwell
Element

2.1 Test Summary

<i>Test Method and Description</i>	<i>Requirement Clause</i>	<i>Applicable to this equipment</i>	<i>Result / Note</i>
Operating frequency	4.2.1	<input type="checkbox"/>	<i>Declaration</i>
Unwanted emissions in the spurious domain	4.2.2	<input checked="" type="checkbox"/>	<i>Pass</i>
TX effective radiated power	4.3.1	<input checked="" type="checkbox"/>	<i>Pass</i>
TX maximum e.r.p. spectral density	4.3.2	<input type="checkbox"/>	<i>Note 1</i>
TX duty cycle	4.3.3	<input type="checkbox"/>	<i>Note 1</i>
TX occupied bandwidth	4.3.4	<input checked="" type="checkbox"/>	<i>Pass</i>
TX out of band emissions	4.3.5	<input type="checkbox"/>	<i>Note 1</i>
TX transient power	4.3.6	<input checked="" type="checkbox"/>	<i>Pass</i>
TX adjacent channel power	4.3.7	<input type="checkbox"/>	<i>Note 1</i>
TX behaviour under low voltage conditions	4.3.8	<input type="checkbox"/>	<i>Note 1</i>
TX adaptive power control	4.3.9	<input type="checkbox"/>	<i>Note 1</i>
TX FHSS	4.3.10	<input type="checkbox"/>	<i>Note 1</i>
TX short term behaviour	4.3.11	<input type="checkbox"/>	<i>Note 1</i>
RX sensitivity	4.4.1	<input type="checkbox"/>	<i>Note 1</i>
Clear channel assessment threshold	4.5.2	<input type="checkbox"/>	<i>Note 1</i>
Polite spectrum access timing parameters	4.5.3	<input type="checkbox"/>	<i>Note 1</i>
RX blocking	4.4.2	<input type="checkbox"/>	<i>Note 1</i>
Adaptive frequency agility	4.5.4	<input type="checkbox"/>	<i>Note 1</i>

Specific note:

1. Only limited testing was performed as per client's request.

General notes:

The results contained in this report relate only to the items tested, in the condition at time of test, and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

The apparatus was set-up and exercised using the configurations, modes of operation and arrangements defined in this report only. Any modifications made are identified in Section 8 of this report.

Particular operating modes, apparatus monitoring methods and performance criteria required by the standards tested to have been performed except where identified in Section 5.2 of this test report (Deviations from Test Standards).

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4 Introduction

This report TRA-046892-45-01B presents the results of the Radio testing on a Semtech Neuchatel SARL, Corecell to specification EN 300 220-2 V3.1.1 Short Range Devices (SRD) operating in the frequency range 25 MHz to 1 000 MHz; Part 2: Harmonized Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU for non specific radio equipment.

The testing was carried out for Semtech Neuchatel SARL by Element, at the address detailed below.

<input checked="" type="checkbox"/>	Element Hull Unit E South Orbital Trading Park Hedon Road Hull HU9 1NJ UK	<input type="checkbox"/>	Element Skelmersdale Unit 1 Pendle Place Skelmersdale West Lancashire WN8 9PN UK
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This report details the configuration of the equipment, the test methods used and any relevant modifications where appropriate.

All test and measurement equipment under the control of the laboratory and requiring calibration is subject to an established programme and procedures to control and maintain measurement standards. The quality management system meets the principles of ISO 9001, and has quality control procedures for monitoring the validity of tests undertaken. Records and sufficient detail are retained to establish an audit trail of calibration records relating to its test results for a defined period. Under control of the established calibration programme, key quantities or values of the test & measurement instrumentation are within specification and comply with the relevant traceable internationally recognised and appropriate standard specifications, which are UKAS calibrated as such where these properties have a significant effect on results. Participation in inter-laboratory comparisons and proficiency testing ensures satisfactory correlation of results conform to Elements own procedures, as well as statistical techniques for analysis of test data providing the appropriate confidence in measurements.

5 Test Specifications

5.1 Normative References

- ETSI EN 300 220-2 V3.1.1 (2017-02) – Short Range Devices (SRD) operating in the frequency range 25 MHz to 1 000 MHz; Part 2: Harmonized Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU for non specific radio equipment.
- ETSI EN 300 220-1 V3.1.1 (2017-02) – Short Range Devices (SRD) operating in the frequency range 25 MHz to 1 000 MHz; Part 1: Technical characteristics and methods of measurement.

5.2 Deviations from Test Standards

There were following deviations from the test standard.

Only limited testing was performed as per client's request.

6 Glossary of Terms

6.1 Acronyms, symbols and abbreviations

§	Denotes a section reference from the standard, EN 300 220-1, not this document
§§	Denotes a section reference from the standard, EN 300 220-2, not this document
AC	Alternating Current
AFA	Adaptive Frequency Agility
AM	Amplitude Modulated
BW	Bandwidth
C	Celcius
CW	Continuous Wave
dB	Decibels
dBm	dB relative to 1 milliwatt
DC	Direct Current
DSSS	Direct Sequence Spread Spectrum (or other non-FHSS spread spectrum)
EIRP	Equivalent Isotropically Radiated Power
emf	electromotive force
EN	European Normative document
erp	Effective Radiated Power
EUT	Equipment under Test
f	Frequency
FHSS	Frequency hopping spread spectrum
Hz	Hertz
IF	Intermediate Frequency
ITU	International Telecommunication Union
LBT	Listen before Talk
LO	Local Oscillator
m	metre
max	Maximum
min	Minimum
N/A	Not Applicable
No.	Number
NRI	National Radio Interface
OCW	Operating Channel Width (i.e. the channel spacing)
PCB	Printed Circuit Board
PDF	Portable Document Format
PSA	Polite Spectrum Access
RE-D	Radio Equipment Directive
RED	Radio Equipment Directive
RE	Radio Equipment
RF	Radio Frequency
RH	Relative Humidity
RMS	Root Mean Square
Rx	Receiver
s	Second
SRD	Short Range Device
Tx	Transmitter
UKAS	United Kingdom Accreditation Service
V	Volt
W	Watt
Ω	Ohm

6.2 Block diagrams

Block diagrams are used in this report to illustrate test set-ups. Each major item of test or support equipment is contained in a block representing a separate physical unit and labelled accordingly. Physical connections, e.g. leads, between units are drawn in solid lines. Other, e.g. over the air, connections are drawn with dashed lines. The arrows indicate the direction of propagation of the signal required in order for the measurement to be taken at the measurement point. They do not signify that propagation in the opposite direction is somehow prevented. Where the environment around specific units is controlled, e.g. use of a shielded chamber, the boundary between the controlled and uncontrolled areas is drawn with a dotted line.

7 Equipment under Test

7.1 EUT Identification

- Name: Corecell
- Model Number: E539V01A with Shield
- Software Revision: 868 MHz EU
- Build Level / Revision Number: Reference Design

7.2 System Equipment

Equipment listed below forms part of the overall test setup and is required for equipment functionality and/or monitoring during testing. The compliance levels achieved in this report relate only to the EUT and not items given in the following list.

*ePCI Interface board
Raspberry Pi
742 724 8 Ferrite
Ribbon extension cable
868 MHz band Antenna
Laptop*

7.3 EUT Mode of Operation

7.3.1 Transmissions

The EUT was transmitting modulated carrier on lowest and highest frequencies.

7.3.2 Reception

The EUT was in permanent receive mode.

7.4 EUT Radio Parameters

Frequencies of operation:	868.100 MHz – 869.525 MHz
Operating channel width:	200 kHz
Antenna type:	External
Antenna Gain:	4.1 dBi
Nominal Supply Voltage:	5 Vdc

