



**Telecommunications & Telematics
for Transports Lab.**

TEST REPORT

Ref. No. ARSK00174

Date: 2010-09-20

Measurements performed in accordance with:



**FCC Rules : Code of Federal Regulations (CFR) no. 47
PART 15 – RADIO FREQUENCY DEVICES**

PRODUCT : ZigBee module general purpose

TESTED MODEL : SPZB32W1A2.1
SPZB32W1C2.1

FCC ID : S9NZB32C2

APPLICANT : STMicroelectronics – Via C. Olivetti, 2 – I-20041 Agrate Brianza (MI)

MANUFACTURER : STMicroelectronics – Via C. Olivetti, 2 – I-20041 Agrate Brianza (MI)

TRADEMARK : STMicroelectronics

OTHER INFORMATION : Testing dates : 2010-09-08 - 2010-09-09
IMQ BEM: 55858

Tested samples No. : 2

Testing Laboratory : IMQ S.p.A. Via Quintiliano, 43 I-20138 MILANO

Tested by : R. Radice Signature: *Roberto Radice* Date : 2010-09-20

Checked by : M. De Angelis Signature: *M. De Angelis* Date : 2010-09-20

Revision Sheet

Release No.	Date	Revision Description
Rev. 0	2010-09-20	Test Results and Evaluation Report

NOTICE: The results of tests and checks reported in this Test Report refer exclusively to the samples tested and described in the Report itself. This report shall not be reproduced partially or in its entirety without the written approval of IMQ S.p.A.

IMQ S.p.A. - Via Quintiliano, 43 – I-20138 MILANO

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1 GENERAL DESCRIPTION OF EQUIPMENT UNDER TEST

1.1 APPLICANT

NAME	STMicroelectronics
ADDRESS	Via C. Olivetti, 2 – I-20041 Agrate Brianza (MI)
COUNTRY	ITALY

1.2 MANUFACTURER

NAME	STMicroelectronics
ADDRESS	Via C. Olivetti, 2 – I-20041 Agrate Brianza (MI)
COUNTRY	ITALY

1.3 EQUIPMENT CLASSIFICATION

According to the definition 15.3 (o) EUT is a **Intentional Radiator operating within the bands 2400-2483,5 MHz** so it shall fulfil provisions of 47CFR Part 15 Subpart C – Intentional radiators – and Section 15.247.

1.4 BASIC DESCRIPTION OF EQUIPMENT UNDER TEST

Parameters	Value
Type of equipment :	<ul style="list-style-type: none"> ▪ ZigBee module general purpose
Model:	<ul style="list-style-type: none"> ▪ SPZB32W1A2.1 ▪ SPZB32W1C2.1
FCC ID. :	<ul style="list-style-type: none"> ▪ S9NZB32C2
Trade Name:	<ul style="list-style-type: none"> ▪ STMicroelectronics
Data cable :	<ul style="list-style-type: none"> ▪ /
Telecom cable :	<ul style="list-style-type: none"> ▪ /
Power supply type :	<ul style="list-style-type: none"> ▪ DC 3.3V
AC power input cable :	<ul style="list-style-type: none"> ▪ /
DC power input cable :	<ul style="list-style-type: none"> ▪ /

Model	Description
SPZB32W1C2.1	Provided with external ANTENOVA Antenna connected with RF reverse SMA connector
SPZB32W1A2.1	Provided with integrated RAINSUN Antenna
<p>Remark: Between the two models no changes to the basic frequency determining and stabilizing circuitry (including clock and data rates), frequency multiplication stages, basic modulator circuit or maximum conducted output power.</p> <p>No simultaneous transmission is possible.</p>	

1.5 FEATURE OF EQUIPMENT UNDER TEST

Power specification	▪ 3.3 V dc
Operating frequency:	▪ 2405 ÷ 2480 MHz (16 Channels)
Maximum RF output power:	▪ 4,97 dBm
Modulation:	▪ O-QPSK
Channel Spacing:	▪ >1 MHz
Antenna:	▪ Dedicated antenna (1 dBi gain) Rainsun p.n. AN0835 ▪ Dedicated antenna (2,2 dBi gain) Antenova mod. Titanic 2.4GHz Part No. 2010B6090-01
RX sensitivity:	▪ -99 dBm
Main SW identification	▪ /
Main HW Board identification	▪ /
Peripherals included (for system application)	▪ None
Interfaces :	▪ None
Integrated interfaces :	▪ None
AC adapter:	▪ None

CHANNEL CONFIGURATION

Channel (No.)	Frequency (MHz)
11	2405.00
12	2410.00
13	2415.00
14	2420.00
15	2425.00
16	2430.00
17	2435.00
18	2440.00
19	2445.00
20	2450.00
21	2455.00
22	2460.00
23	2465.00
24	2470.00
25	2475.00
26	2480.00

2 TEST CONFIGURATION OF EQUIPMENT UNDER TEST

2.1 ENVIRONMENTAL CONDITIONS

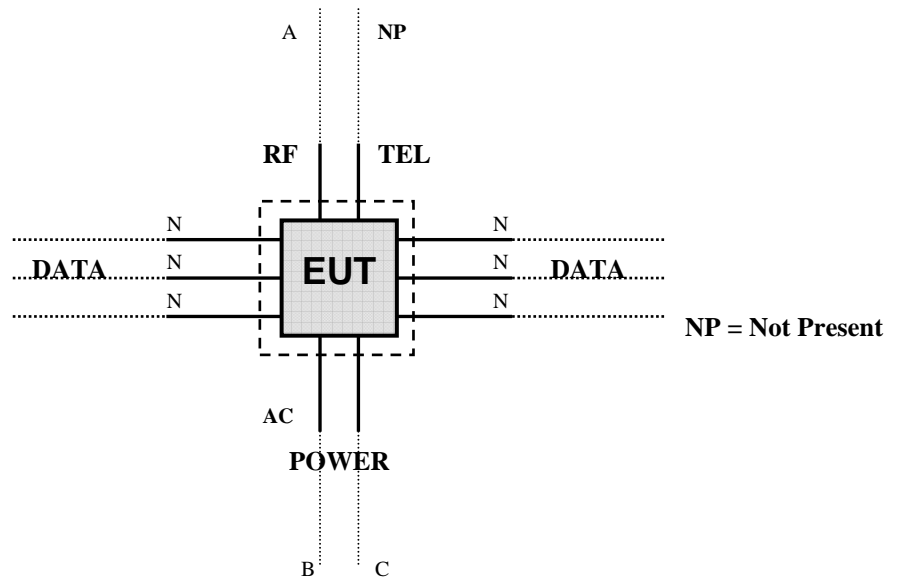
TEST CONDITIONS	MEASURED
Ambient Temperature	20 ÷ 25 °C
Relative Humidity	50 ÷ 60 %
Atmospheric Pressure	900 ÷ 1000 mbar

2.2 DESCRIPTION OF SUPPORT EQUIPMENT

Here following the details concerning equipment needed for correct operation or loading of the EUT:

EQUIPMENT	MANUFACTURER	MODEL
Personal Computer	IBM	-----
Test Jig	STMicroelectronics	-----

2.3 INTERFACE IDENTIFICATION AND CONNECTION DIAGRAM OF TEST SYSTEM



#	Interface	Description	Maximum length	Ref. Document
1	Enclosure	Open frame board	/	/
2	AC mains power input/output port	Port not present	/	/
3	DC power port	+5V dc via USB Port furnished on test jig board; ZigBee module: +3.3 V dc	/	/
4	Signal / control port	Port not present	/	/
5	Antenna port (RF)	Dedicated SMD antenna integrated on ZigBee module & external dedicated Antenna	/	antenna description

3 OPERATION OF EQUIPMENT UNDER TEST

3.1 OPERATING TEST CONDITIONS

Ref.	Description
#1	Continuous transmission with Boost mode activated (single channel transmission)

4 TESTS IDENTIFICATION AND RESULTS

TABLE 1 : SUMMARY OF TESTS

CFR47 Part 15 Section	Title	Operating condition	Result	Test No.
15.203 15.247 (b)(4)(i)	Antenna Requirements	/	PASS	1
15.207 (a)	Conducted Emission	#1	PASS	2
15.209 (a) (f)	Radiated Emission	#1	PASS	3
15.247 (a)	Frequency Hopping Spread Spectrum Specifications			
15.247(a)(1)(iii)	Number of Hopping Channels Used	Not applicable		
15.247(a)	20 dB Bandwidth	Not applicable		
15.247(a)(1)	Carrier frequency (Hopping Channel) Separation	Not applicable		
15.247(a)(1)(iii)	Time occupancy (Dwell Time) of Each Channel (ch) within a $0,4 \times N_{ch}$ (sec) Period	Not applicable		
15.247(a)(2)	6dB Minimum Bandwidth	#1	PASS	4
15.247(b)	Maximum Peak Output Power			
15.247(b) (1)	Peak Output Power	#1	PASS	5
15.247(b) (4)	Antenna gain	Not applicable		
15.247(c)	Operation with directional antenna gains greater than 6 dBi	Not applicable		
15.247 (d)	100 kHz Bandwidth of Frequency Band Edges	#1	PASS	6

CFR47 Part 15 Section	Title	Operating condition	Result	Test No.
15.247 (d)	Conducted Emission	#1	PASS	7
15.247 (e)	Power Spectral Density	#1	PASS	8
15.247 (f)	Hybrid systems	Not applicable		
15.247 (g)	FHSS Transmission characteristics	Not applicable		
15.247 (h)	Recognition of occupied channel and multiple transmission system	Not applicable		
15.247(i) (§ 47CFR 1.1307(b)(1))	RF humane exposure	#1	PASS	9

4.1 METHODS OF MEASUREMENT

All compliance measurements have been carried out using the procedures described in the standard ANSI C63.4-2003 (excluding sub-par. 4.1.5.2, 5.7.9 and 14) and Section 15.31 of CFR47 Part 15 – Subpart A (General).

Additional test requirements have been adopted according to the reference Section indicated in the Test Table

4.2 FREQUENCY RANGE INVESTIGATED

- a. Conducted emission tests : from 150 kHz to 30 MHz.
- b. Radiated emission tests : from 2 MHz to tenth harmonic of fundamental

5 MEASUREMENTS AND TESTS DATA

TEST No. 1	Title	47CFR Part 15 Ref. Section
	“Antenna Requirements”	15.203 / 15.204
TEST REQUIREMENTS	<p>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 Sections 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 Section 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.</p>	

Antenna specifications		
N° of authorized antenna types	▪ 2	
Antenna type	<ul style="list-style-type: none"> ▪ Dedicated SMD antenna integrated on ZigBee MODULE ▪ External dedicated antenna fitted with a reverse SMA connector and a blade made of flexible material that can be rotated 360 degree 	
Maximum total gain	▪ 2,2 dBi	
External power amplifiers	▪ Not present	
Antenna Description		
No.	Manufacturer	Model Type
1	ANTENOVA	Titanic 2.4GHz Part No. 2010B6090-01
2	RAINSUN	p.n. AN0835

Test Result:

The transmitter meets the requirements of section 15.203 and 15.204

TEST No. 2	Title "Conducted emission"	47CFR Part 15 Ref. Section
		15.207
TEST REQUIREMENTS	Test setup	ANSI C63.4
	Limits of mains terminal disturbance voltage	15.207 (a)
	Frequency range	150 kHz – 30 MHz
	IF bandwidth	9 kHz
	EMC class	B

TEST DATA	PORT UNDER TEST	OPERATING CONDITION	RESULT
	AC mains power input port	#1	Complies
	Note: In search of max noise (phase(s) and neutral) for both the models type SPZB32W1A2.1 and SPZB32W1C2.1		

- 1) The EUT was placed on a wooden table of size, 80 cm by 80 cm, raised 80 cm in which is located 40 cm away from the vertical wall the shielded room.
- 2) Each EUT power cord input cord was individually connected through a 50Ω/50μH LISN to the input power source.
- 3) Exploratory measurements were made to identify the frequency of the emission that had the highest amplitude relative to the limit by operating the EUT in a range of typical modes of operation, cable position, and with a typical system equipment configuration and arrangement. Based on the exploratory tests of the EUT, the one EUT cable configuration and arrangement and mode of operation that had produced the emission with the highest amplitude relative to the limit was selected for the final measurement.
- 4) The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment is the system) was then performed over the frequency range of 0.15 MHz to 30 MHz.
- 5) The measurements were made with the detector set to PEAK and AVAREGE amplitude within a bandwidth of 10 kHz during the measurements.
- 6) The measurements with Quasi-Peak detector are performed only for frequencies for which the Peak values are \geq (Q.P. limit - 6 dB).

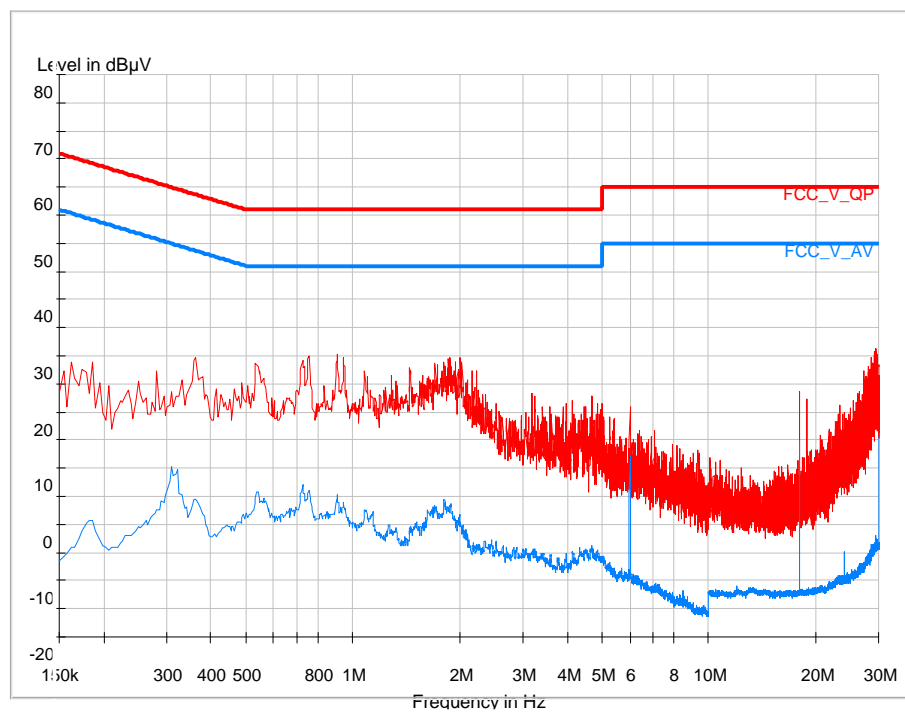
Test Result:

Within the specifications

MEASUREMENTS RESULTS

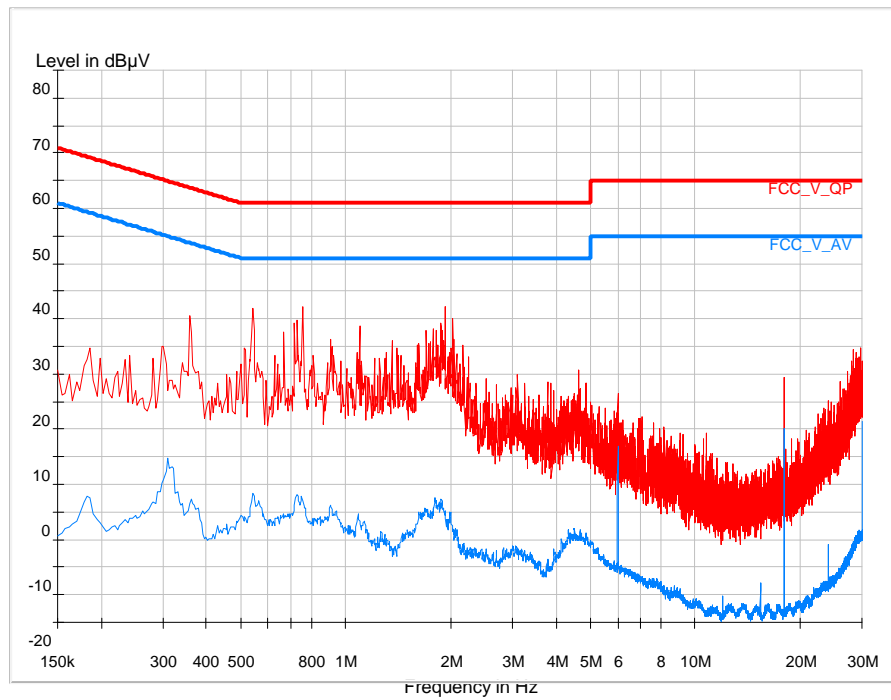
CONDUCTED DISTURBANCE ON AC MAINS POWER PORT OF AC/DC ADAPTER

MEASURE LINE: PHASE



CONDUCTED DISTURBANCE ON AC MAINS POWER PORT OF AC/DC ADAPTER

MEASURE LINE: NEUTRAL



TEST No. 3	Title "Radiated disturbances"	47CFR Part 15 Ref. Section
		15.209
TEST REQUIREMENTS	Test setup	ANSI C63.4
	Test facility	Anechoic chamber
	Test distance	3 m
	Limits for radiated disturbances	15.209 (a)
	Frequency range	2 MHz to tenth harmonic of fundamental
	IF bandwidth (below 30 MHz)	9 kHz
	IF bandwidth (below 1000 MHz)	120 kHz
	IF bandwidth (above 1000 MHz)	1 MHz
	EMC class	B
	(*) In accordance with part 15.31 (f) (2), where the measurement distance was specified to be 30 or 300 meters, a correction factor was applied in order to permit measurement to be performed at a separation distance. The applied formula for limits at 3 meter is: Extrapolation (dB) = $40\log(300\text{meter} / 3\text{meter}) = +80\text{db}$ Extrapolation (dB) = $40\log(30\text{meter} / 3\text{meter}) = +40\text{db}$	

- 1) The EUT was placed on turntable which is 0.8 m above the ground plane
- 2) The turntable shall rotate from 0° to 360° degrees to determine the position of maximum emission level.
- 3) The EUT is positioned 3 m away from the receiving antenna which varied from 1 to 4 m to find the highest emission.
- 4) The measurements were made with the detector set to PEAK and AVERAGE amplitude within a bandwidth of 100 kHz below 1000 MHz and 1 MHz above 1000 MHz.
- 5) The receiving antenna was positioned in both horizontal and vertical polarization.
- 6) The measurements with Quasi-Peak detector, below 1000 MHz are performed only for frequencies for which the Peak values are \geq (Q.P. limit - 6 dB).