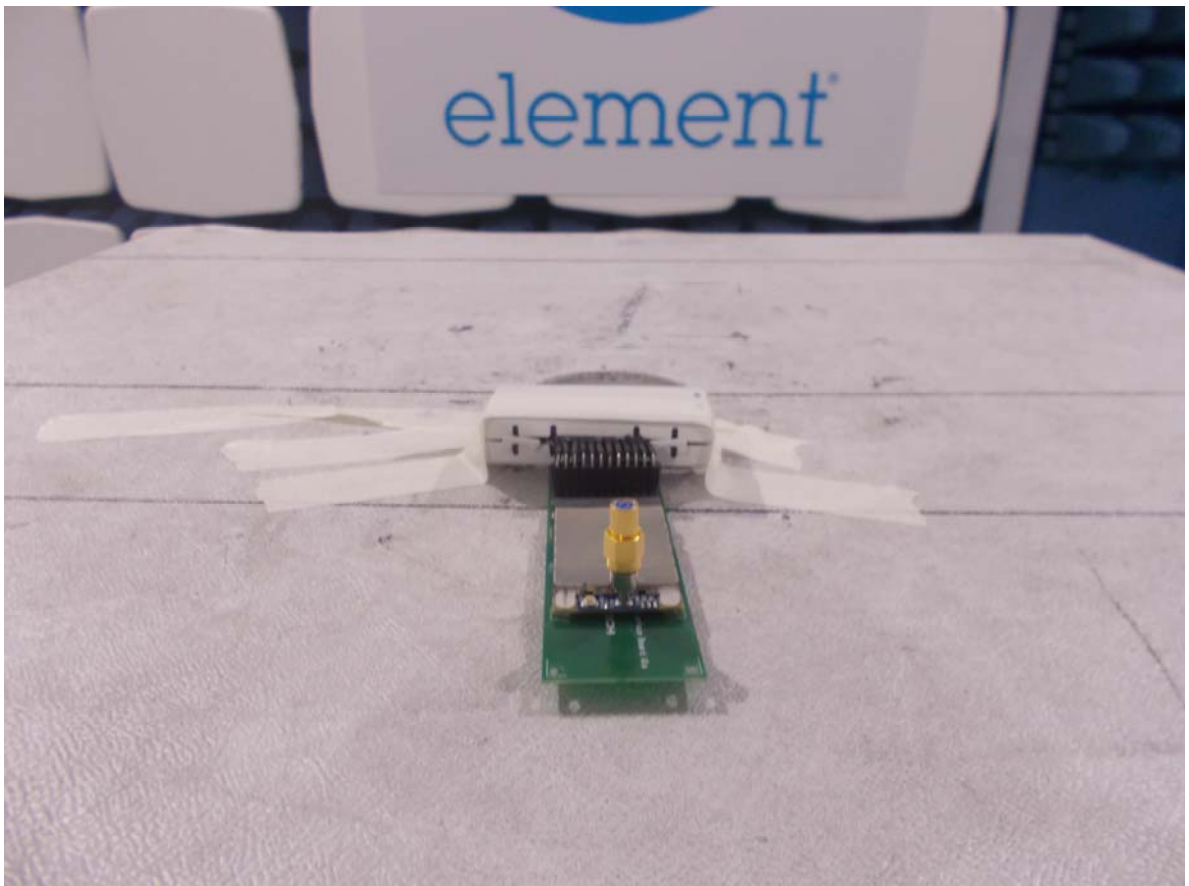
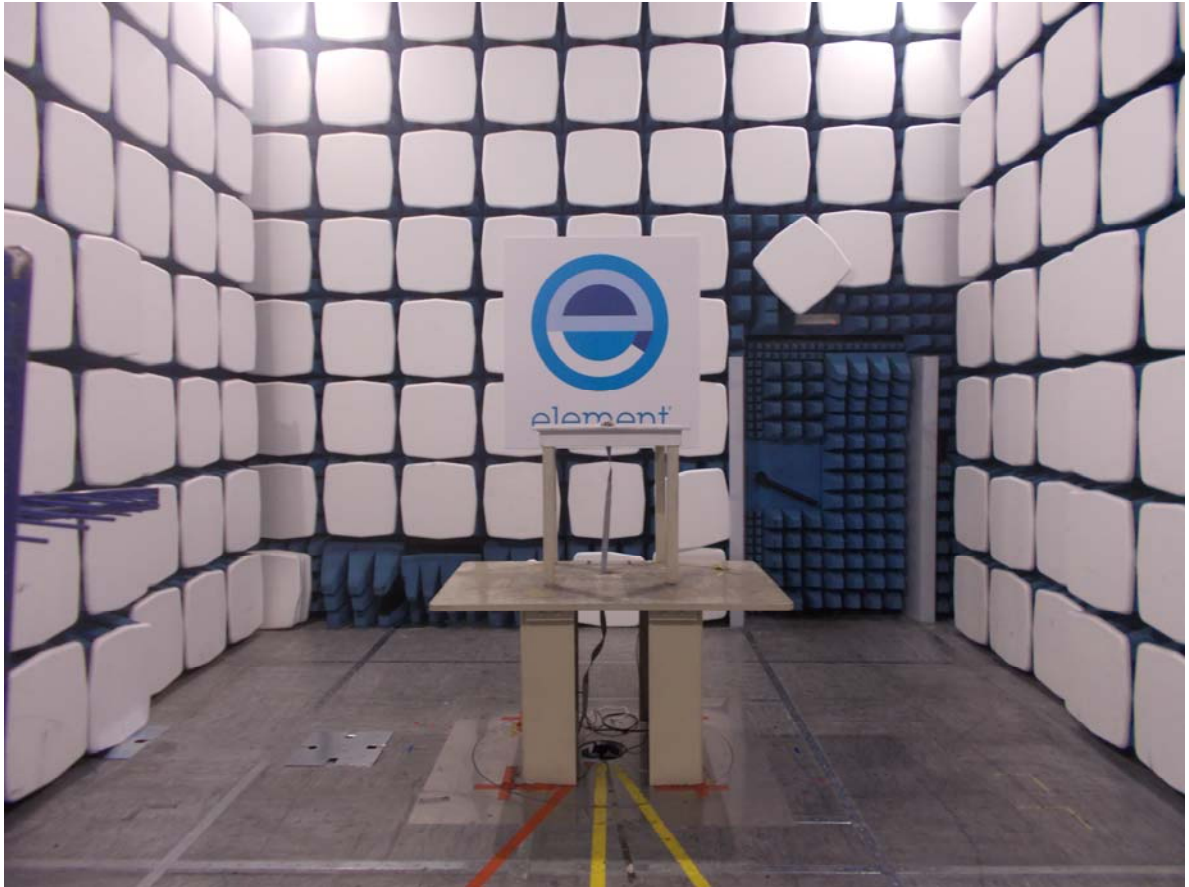
7.5 EUT Description

The EUT is a reference design.

8 Modifications

No modifications were performed during this assessment.

9 EUT Test Setup Photographs





10 General Technical Parameters

10.1 Normal Conditions

The EUT was tested under the normal environmental conditions of the test laboratory, except where otherwise stated. The normal power source applied was 5 Vdc.

10.2 Extreme Test Conditions

Where extreme temperatures are required to be tested the following extremes were used:

Applicable	Category	Range
<input type="checkbox"/>	Category I (General)	-20 °C to +55 °C
<input type="checkbox"/>	Category II (Portable)	-10 °C to +55 °C
<input type="checkbox"/>	Category III (Equipment for normal indoor use)	+5 °C to +35 °C
<input type="checkbox"/>	Category IV (Automotive)	-40 °C to +125 °C
<input checked="" type="checkbox"/>	Declared by provider	-40 °C to +85 °C

Where extreme voltages are required to be tested the following extremes were used:

Applicable	Category	Range
<input type="checkbox"/>	Mains (single nominal voltage)	230 Vac \pm 10%
<input type="checkbox"/>	Regulated lead-acid	12 V x 1.3 max. 12 V x 0.9 min.
<input type="checkbox"/>	Other battery types	3.2 V max. 3 V x 0.85 min.
<input checked="" type="checkbox"/>	Other (including multi-ranging mains)	5 Vdc max. 5 Vdc Min.

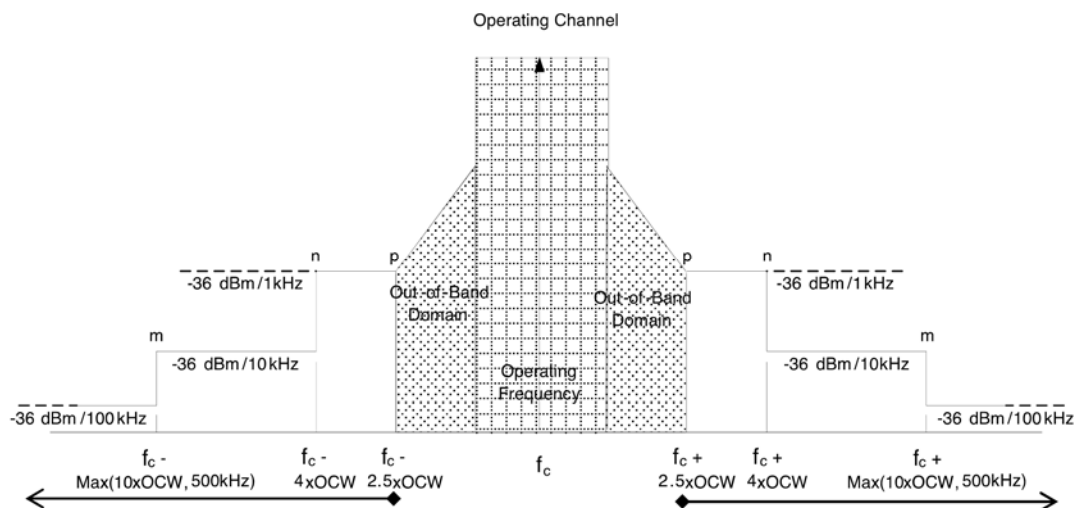
11 Unwanted emissions in the spurious domain

11.1 Definition

11.1.1 Unwanted emissions for a TX mode

Spurious emissions are unwanted emissions in the spurious domain at frequencies other than those of the Operating Channel and its Out Of Band Domain. The relevant spurious domain is shown in Figure 7.

Figure 7: Spectrum Mask for Unwanted Emissions in the Spurious Domain with reference BW



11.1.2 Unwanted emissions for all other modes

Spurious radiations from the EUT are components, at any frequency, radiated by the equipment and antenna.

11.2 Test Parameters

Test Location:	Element Hull
Test Chamber:	Wireless Lab 2
Test Standard and Clause:	ETSI EN 300 220-1 V3.1.1 (2017-02), Clause 5.9
EUT Frequencies measured:	868.100 MHz & 869.525 MHz
Deviations From Standard:	None
Measurement Detector:	RMS

Environmental Conditions (Normal Environment)

Conducted	Radiated	
Temperature: 25 °C	Temperature: 26 °C	Standard Requirement: +15 °C to +35 °C
Humidity: 40 %RH	Humidity: 54 %RH	Standard Requirement: 20%RH to 75%RH
Supply: 5 Vdc	Supply: 5 Vdc	As declared

Test Limits

The power of any unwanted emission in the spurious domain shall not exceed the values given in Table 19.

Table 19: Spurious domain emission limits

<i>Frequency</i> <i>State</i>	<i>47 MHz to 74 MHz</i> <i>87,5 MHz to 118 MHz</i> <i>174 MHz to 230 MHz</i> <i>470 MHz to 790 MHz</i>	<i>Other frequencies below 1 000 MHz</i>	<i>Frequencies above 1 000 MHz</i>
<i>Tx mode</i>	-54 dBm	-36 dBm	-30 dBm
<i>RX and all other modes</i>	-57 dBm	-57 dBm	-47 dBm

11.3 Radiated Measurement

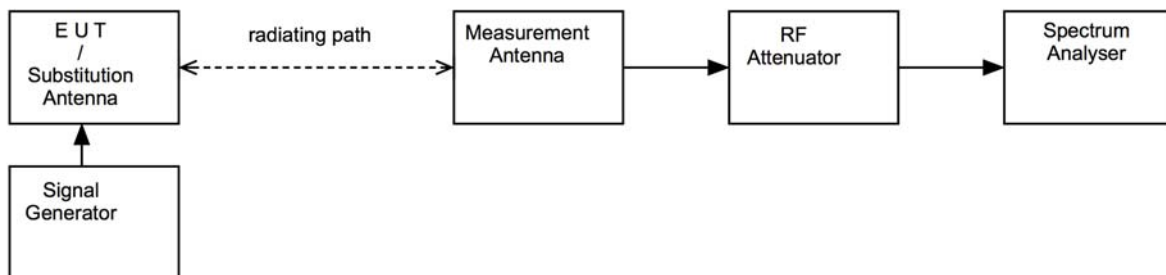
11.3.1 Test Method

With the EUT connected as per Figure vii-a, and with its antenna replaced by a non-radiating load, the RF spectrum was observed as it was rotated through 360 degrees.

The EUT was substituted with a known generator and antenna and for the same level achieved at the analyser, the effective radiated power was recorded.

Measurements were made over the range 30 MHz to 6 GHz.

Figure vii-a Test Setup



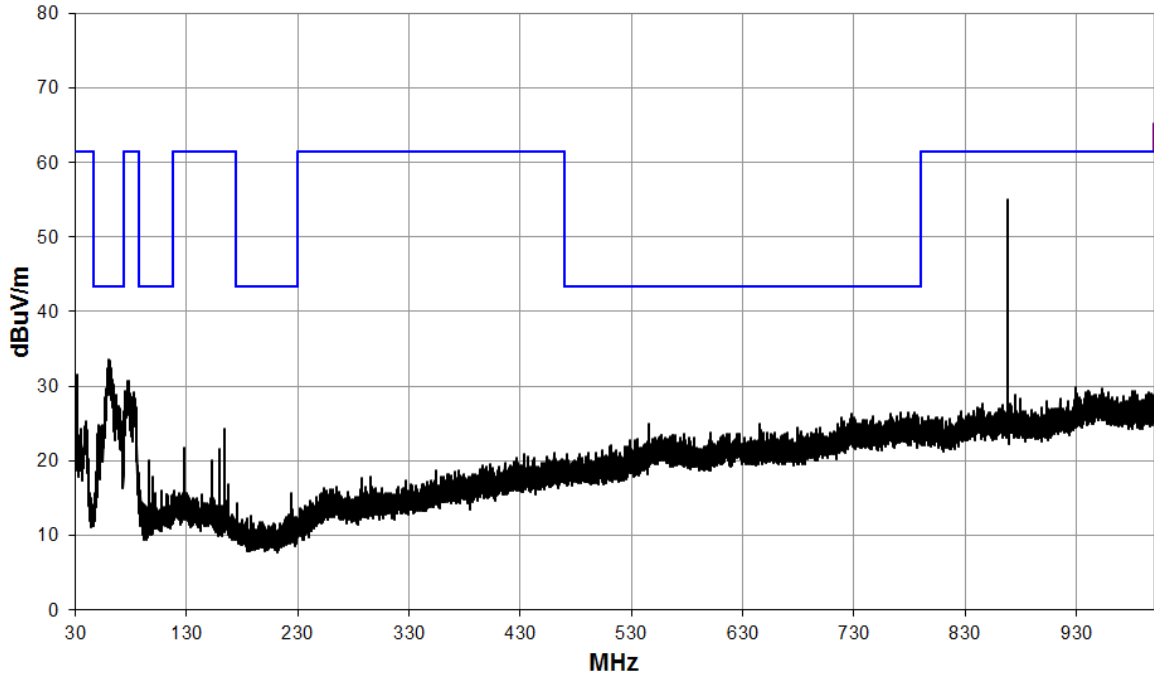
11.3.2 Test Equipment

<i>Equipment Description</i>	<i>Manufacturer</i>	<i>Equipment Type</i>	<i>Element No</i>	<i>Due For Calibration</i>
Ferrite Lined Chamber	Rainford	ATS	REF2259	2020-08-03
Spectrum Analyser	R&S	FSU50	U544	2020-06-05
Pre-Amp (9 kHz - 1 GHz)	Sonoma	310	REF927	2020-05-29
Pre-Amp (1 - 26.5 GHz)	Agilent	8449B	REF913	2020-02-06
Bilog Antenna	Chase	CBL6111B	REF2233	2020-08-17
Horn Antenna	EMCO	3115	RFG129	2020-02-12

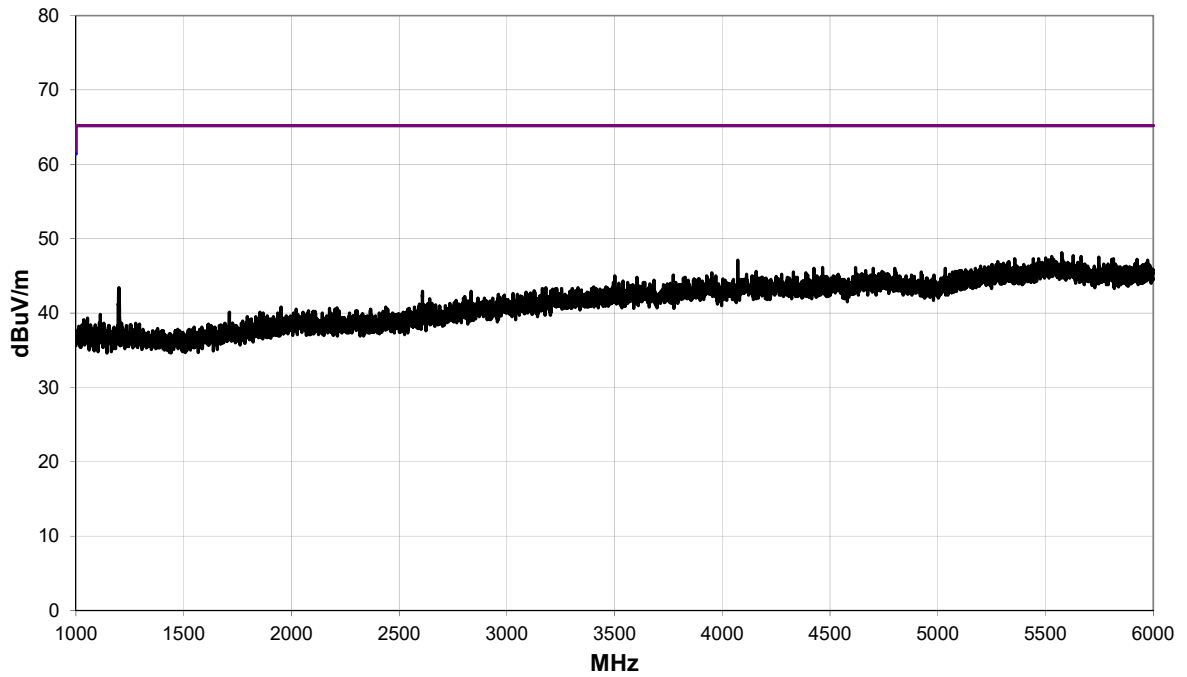
11.3.3 Test Results

Mode: Transmit; Frequency: 868.100 MHz					
Emission	Frequency (MHz)	Emission level (dBm)	Limit (dBm)	Margin (dB)	Result
No emissions were detected within 10 dB of the limit					