LIMITS FOR SPURIOUS

Band of operations	Peak (dB μ V/m)	Average Limit (dB μ V/m)
Restricted bands (par. 15.205)	74,00	54,00
Other bands	According to 15.209 or fundamental -20dB (which is greater)	According to 15.209 or fundamental -20dB (which is greater)

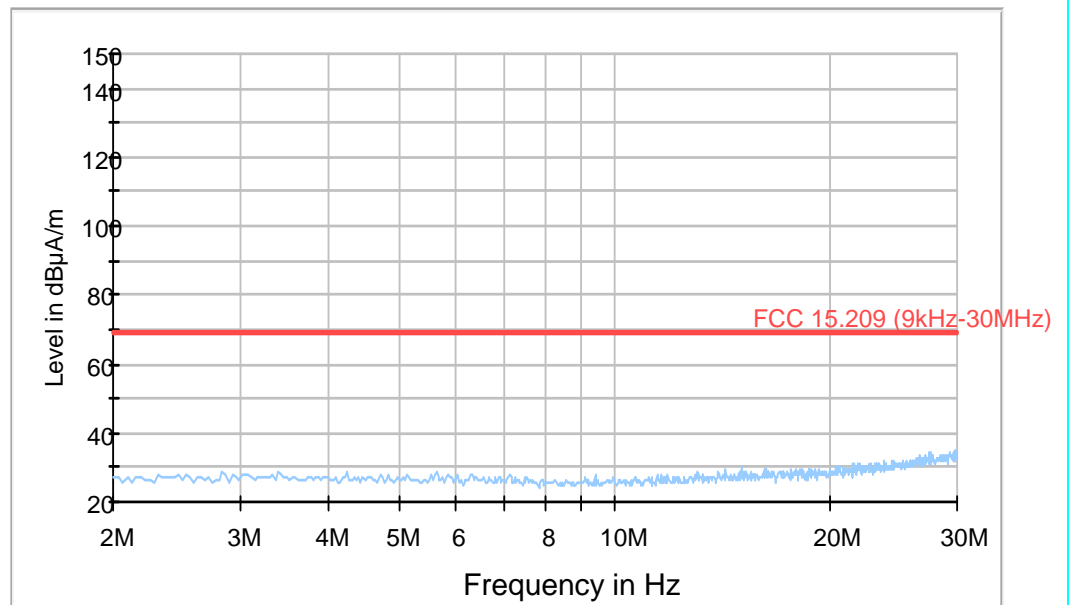
Tested samples

SAMPLE	
1)	Model SPZB32W1C2.1 provided with ANTENOVA Antenna
2)	Model SPZB32W1A2.1 provided with RAIN SUN Antenna

MEASUREMENTS RESULTS (2+30 MHz)

Model SPZB32W1A2.1

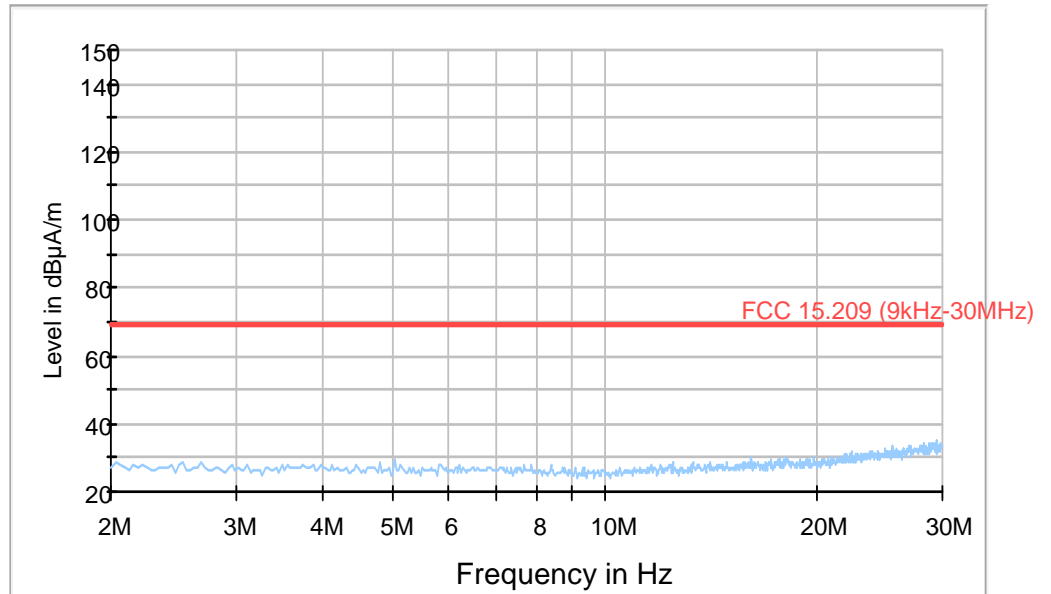
AUTOTEST 3m with Scans LOOP HFH2-Z2 ESMI 9kHz 30MHz (ris in dBuVr)



MEASUREMENTS RESULTS (2+30 MHz)

Model SPZB32W1C2.1

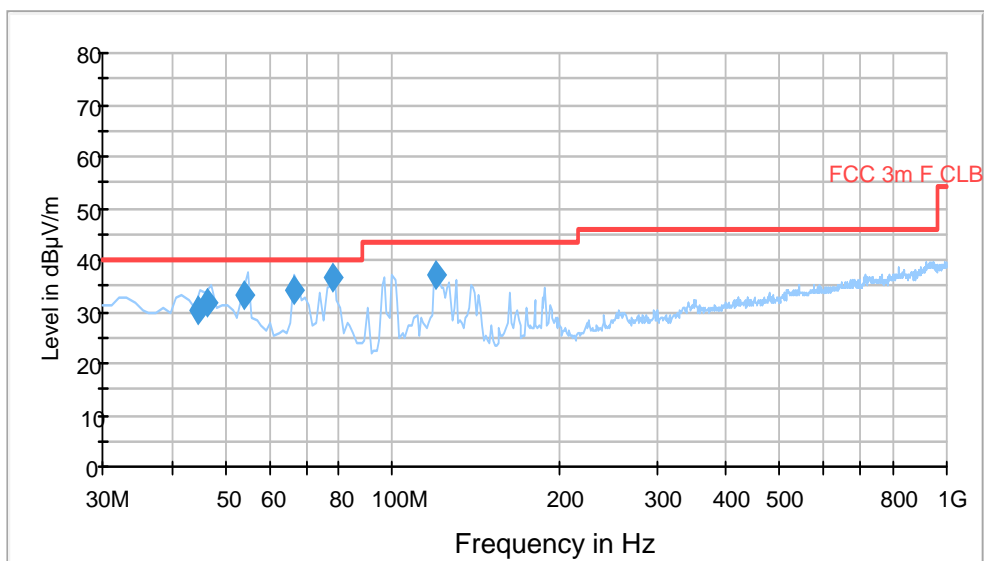
AUTOTEST 3m with Scans LOOP HFH2-Z2 ESMI 9kHz 30MHz (ris in dBuVr



MEASUREMENTS RESULTS (30+1000 MHz)

Model SPZB32W1A2.1

FCC part15 CLB 3m with Scans ARA ESMI



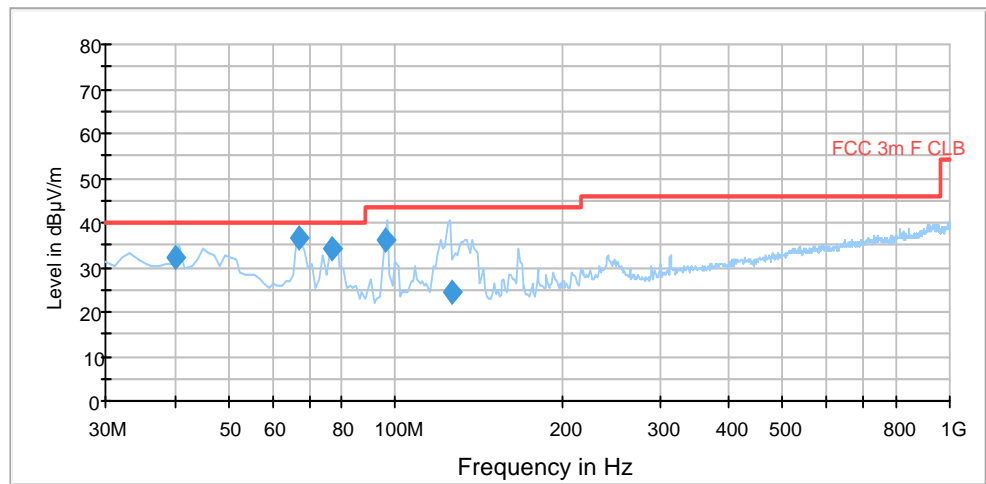
FINAL TEST (QUASI-PEAK DETECTOR)

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time	Antenna height	Polarity	Turntable position	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
44.588889	30.2	1000.00	99.9	V	90.0	17.1	9.80	40.00
46.394444	31.9	1000.00	99.9	V	-90.0	16.6	8.10	40.00
53.938889	33.0	1000.00	99.9	V	-197.0	14.7	7.00	40.00
66.744444	34.2	1000.00	99.9	V	-175.0	11.6	5.80	40.00
77.950000	36.5	1000.00	162.0	V	45.0	9.2	3.50	40.00
119.955556	36.9	1000.00	183.0	V	-42.0	12.3	6.60	43.50

MEASUREMENTS RESULTS (30+1000 MHz)

Model SPZB32W1C2.1

FCC part15 CLB 3m with Scans ARA ESMI



FINAL TEST (QUASI-PEAK DETECTOR)

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time	Antenna height	Polarity	Turntable position	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
40.177778	32.0	1000.00	105.0	V	90.0	18.2	8.00	40.00
66.794444	36.8	1000.00	99.9	V	0.0	11.6	3.20	40.00
77.072222	34.2	1000.00	182.0	V	45.0	9.4	5.80	40.00
96.022222	36.1	1000.00	249.0	H	-90.0	11.4	7.40	43.50
126.822222	24.6	1000.00	311.0	H	-45.0	12.1	18.90	43.50

MEASUREMENTS RESULTS (1000 MHz to 24800 MHz)

Module type SPZB32W1A2.1:

Channel n°11: 2405,00 MHz) (with Dedicated SMD antenna RAINSUN)