30 MHz to 1 GHz

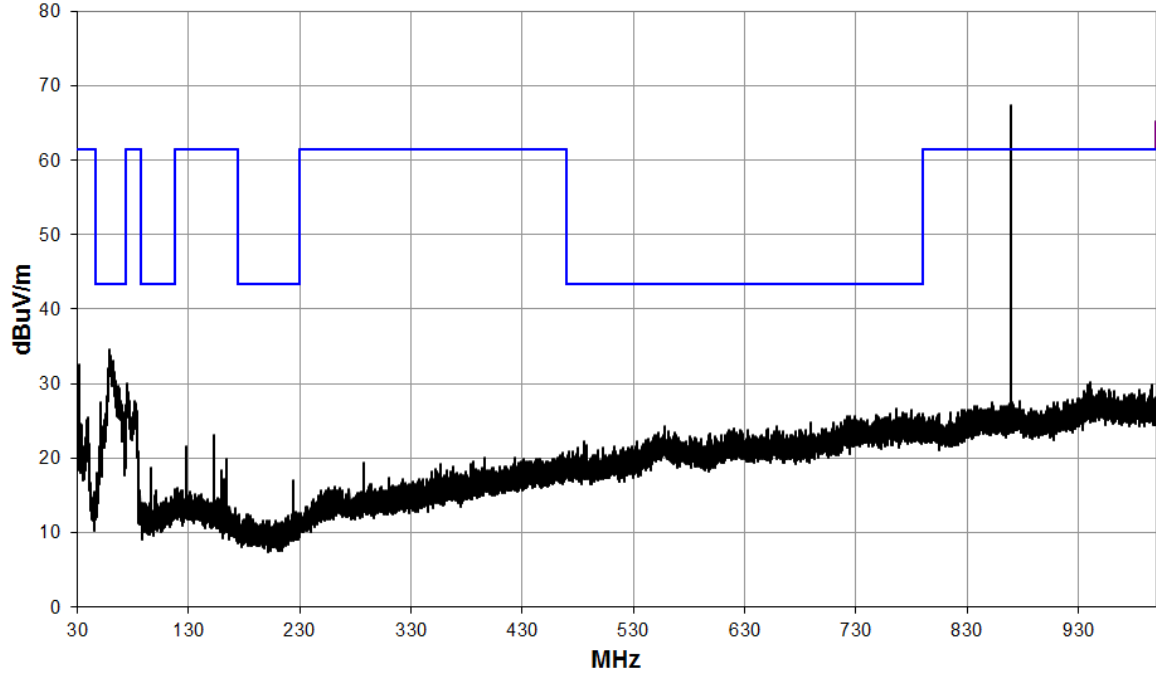


1 GHz to 6 GHz

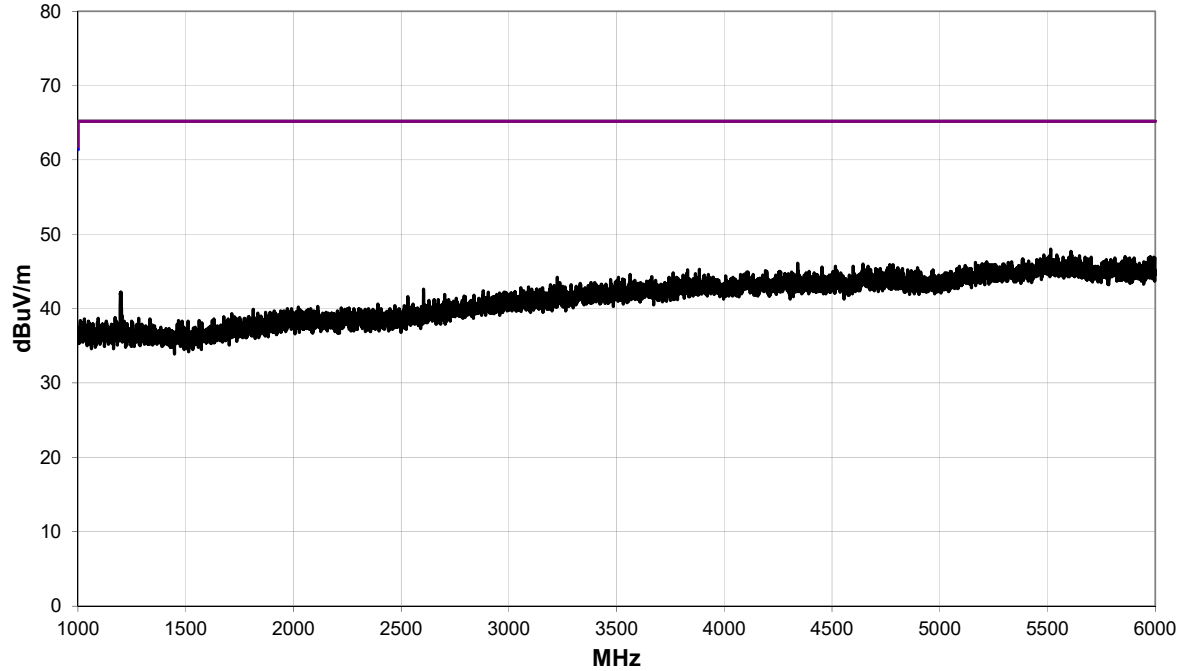


Mode: Transmit; Frequency: 869.525 MHz					
Emission	Frequency (MHz)	Emission level (dBm)	Limit (dBm)	Margin (dB)	Result
No emissions were detected within 10 dB of the limit					

30 MHz to 1 GHz

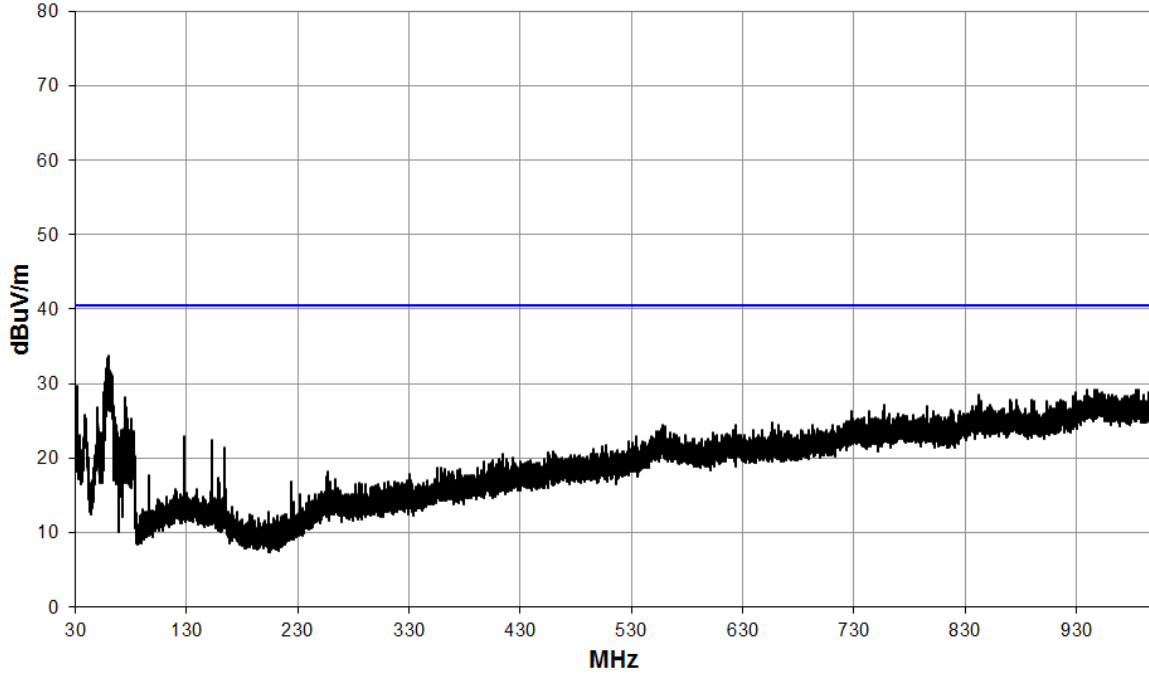


1 GHz to 6 GHz

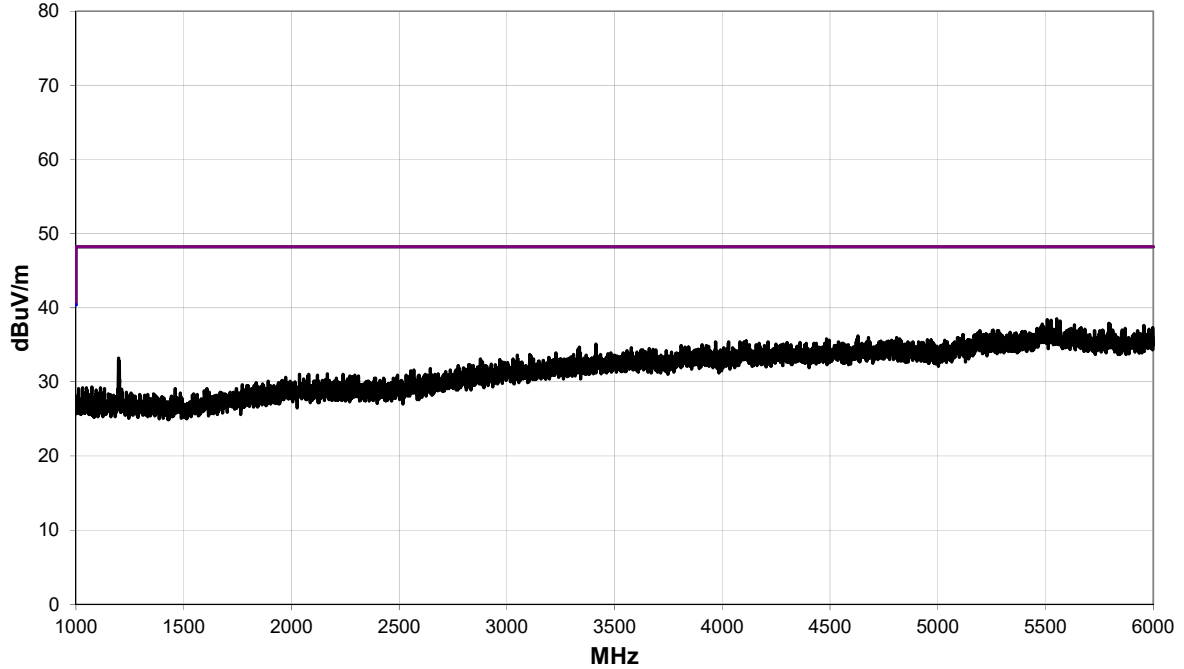


<i>Mode: Receive</i>					
<i>Emission</i>	<i>Frequency (MHz)</i>	<i>Emission level (dBm)</i>	<i>Limit (dBm)</i>	<i>Margin (dB)</i>	<i>Result</i>
No emissions were detected within 10 dB of the limit					

30 MHz to 1 GHz



1 GHz to 6 GHz



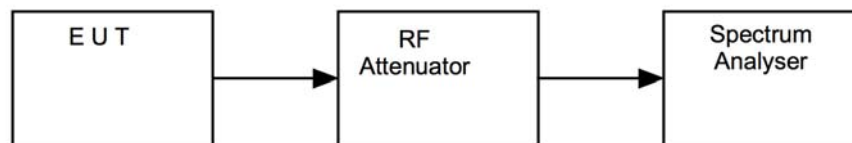
11.4 Conducted Measurement

11.4.1 Test Method

With the EUT connected as per Figure vii-b, the RF spectrum of the EUT was observed. Additional filtering (with calibrated path losses taken into account) was added prior to the analyser, where necessary, to prevent overload.

Measurements were made over the range 9 kHz to 6 GHz.

Figure vii-b Test Setup

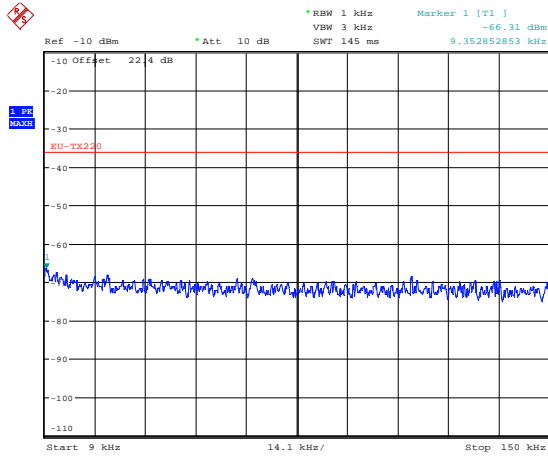


11.4.2 Test Equipment

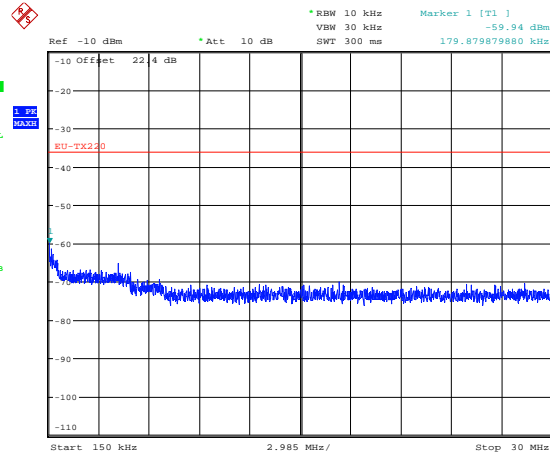
<i>Equipment Description</i>	<i>Manufacturer</i>	<i>Equipment Type</i>	<i>Element No</i>	<i>Due For Calibration</i>
Spectrum Analyser	R&S	FSU50	U544	2020-06-05

11.4.3 Test Results

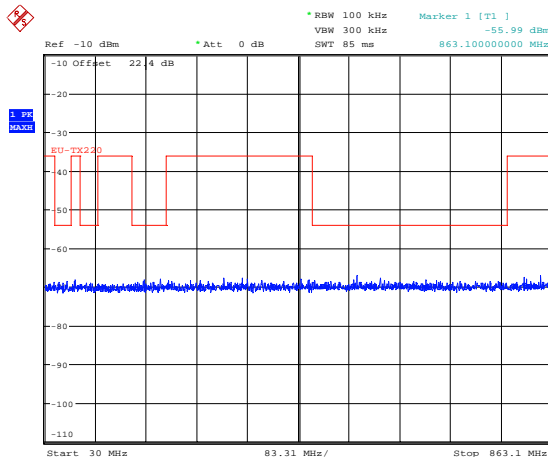
Mode: Transmit; Frequency: 868.100 MHz					
Emission	Frequency (MHz)	Emission level (dBm)	Limit (dBm)	Margin (dB)	Result
No emissions were detected within 10 dB of the limit					