PEAK RESULT (RBW=1MHz; VBW=1MHz)

Frequency (MHz)	Measured Level (dBμV/m)	Limit (μVolt/meter)	Limit (dBμV/m)	Margin (dB)	Pol.
2405 (fundamental)	92,87	-----	-----	-----	Vertical
4810	48,53	5000	74,00	25,47	Vertical
7215	45,00	5000	74,00	29,00	Vertical
9620	47,37	5000	74,00	26,63	Horizontal
12025	49,69	5000	74,00	24,31	Horizontal
14430	52,16	5000	74,00	21,84	Horizontal
16835	57,66	5000	74,00	16,34	Horizontal
f>17000	No spurious				

AVERAGE FACTOR

T. Pulse (ms)	TX on + TX off (ms)	Duty cycle	Average Factor (dB)
3,80	100	0,0380	-28,40

AVERAGE RESULT (RBW=1MHz; VBW=10Hz)

Frequency (MHz)	Measured Level (dB μ V/m)	Limit (μ Volt/meter)	Limit (dB μ V/m)	Margin (dB)	Pol.
2405 (fundamental)	64,47	-----	-----	-----	Vertical
4810	20,13	500	54,00	33,87	Vertical
7215	16,60	500	54,00	37,40	Vertical
9620	18,67	500	54,00	35,33	Horizontal
12025	21,29	500	54,00	32,71	Horizontal
14430	23,76	500	54,00	30,24	Horizontal
16835	29,26	500	54,00	24,74	Horizontal

Channel n°20: 2450,00 MHz (with Dedicated SMD anten na RAINSUN)

PEAK RESULT (RBW=1MHz; VBW=1MHz)

Frequency (MHz)	Measured Level (dB μ V/m)	Limit (μ Volt/meter)	Limit (dB μ V/m)	Margin (dB)	Pol.
2450 (fundamental)	95,53	-----	-----	-----	Vertical
4900	44,11	5000	74,00	29,89	Vertical
7350	45,06	5000	74,00	28,94	Vertical
9800	48,82	5000	74,00	25,18	Horizontal
12250	48,77	5000	74,00	25,23	Vertical
14700	53,17	5000	74,00	20,83	Vertical
17150	59,17	5000	74,00	14,83	Vertical
f>17200	No spurious				

AVERAGE FACTOR

T. Pulse (ms)	TX on + TX off (ms)	Duty cycle	Average Factor (dB)
3,80	100	0,0380	-28,40

AVERAGE RESULT (RBW=1MHz; VBW=10Hz)

Frequency (MHz)	Measured Level (dB μ V/m)	Limit (μ Volt/meter)	Limit (dB μ V/m)	Margin (dB)	Pol.
2450 (fundamental)	67,13	-----	-----	-----	Vertical
4900	15,71	500	54,00	38,29	Vertical
7350	16,66	500	54,00	37,34	Vertical
9800	20,42	500	54,00	33,58	Horizontal
12250	20,37	500	54,00	33,63	Vertical
14700	24,77	500	54,00	29,23	Vertical
17150	30,77	500	54,00	23,23	Vertical

Channel n°26: 2480,00 MHz (with Dedicated SMD anten na RAIN SUN)

PEAK RESULT (RBW=1MHz; VBW=1MHz)

Frequency (MHz)	Measure Level (dB μ V/m)	Limit (μ Volt/meter)	Limit (dB μ V/m)	Margin (dB)	Pol.
2480 (fundamental)	95,43	-----	-----	-----	Vertical
4960	43,32	5000	74,00	30,68	Vertical
7440	45,06	5000	74,00	28,94	Horizontal
9920	48,90	5000	74,00	25,10	Vertical
12400	48,06	5000	74,00	25,94	Horizontal
14480	51,84	5000	74,00	22,16	Horizontal
17360	58,43	5000	74,00	15,57	Vertical
f>17500	No spurious				

AVERAGE FACTOR

T. Pulse (ms)	TX on + TX off (ms)	Duty cycle	Average Factor (dB)
3,80	100	0,0380	-28,40

AVERAGE RESULT (RBW=1MHz; VBW=10Hz)

Frequency (MHz)	Measured Level (dB μ V/m)	Limit (μ Volt/meter)	Limit (dB μ V/m)	Margin (dB)	Pol.
2480 (fundamental)	67,03	-----	-----	-----	Vertical
4960	14,92	500	54,00	39,08	Vertical
7440	16,66	500	54,00	37,34	Horizontal
9920	20,50	500	54,00	33,50	Vertical
12400	19,66	500	54,00	34,34	Horizontal
14480	23,44	500	54,00	30,56	Horizontal
17360	30,03	500	54,00	23,97	Vertical

MEASUREMENTS RESULTS (1000 MHz to 24800 MHz)

Module type SPZB32W1C2.1:

Channel n°11: 2405,00 MHz (with Dedicated antenna A NTENOVA)

PEAK RESULT (RBW=1MHz; VBW=1MHz)

Frequency (MHz)	Measured Level (dB μ V/m)	Limit (μ Volt/meter)	Limit (dB μ V/m)	Margin (dB)	Pol.
2405 (fundamental)	96,88	-----	-----	-----	Vertical
4810	44,25	5000	74,00	29,75	Vertical
7215	46,16	5000	74,00	27,84	Horizontal
9620	47,86	5000	74,00	26,14	Horizontal
12025	49,46	5000	74,00	24,54	Horizontal
14430	52,47	5000	74,00	21,53	Vertical
16835	57,83	5000	74,00	16,17	Vertical
f>17000	No spurious				

AVERAGE FACTOR

T. Pulse (ms)	TX on + TX off (ms)	Duty cycle	Average Factor (dB)
3,80	100	0,0380	-28,40

AVERAGE RESULT (RBW=1MHz; VBW=10Hz)

Frequency (MHz)	Measured Level (dB μ V/m)	Limit (μ Volt/meter)	Limit (dB μ V/m)	Margin (dB)	Pol.
2405 (fundamental)	68,48	-----	-----	-----	Vertical
4810	15,85	500	54,00	38,15	Vertical
7215	17,76	500	54,00	36,24	Horizontal
9620	19,46	500	54,00	34,54	Horizontal
12025	21,06	500	54,00	32,94	Horizontal
14430	24,07	500	54,00	29,93	Vertical
16835	29,23	500	54,00	24,77	Vertical

Channel n°20: 2450,00 MHz (with Dedicated antenna A NTENOVA)

PEAK RESULT (RBW=1MHz; VBW=1MHz)

Frequency (MHz)	Measured Level (dB μ V/m)	Limit (μ Volt/meter)	Limit (dB μ V/m)	Margin (dB)	Pol.
2450 (fundamental)	96,06	-----	-----	-----	Vertical
4900	43,29	5000	74,00	30,71	Vertical
7350	45,94	5000	74,00	28,06	Vertical
9800	49,55	5000	74,00	24,45	Horizontal
12250	49,53	5000	74,00	24,47	Horizontal
14700	54,02	5000	74,00	19,98	Horizontal
17150	60,27	5000	74,00	13,73	Horizontal
f>18000	No spurious				

AVERAGE FACTOR

T. Pulse (ms)	TX on + TX off (ms)	Duty cycle	Average Factor (dB)
3,80	100	0,0380	-28,40

AVERAGE RESULT (RBW=1MHz; VBW=10Hz)

Frequency (MHz)	Measured Level (dB μ V/m)	Limit (μ Volt/meter)	Limit (dB μ V/m)	Margin (dB)	Pol.
2450 (fundamental)	67,66	-----	-----	-----	Vertical
4900	14,89	500	54,00	39,11	Vertical
7350	17,54	500	54,00	36,46	Vertical
9800	21,50	500	54,00	32,50	Horizontal
12250	21,13	500	54,00	32,87	Horizontal
14700	25,62	500	54,00	28,38	Horizontal
17150	31,87	500	54,00	22,13	Horizontal

Channel n°26: 2480,00 MHz (with Dedicated antenna A NTENOVA)

PEAK RESULT (RBW=1MHz; VBW=1MHz)

Frequency (MHz)	Measure Level (dB μ V/m)	Limit (μ Volt/meter)	Limit (dB μ V/m)	Margin (dB)	Pol.
2480 (fundamental)	93,75	-----	-----	-----	Vertical
4960	43,27	5000	74,00	30,73	Vertical
7440	44,77	5000	74,00	29,23	Vertical
9920	49,94	5000	74,00	24,06	Vertical
12400	48,46	5000	74,00	25,54	Vertical
14480	52,21	5000	74,00	21,79	Vertical
17360	58,67	5000	74,00	15,33	Vertical
f>18000	No spurious				