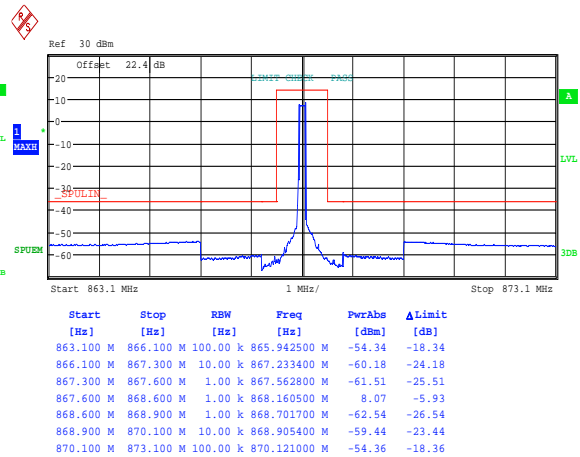
9 kHz to 150 kHz



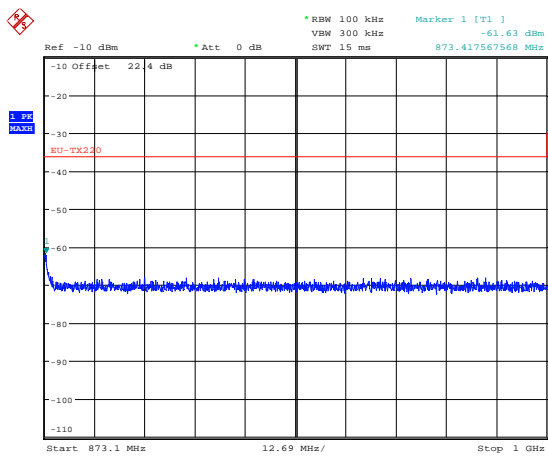
150 kHz to 30 MHz



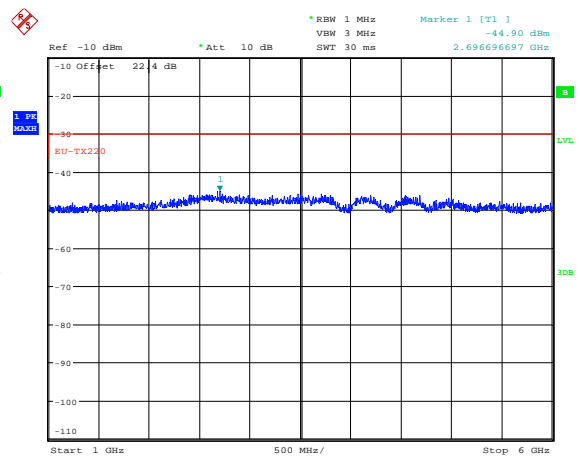
30 MHz to 863.1 MHz



863.1 MHz to 873.1 MHz

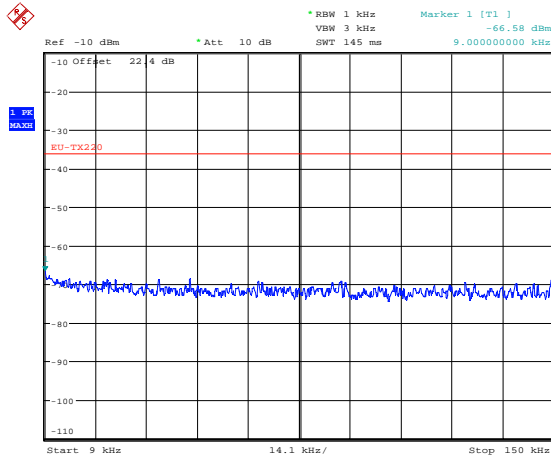


873.1 MHz to 1 GHz

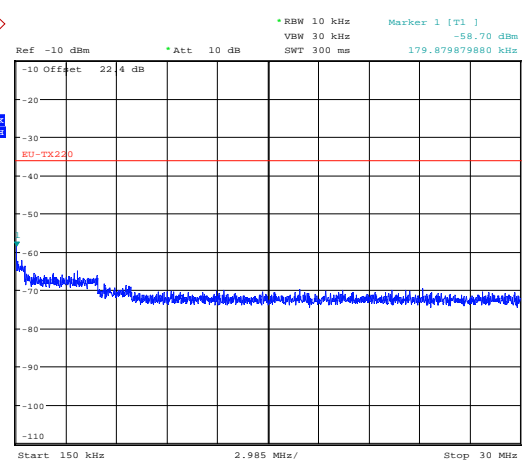


1 GHz to 6 GHz

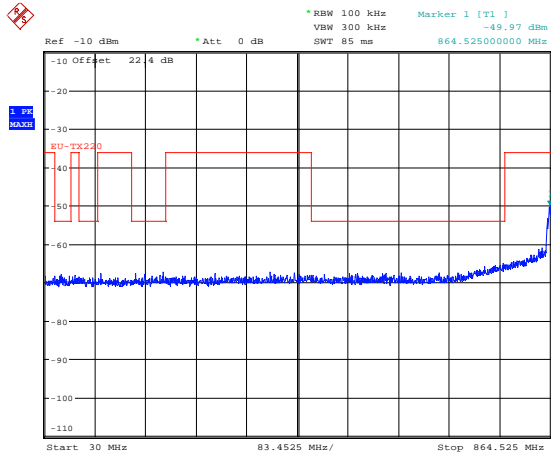
Mode: Transmit; Frequency: 869.525 MHz					
Emission	Frequency (MHz)	Emission level (dBm)	Limit (dBm)	Margin (dB)	Result
No emissions were detected within 10 dB of the limit					



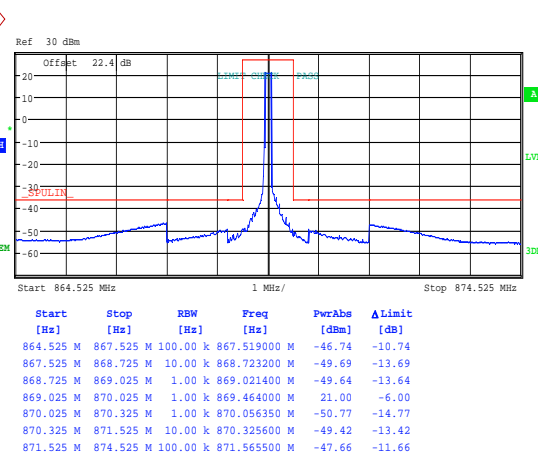
9 kHz to 150 kHz



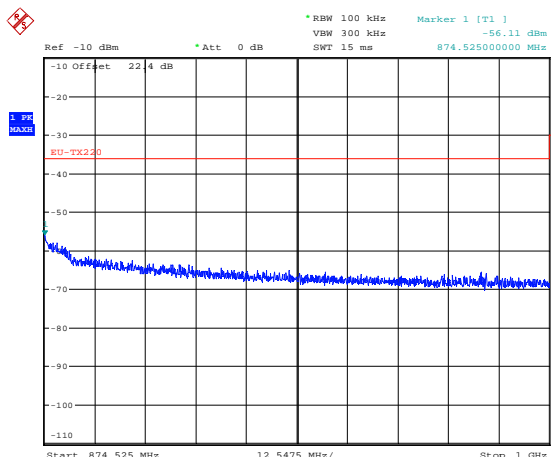
150 kHz to 30 MHz



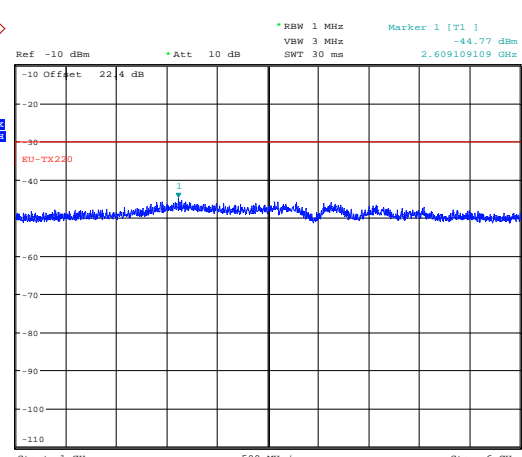
30 MHz to 864.525 MHz



864.525 MHz to 874.525 MHz

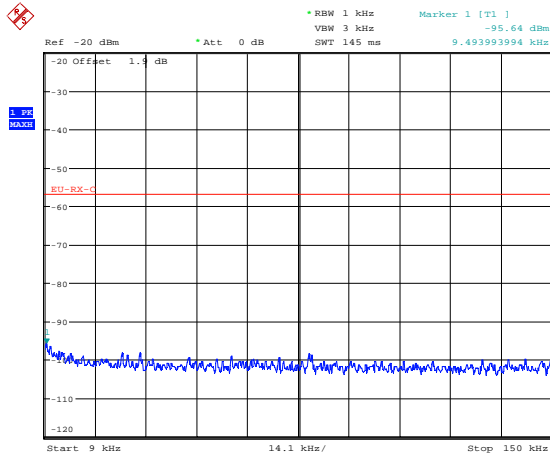


874.525 MHz to 1 GHz

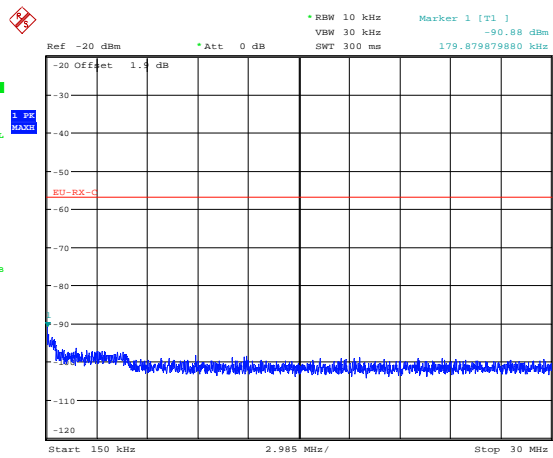


1 GHz to 6 GHz

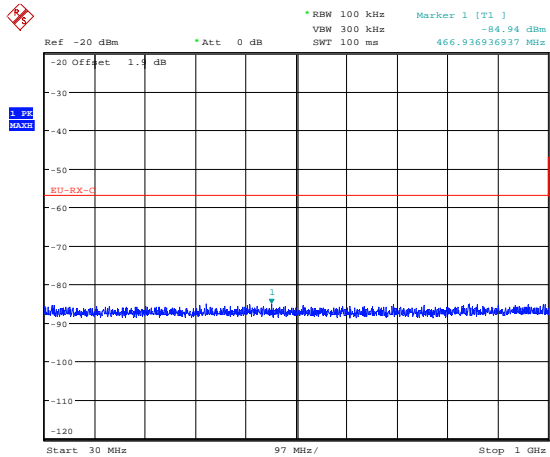
Mode: Receive					
Emission	Frequency (MHz)	Emission level (dBm)	Limit (dBm)	Margin (dB)	Result
No emissions were detected within 10 dB of the limit					



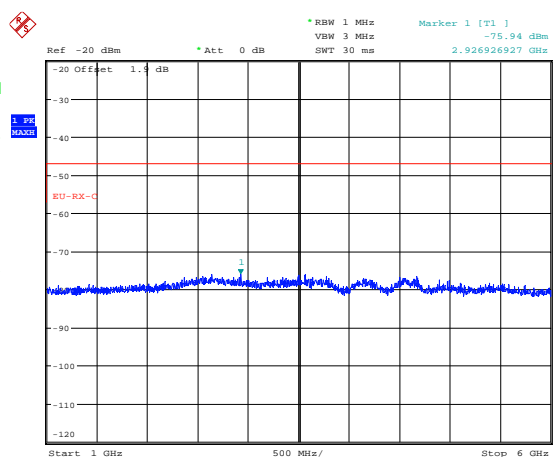
9 kHz to 150 kHz



150 kHz to 30 MHz



30 MHz to 1 GHz



1 GHz – 6 GHz

12 Effective radiated power

12.1 Definition

The effective radiated power (e.r.p.) is the power radiated in the direction of the maximum radiated power under specified conditions of measurements for any condition of modulation. For equipment with a permanent or temporary antenna connection it may be taken as the power delivered from that connector taking into account the antenna gain.

12.2 Test Parameters

Test Location:	Element Hull
Test Chamber:	Wireless Lab 1 & 3
Test Standard and Clause:	ETSI EN 300 220-1 V3.1.1 (2017-02), Clause 5.2
EUT Frequencies measured:	868.100 MHz & 869.525 MHz
Measurement Distance:	3 m to front face of EUT / At antenna port
EUT Height:	1.5 m
Measurement Antenna Height:	1-4 m
Antenna Polarisation:	Vertical and Horizontal
Deviations From Standard:	None

Environmental Conditions (Normal Environment)

Conducted	Radiated	
Temperature: 24 °C	Temperature: 26 °C	Standard Requirement: +15 °C to +35 °C
Humidity: 51 %RH	Humidity: 54 %RH	Standard Requirement: 20%RH to 75%RH
Supply: 5 Vdc	Supply: 5 Vdc	As declared

Extreme Environment Test Levels

T _{minimum}	-40 °C
T _{maximum}	+85 °C
V _{minimum}	5 Vdc
V _{maximum}	5 Vdc

Test Limits

The effective radiated power shall not be greater than the value allowed in §§ annex B, table B.1 for the chosen operational frequency bands. The signal shall be located within the operational frequency bands.

Table B.1: EU wide harmonised national radio interfaces from 25 MHz to 1000 MHz

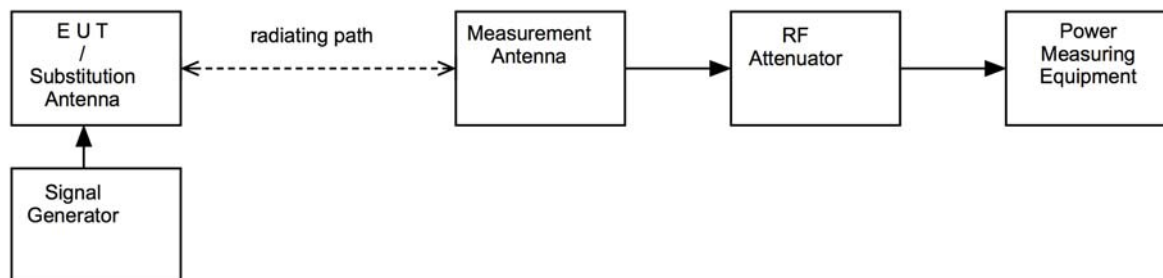
Frequency Band		Maximum radiated power, e.r.p.	Channel access and occupation rules	Maximum occupied bandwidth	Band number from EC Decision 2013/752/EU	Class 1 sub-class number according Commission Decision 2000/299/EU
M	868.000 MHz to 868.600 MHz	25 mW e.r.p.	≤ 1 % duty cycle or polite spectrum access	The whole sub-band except for audio & video applications limited to 300 kHz	48	28
P	869.400 MHz to 869.650 MHz	500 mW e.r.p.	≤ 10 % duty cycle or polite spectrum access	The whole band	54b	30

12.3 Test Method

12.3.1 Radiated measurement

With the EUT connected as per Figure iii-a, the EUT fundamental frequency was maximised by rotating the EUT through 360°, in three orthogonal planes, and adjusting the measurement antenna height through 1-4m. The EUT was substituted with a known signal generator and antenna and the maximum of all signals was recorded. The measurements were made in both horizontal and vertical polarisation.

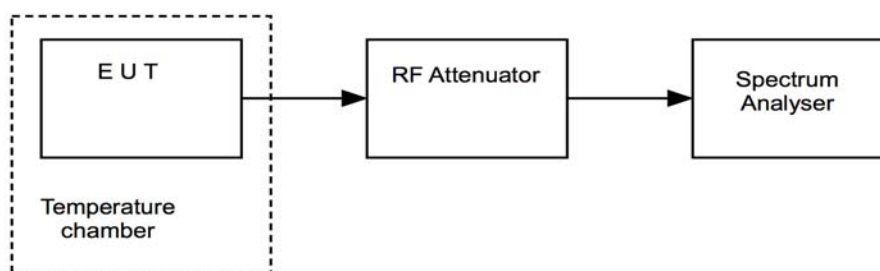
Figure iii-a Test Setup



12.3.2 Conducted measurement

With the EUT connected as per Figure iii-b, the power of the EUT was measured at the antenna port.

Figure iii-b Test Setup



12.4 Test Equipment

Equipment Description	Manufacturer	Equipment Type	Element No	Due For Calibration
Ferrite Lined Chamber	Rainford	ATS	REF2259	2020-08-03
Spectrum Analyser	R&S	FSU50	U544	2020-06-05
Pre-Amp (9 kHz - 1 GHz)	Sonoma	310	REF927	2020-05-29
Signal Generator	R&S	SMBV100A	REF916	2020-07-01
Bilog Antenna	Chase	CBL6111B	REF2233	2020-08-17
Biconical Antenna	Schwarzbeck	VUBA9117	REF2239	2021-07-13
Thermometer	Fluke	53 II B	REF2110	2020-06-24
Temperature Chamber	Thermotron	S-1.2 CE	REF423	Cal with REF2110

12.5 Test Results

Radiated measurements

Test Environment		Frequency (MHz)	e.r.p. (dBm)	e.r.p. (mW)	Result
T _{nominal}	V _{nominal}	868.100	8.2	6.6	Pass
T _{nominal}	V _{nominal}	869.525	22.0	159.6	Pass

Conducted measurements

Test Environment		Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBd)	e.r.p. (dBm)	e.r.p. (mW)	Result
T _{nominal}	V _{nominal}	868.100	12.9	-1.9	11	12.6	Pass
T _{nominal}	V _{nominal}	869.525	26.3	-1.9	24.4	275.4	Pass

Conducted extreme measurements

Frequency: 868.100 MHz				
Test Environment		e.r.p. (dBm)	e.r.p. (mW)	Result
T _{nominal}	V _{nominal}	11.0	12.6	Pass
T _{minimum}	V _{minimum}	11.6	14.5	Pass
	V _{maximum}	11.6	14.5	Pass
T _{maximum}	V _{minimum}	10.7	11.7	Pass
	V _{maximum}	10.7	11.7	Pass

Frequency: 869.525 MHz				
Test Environment		e.r.p. (dBm)	e.r.p. (mW)	Result
T _{nominal}	V _{nominal}	24.4	275.4	Pass
T _{minimum}	V _{minimum}	25.5	354.8	Pass
	V _{maximum}	25.5	354.8	Pass
T _{maximum}	V _{minimum}	22.5	177.8	Pass
	V _{maximum}	22.5	177.8	Pass

13 Occupied bandwidth

13.1 Definition

The occupied bandwidth (OBW) is the frequency range in which 99% of the total mean power of a given emission falls. The maximum occupied bandwidth includes all associated side bands above the appropriate emissions level and the frequency error or drift under extreme conditions.

13.2 Test Parameters

Test Location:	Element Hull
Test Chamber:	Environmental Lab
Test Standard and Clause:	ETSI EN 300 220-1 V3.1.1 (2012-05), Clause 5.6
EUT Frequencies measured:	868.100 MHz & 869.525 MHz
Operating Channel Width:	200 kHz
Deviations From Standard:	None
Measurement Detector:	RMS

Environmental Conditions (Normal Environment)

Temperature: 24 °C	Standard Requirement: +15 °C to +35 °C
Humidity: 51 %RH	Standard Requirement: 20 %RH to 75 %RH
Supply: 5 Vdc	As declared

Extreme Environment Test Levels

T_{minimum}	-40 °C
T_{maximum}	85 °C
V_{minimum}	5 Vdc
V_{maximum}	5 Vdc

Test Limits

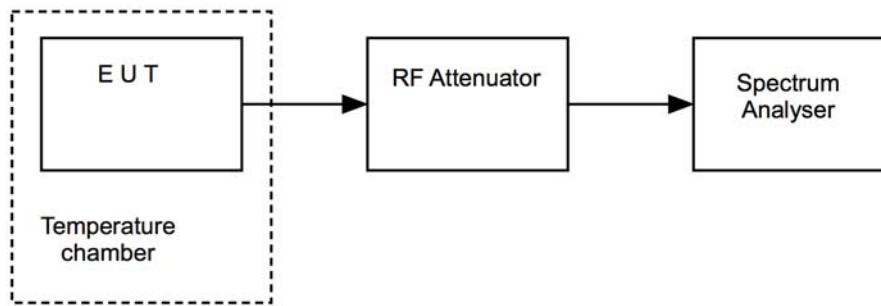
The Operating Channel (OC) shall be declared and shall reside entirely within the Operational Frequency Band.