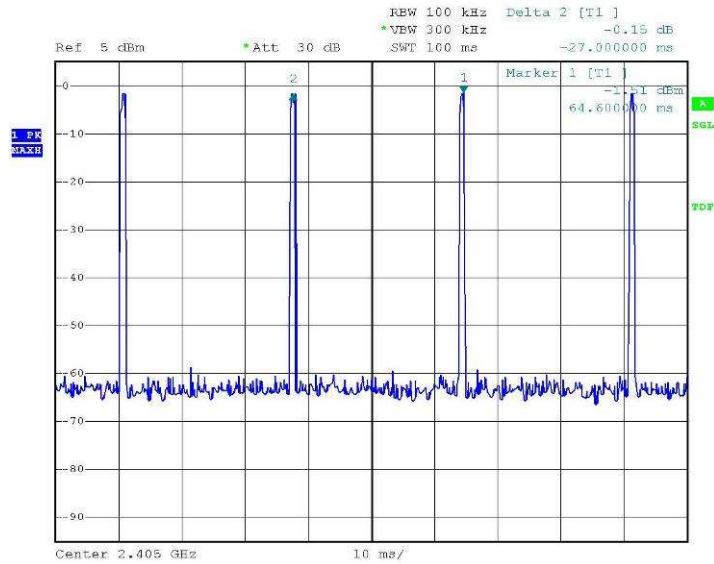
AVERAGE FACTOR

T. Pulse (ms)	TX on + TX off (ms)	Duty cycle	Average Factor (dB)
3,80	100	0,0380	-28,40

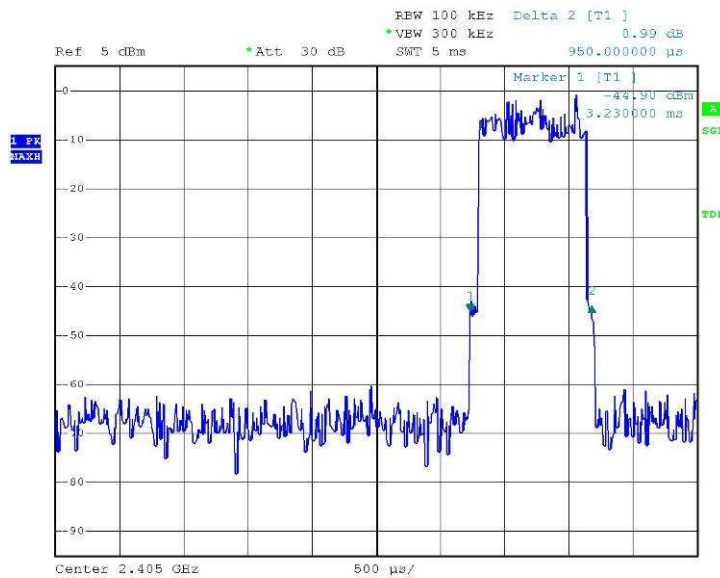
AVERAGE RESULT (RBW=1MHz; VBW=10Hz)

Frequency (MHz)	Measured Level (dB μ V/m)	Limit (μ Volt/meter)	Limit (dB μ V/m)	Margin (dB)	Pol.
2480 (fundamental)	65,35	-----	-----	-----	Vertical
4960	14,87	500	54,00	39,13	Vertical
7440	16,37	500	54,00	37,63	Vertical
9920	21,54	500	54,00	32,46	Vertical
12400	20,06	500	54,00	33,94	Vertical
14480	23,81	500	54,00	30,19	Vertical
17360	30,27	500	54,00	23,73	Vertical

Number of transmissions in 100ms : 4 transmissions



TX ON: 777 μs



In a 100ms period, there are 4 transmissions, so the TX on is:

$$0,950\text{ms} \times 4 = 3,80 \text{ ms}$$

TEST No.4	Title	47CFR Part 15 Ref. Section
		"6 dB Bandwidth"
TEST SET-UP & REQUIREMENTS	Spectrum analyzer settings	
	Span	3 MHz
	Resolution (or IF) Bandwidth (RBW)	100 kHz
	Video (or Average) Bandwidth (VBW)	300 kHz
	Sweep time	2,5 ms
	Detector function	Peak
	Trace	max hold
	Attenuator	/
	LIMIT	----

The EUT is set to transmit has its maximum data rate.

The transmitter output was connected to the spectrum analyzer through a test fixture (radio frequency coupling device associated with the dedicated antenna of the equipment under test)

The Channel bandwidth is defined as the total spectrum the power of which is higher than peak power minus 6 dB.

Test Result:

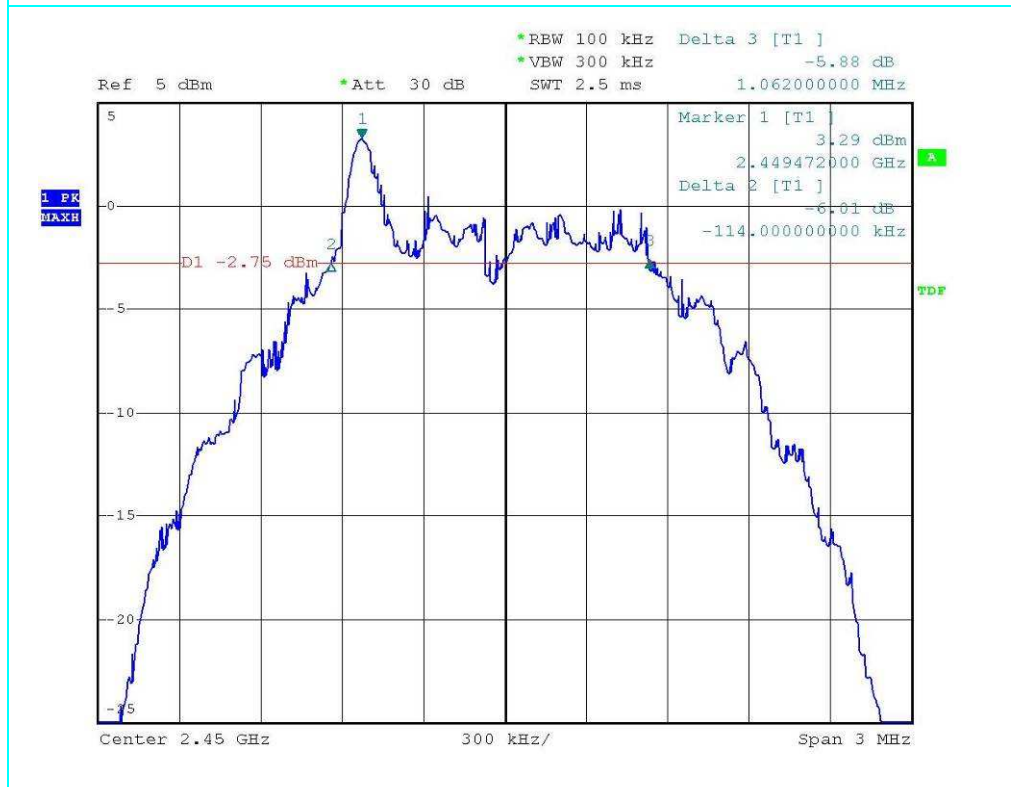
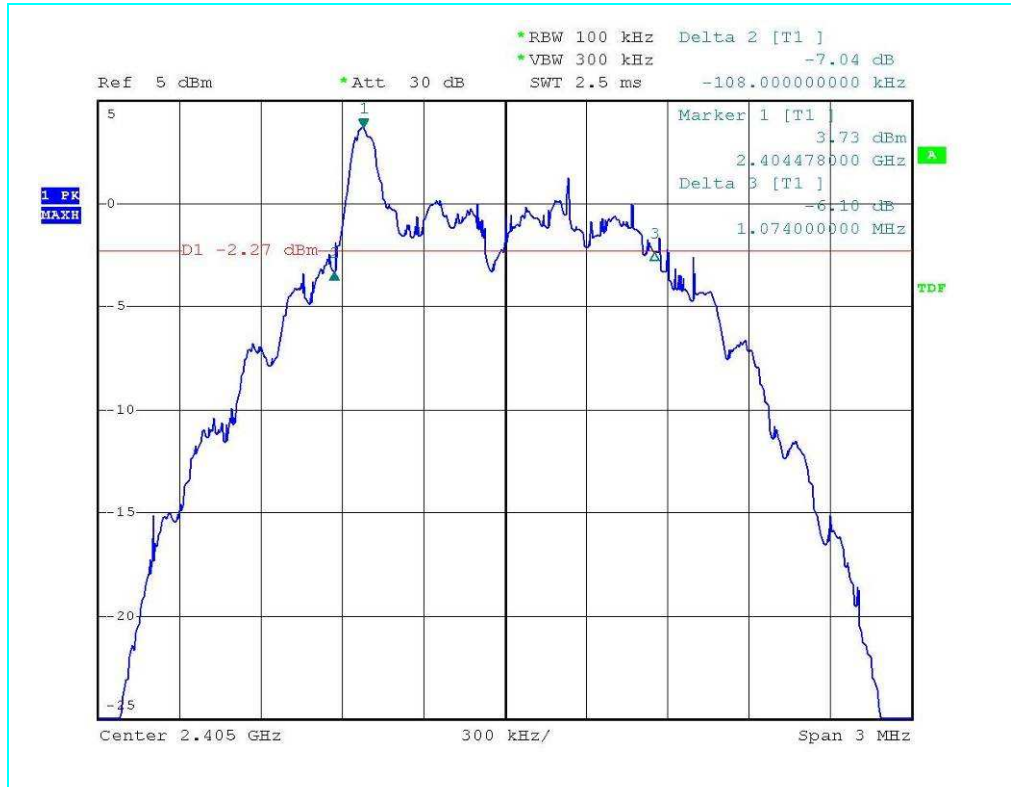
The Test results is identical for both the models type SPZB32W1A2.1 and SPZB32W1C2.1

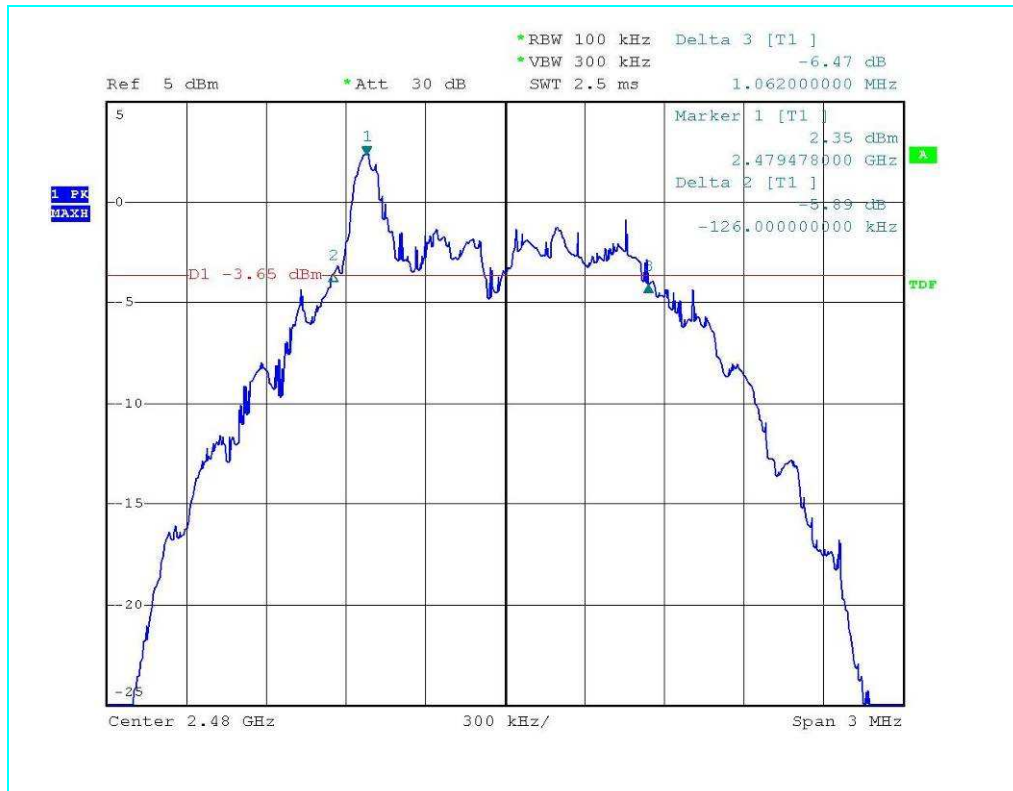
Channel (No.)	Frequency (MHz)	Channel Bandwidth (kHz)	Plot (No.)
11	2405,00	1180	1
20	2450,00	1176	2
26	2480,00	1188	3

Tested samples

SAMPLE
1) Model SPZB32W1C2.1 provided with ANTENOVA Antenna
2) Model SPZB32W1A2.1 provided with RAIN SUN Antenna

Plot No. 1÷3:





TEST No.5	Title	47CFR Part 15 Ref. Section
		“ Maximum Peak Output Power with External Antenna (De Facto EIRP)”
TEST SET-UP & REQUIREMENTS	Spectrum analyzer settings	
	Span	40 MHz
	Resolution (or IF) Bandwidth (RBW)	10 MHz
	Video (or Average) Bandwidth (VBW)	10 MHz
	Sweep time	2,5 ms
	Detector function	Peak
	Trace	max hold
	Attenuator	/
	LIMIT	1 Watt (30dBm)

Conducted measurements:

The transmitter output was connected to the spectrum analyzer via a low loss cable.

Radiated measurements:

As the EUT is supplied with a dedicated antenna, the effective radiated power is measured in a 3 m anechoic chamber with the substitution antenna method.

Tested samples

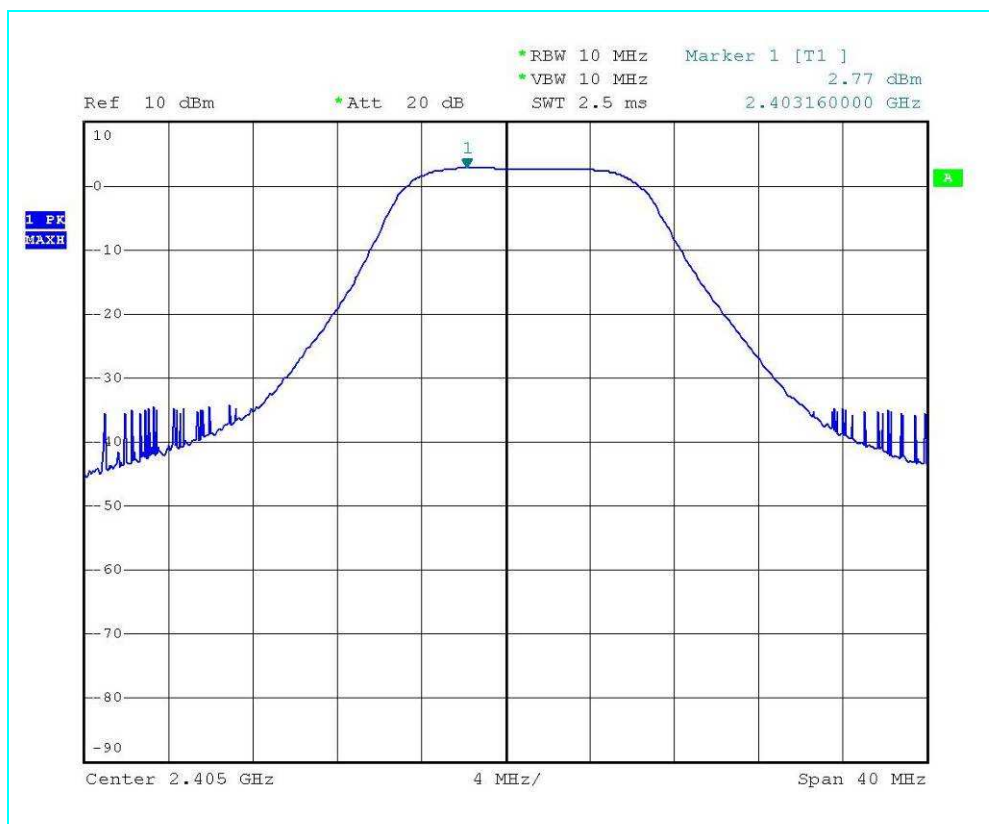
SAMPLE
1) Model SPZB32W1C2.1 provided with ANTENOVA Antenna
2) Model SPZB32W1A2.1 provided with RAIN SUN Antenna

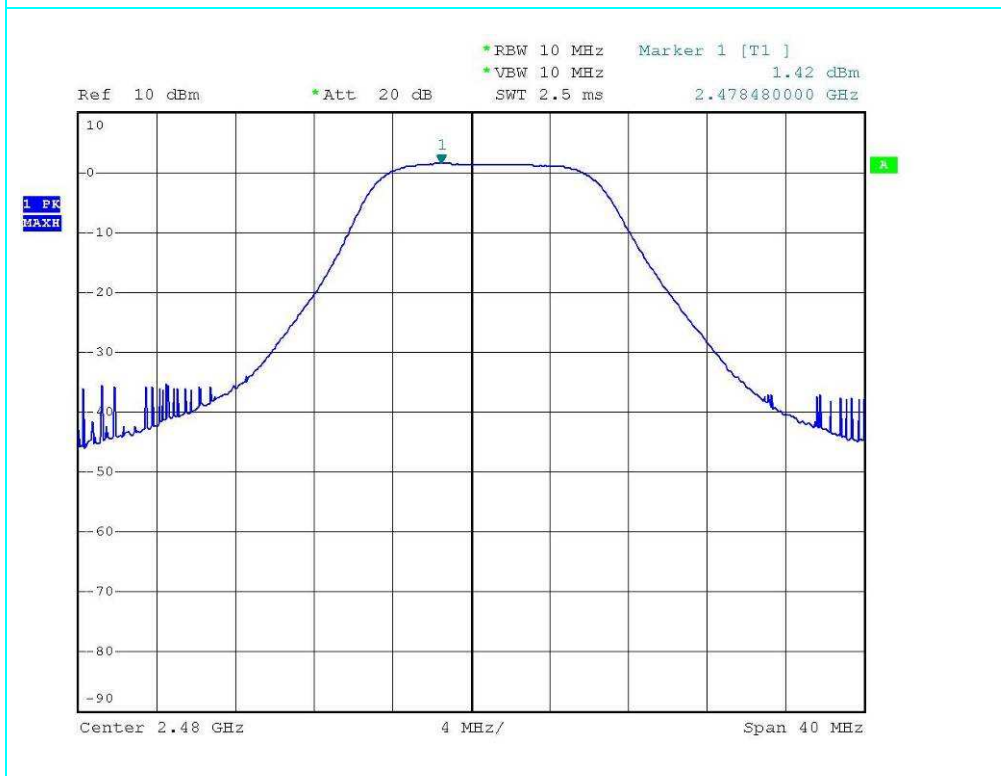
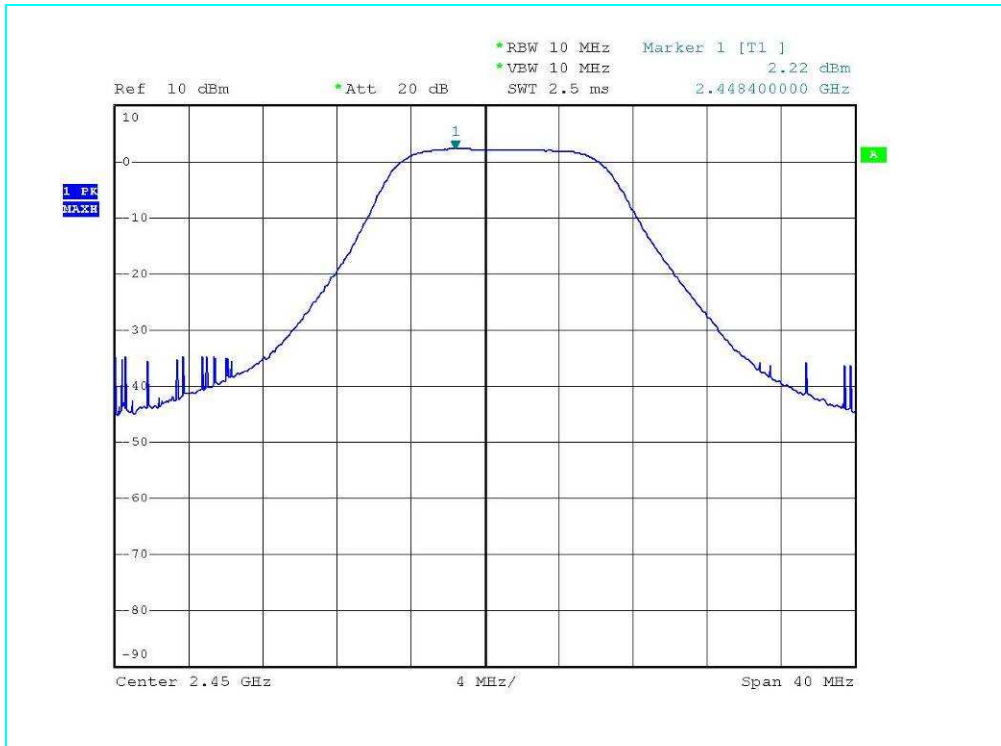
Test Result