The Maximum Occupied Bandwidth at 99% shall reside entirely within the Operating Channel defined by F_{low} and F_{high} .

13.3 Test Method

With the EUT connected as per Figure iv, the bandwidth of the EUT was measured on a spectrum analyser.

Figure iv Test Setup



13.4 Test Equipment

<i>Equipment Description</i>	<i>Manufacturer</i>	<i>Equipment Type</i>	<i>Element No</i>	<i>Due For Calibration</i>
Spectrum Analyser	R&S	FSU50	U544	2020-06-05
Thermometer	Fluke	53 II B	REF2110	2020-06-24
Temperature Chamber	Thermotron	S-1.2 CE	REF423	Cal with REF2110

13.5 Test Results

<i>Frequency: 868.100 MHz</i>						
<i>Test Environment</i>		<i>F_l (MHz)</i>	<i>F_h (MHz)</i>	<i>Occupied Bandwidth (kHz)</i>	<i>Within Operating Channel</i>	<i>Result</i>
T _{nominal}	V _{nominal}	868.034295	868.164103	129.808	Yes	Pass
T _{minimum}	V _{minimum}	868.034295	868.164103	129.808	Yes	Pass
	V _{maximum}	868.034295	868.164103	129.808	Yes	Pass
T _{maximum}	V _{minimum}	868.034295	868.164103	129.808	Yes	Pass
	V _{maximum}	868.034295	868.164103	129.808	Yes	Pass
<i>Centre Frequency (MHz)</i>		<i>Lowest F_l (MHz)</i>	<i>Highest F_h (MHz)</i>	<i>Maximum Occupied Bandwidth (kHz)</i>	<i>Within Operating Channel</i>	<i>Result</i>
868.100		868.034295	868.164103	129.808	Yes	Pass

<i>Frequency: 869.525 MHz</i>						
<i>Test Environment</i>		<i>F_l (MHz)</i>	<i>F_h (MHz)</i>	<i>Occupied Bandwidth (kHz)</i>	<i>Within Operating Channel</i>	<i>Result</i>
T _{nominal}	V _{nominal}	869.459295	869.589103	129.808	Yes	Pass
T _{minimum}	V _{minimum}	869.459295	869.589103	129.808	Yes	Pass
	V _{maximum}	869.459295	869.589103	129.808	Yes	Pass
T _{maximum}	V _{minimum}	869.462500	869.592308	129.808	Yes	Pass
	V _{maximum}	869.462500	869.592308	129.808	Yes	Pass
<i>Centre Frequency (MHz)</i>		<i>Lowest F_l (MHz)</i>	<i>Highest F_h (MHz)</i>	<i>Maximum Occupied Bandwidth (kHz)</i>	<i>Within Operating Channel</i>	<i>Result</i>
869.525		869.459295	869.592308	133.013	Yes	Pass

14 Transient power

14.1 Definition

Transient power is the power falling into adjacent spectrum due to switching the transmitter on and off during normal operation (e.g. cyclic keying during data transmission).

14.2 Test Parameters

Test Location:	Element Hull
Test Chamber:	Wireless Lab 2
Test Standard and Clause:	ETSI EN 300 220-1 V3.1.1 (2017-02), Clause 5.10
EUT Frequencies measured:	868.100 MHz & 869.525 MHz
Deviations From Standard:	None
Measurement detector:	RMS
Operating Channel Width:	200 kHz

Environmental Conditions (Normal Environment)

Temperature: 27 °C	Standard Requirement: +15 °C to +35 °C
Humidity: 49 %RH	Standard Requirement: 20 %RH to 75 %RH
Supply: 5 Vdc	As declared

Test Limits

The transient power shall not exceed the values given in Table 23.

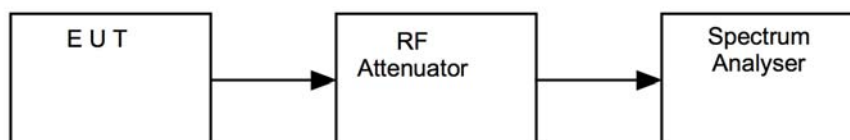
Table 23: Transmitter Transient Power Limits

<i>Absolute offset from centre frequency</i>	<i>RBW_{REF}</i>	<i>Peak power limit applicable at all measurement points</i>
≤ 400 kHz	1 kHz	0 dBm
> 400 kHz	1 kHz	-27 dBm

14.3 Test Method

With the EUT connected as per Figure viii, the transmitter transient characteristic was measured.

Figure viii Test Setup



14.4 Test Equipment

Equipment Description	Manufacturer	Equipment Type	Element No	Due For Calibration
Spectrum Analyser	R&S	FSU50	U544	2020-06-05

14.5 Test Results

Frequency: 868.100 MHz						
Measurement frequency (MHz)	Frequency offset (kHz)	RBW (kHz)	RBW_{REF} (kHz)	Power in RBW (dBm)	Power in RBW_{REF} (dBm)	Result
866.800	-1300	300	1	-43.0	-67.7	PASS
867.600	-500	100	1	-48.8	-68.8	PASS
867.900	-200	30	1	-41.3	-56.0	PASS
867.997	-103	1	1	-42.1	-42.1	PASS
868.203	103	1	1	-42.7	-42.7	PASS
868.300	200	30	1	-39.7	-54.5	PASS
868.600	500	100	1	-48.7	-68.7	PASS
869.400	1300	300	1	-41.3	-66.0	PASS

Frequency: 869.525 MHz						
Measurement frequency (MHz)	Frequency offset (kHz)	RBW (kHz)	RBW_{REF} (kHz)	Power in RBW (dBm)	Power in RBW_{REF} (dBm)	Result
868.225	-1300	300	1	-29.3	-54.1	PASS
869.025	-500	100	1	-34.9	-54.9	PASS
869.325	-200	30	1	-26.7	-41.4	PASS
869.422	-103	1	1	-28.6	-28.6	PASS
869.628	103	1	1	-31.7	-31.7	PASS
869.725	200	30	1	-27.8	-42.6	PASS
870.025	500	100	1	-34.5	-54.5	PASS
870.825	1300	300	1	-27.9	-52.7	PASS

15 Measurement Uncertainty

Required Measurement Uncertainties

The following maximum measurement uncertainty requirements are defined in the standard:

Parameter	Uncertainty
Radio frequency	$\pm 1 \times 10^{-7}$
RF power, conducted	$\pm 1,5$ dB
Adjacent channel power	± 3 dB
Conducted spurious emission of transmitter, valid up to 6 GHz	± 3 dB
Conducted emission of receivers	± 3 dB
Radiated emission of transmitter, valid up to 6 GHz	± 6 dB
Radiated emission of receiver, valid up to 6 GHz	± 6 dB
RF level uncertainty for a given BER	$\pm 1,5$ dB
Temperature	± 1 °C
Humidity	± 10 %

Calculated Measurement Uncertainties

All statements of uncertainty are expanded standard uncertainty using a coverage factor of 1.96 to give a 95% confidence:

[1] Frequency error

Uncertainty in test result (Power Meter) = **0.113 ppm**

Uncertainty in test result (Spectrum Analyser) = **0.265 ppm**

[2] Average power, conducted

Uncertainty in test result (Power Meter) = **1.08 dB**

Uncertainty in test result (Spectrum Analyser) = **2.48 dB**

Uncertainty in test result (radiated) = **4.71 dB**

[3] Effective Radiated Power

Uncertainty in test result = **4.71 dB**

[4] Transient Power

Uncertainty in test result = **1.008 dB**

[5] Adjacent Channel Power

Uncertainty in test result = **1.86 dB**

[6] Modulation bandwidth

Uncertainty in test result = **2.59 % (frequency)**

Uncertainty in test result = **1.32 dB (amplitude)**

[7] Unwanted emissions in the spurious domain

Uncertainty in test result – Up to 8.1GHz = **3.31 dB**

Uncertainty in test result (radiated) = **4.75 dB**

[8] Receiver sensitivity

Uncertainty in test result = **3.23 dB**

[9] LBT threshold

Uncertainty in test result (level) = **3.23 dB**

Uncertainty in test result (time) = **7.98 %**

[10] Adjacent channel selectivity

Uncertainty in test result = **1.24 dB**

[11] Receiver blocking, conducted

Uncertainty in test result = **1.24 dB**

[12] Spurious response rejection

Uncertainty in test result = **1.24 dB**

[13] Receiver spurious radiation

Uncertainty in test result – Up to 8.1GHz = **3.31 dB**

Uncertainty in test result (radiated) = **4.75 dB**