The Test results is identical for both the models type SPZB32W1A2.1 and SPZB32W1C2.1

Conducted measure (Peak detector)

Channel (No.)	Frequency (MHz)	Measured Output Power (dBm)	Max. Antenna Gain (dB)	Calculated Radiated Output Power (dBm)
11	2405,00	2,77	2,2	4,97
20	2450,00	2,22		4,42
26	2480,00	1,42		3,62





TEST No. 6	Title "Band-edge Compliance of RF Conducted Emissions "		47CFR Part 15 Ref. Section
			15.247 (d)
TEST SET-UP & REQUIREMENTS	Spectrum analyzer settings		
	Span	Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation	
	Resolution (or IF) Bandwidth (RBW)	1 MHz (100 kHz band-edge)	
	Video (or Average) Bandwidth (VBW)	1 MHz (100 kHz band-edge)	
	Sweep time	Auto	
	Detector function	Peak	
	Trace	Max hold	
	Attenuator	/	
	LIMIT	> 20 dB below that in the 100 kHz bandwidth within the assigned band	

Only for measuring emissions up to 2 MHz removed from the band-edge the "delta" technique for Radiated emissions was used.

Delta technique: The transmitter output was connected to the spectrum analyzer through a test fixture (radio frequency coupling device associated with the dedicated antenna of the equipment under test)

Once the trace is stabilized, by the marker the emission at the band edge (or on the highest modulation product outside of the band, if this level is greater than that at the band edge) was set.

The "n" by the marker-delta function and the marker-to-peak function the peak of the in-band emission was selected. The marker-delta value displayed was compared with the limit specified in this Section.

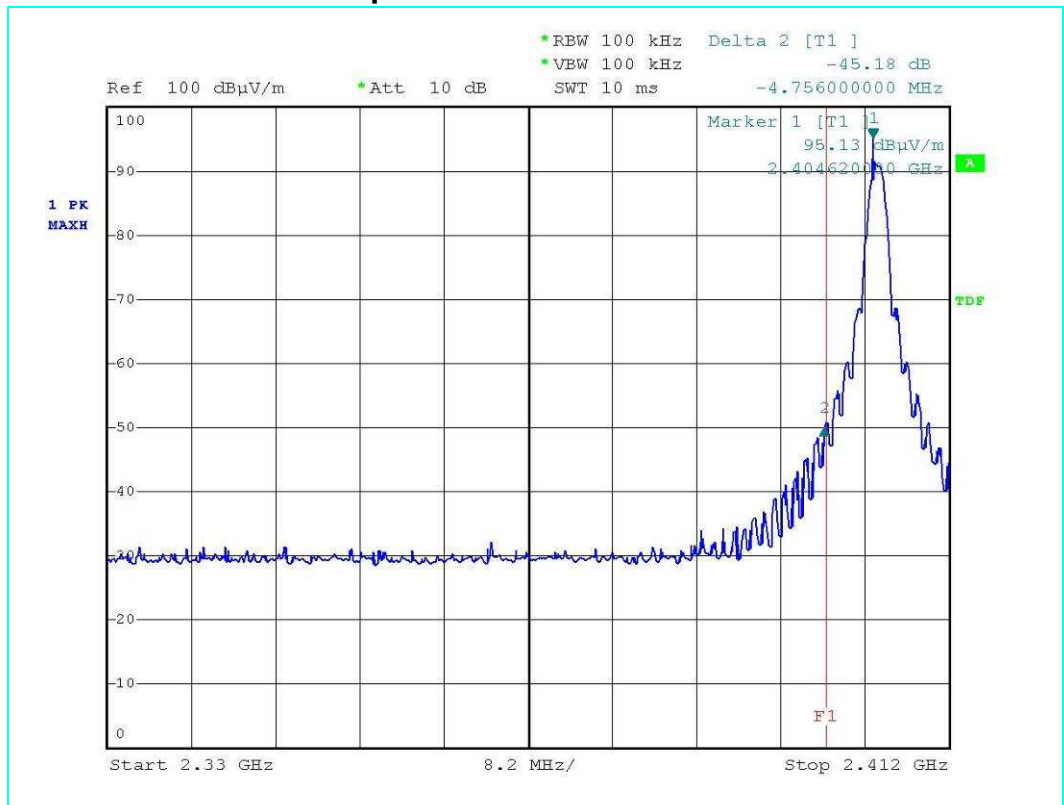
Tested samples

SAMPLE
1) Model SPZB32W1C2.1 provided with ANTENOVA Antenna
2) Model SPZB32W1A2.1 provided with RAIN SUN Antenna

Test Result:

Band-edge compliance, lower band edge, (Peak)

Model SPZB32W1C2.1 provided with ANTENOVA Antenna

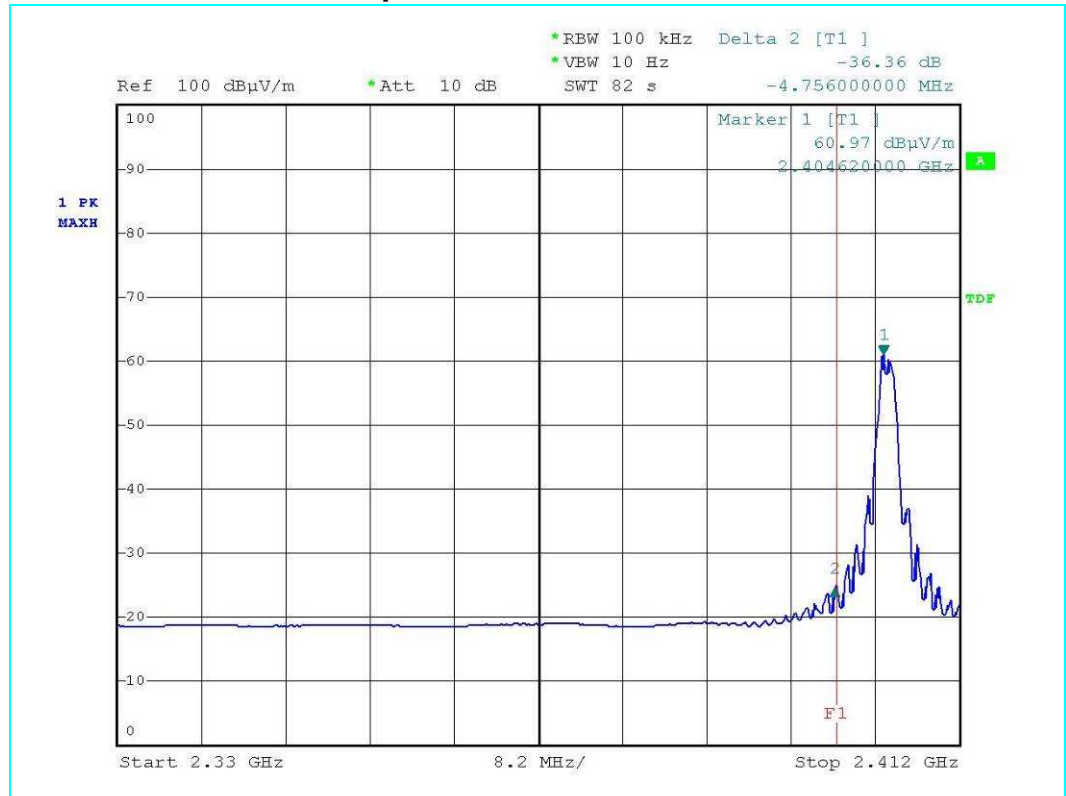


All out of band spurious emissions are more 20 dB below the in band power of the fundamental.

Band-edge compliance to radiated emission test				
Band edge	Different to the signal peak (dB)	Field strength measured (dBµV/m)	Field strength at the band-edge (dBµV/m) (peak detector)	Peak Limit at the band-edge (dBµV/m)
Lower (2399.86MHz)	45,18	95,13	49,95	74,00
Within the limit				

Band-edge compliance, lower band edge, (Average)

Model SPZB32W1C2.1 provided with ANTENOVA Antenna

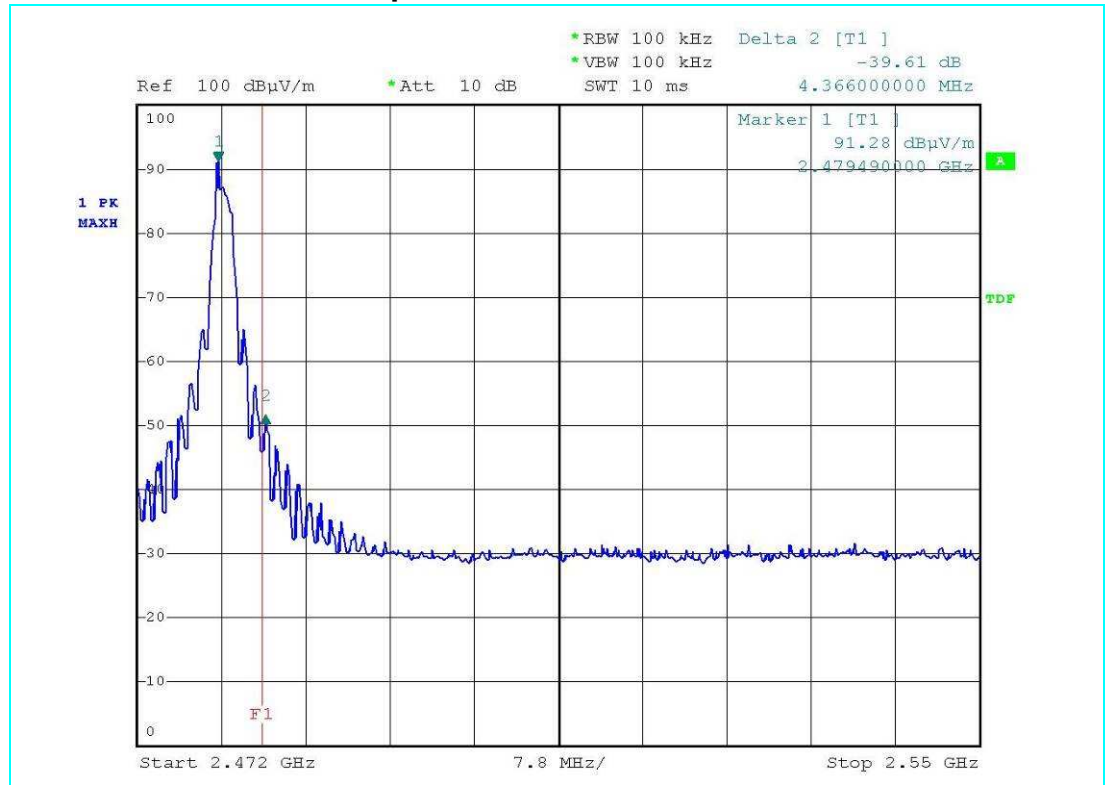


All out of band spurious emissions are more 20 dB below the in band power of the fundamental.

Band-edge compliance to radiated emission test				
Band edge	Different to the signal peak (dB)	Field strength measured (dBμV/m)	Field strength at the band-edge (dBμV/m) (average detector)	Average Limit at the band-edge (dBμV/m)
Lower (2399.86MHz)	36,36	60,97	24,61	54,00
Within the limit				

Band-edge compliance, upper band edge, (Peak)

Model SPZB32W1C2.1 provided with ANTENOVA Antenna

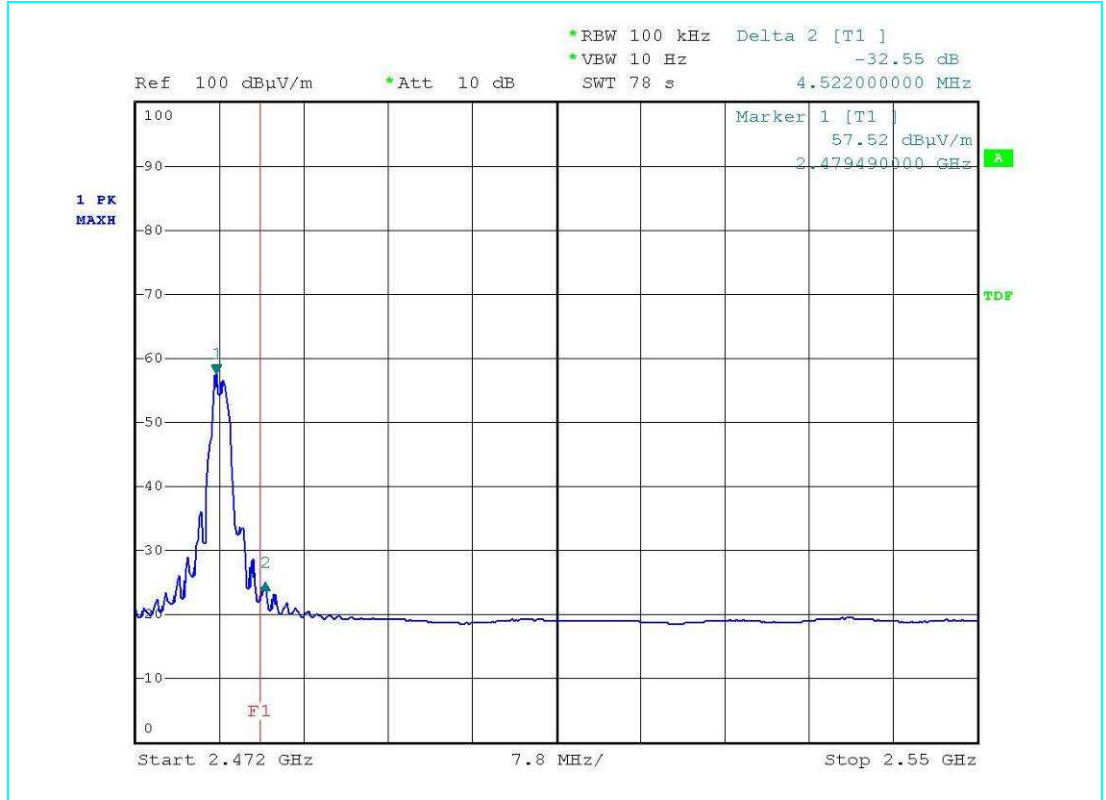


All out of band spurious emissions are more 20 dB below the in band power of the fundamental.

Band-edge compliance to radiated emission test				
Band edge	Different to the signal peak (dB)	Field strength measured (dBμV/m)	Field strength at the band-edge (dBμV/m) (peak detector)	Peak Limit at the band-edge (dBμV/m)
Upper (2483,85 MHz)	39,61	91,28	51,67	74,00
Within the limit				

Band-edge compliance, upper band edge, (Average)

Model SPZB32W1C2.1 provided with ANTENOVA Antenna



All out of band spurious emissions are more 20 dB below the in band power of the fundamental.

Band-edge compliance to radiated emission test				
Band edge	Different to the signal peak (dB)	Field strength measured (dBμV/m)	Field strength at the band-edge (dBμV/m) (average detector)	Average Limit at the band-edge (dBμV/m)
Upper (2484,01 MHz)	32,55	57,52	24,97	54,00
Within the limit				

Spurious Emission in restricted band near 2400-2483.5 MHz

Model SPZB32W1C2.1 provided with ANTENOVA Antenna

PEAK DETECTOR

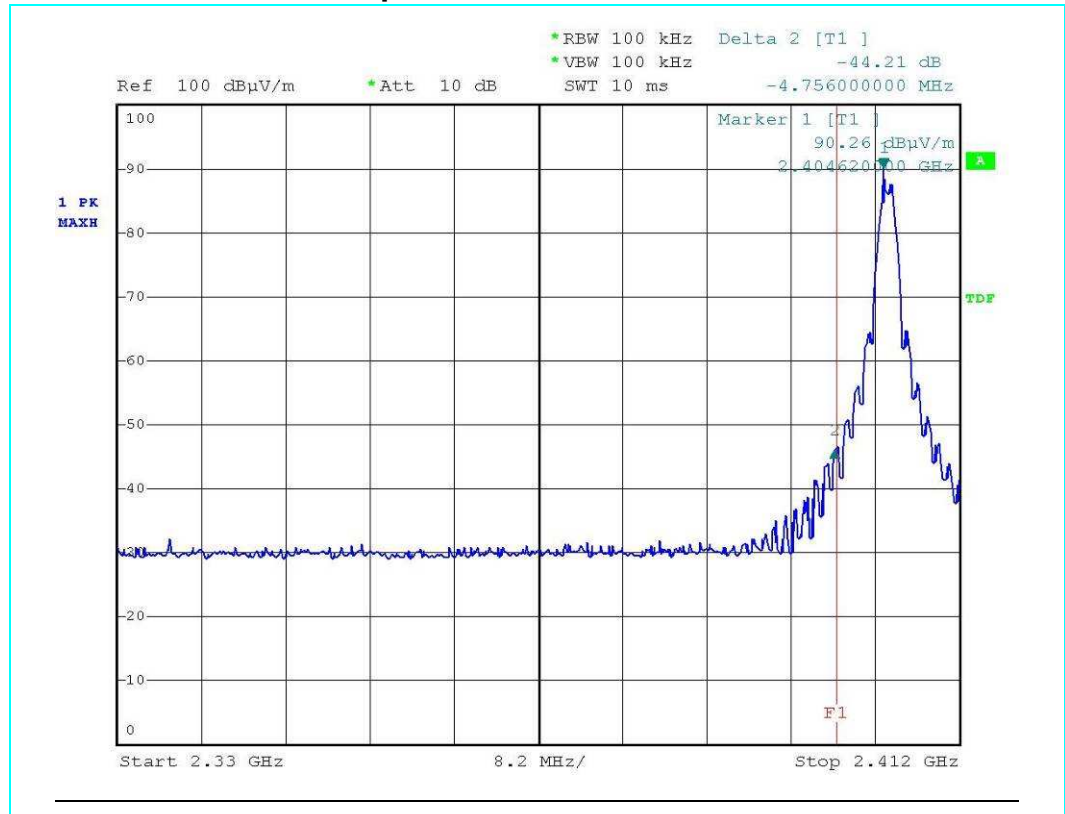
Frequency (MHz)	Measured Level (dB μ V/m)	Limit (μ Volt/meter)	Limit (dB μ V/m)	Margin (dB)
2397,00	45,56	5000	74,00	28,44
2485,80	43,40	5000	74,00	30,60

AVERAGE DETECTOR

Frequency (MHz)	PK level – 28,40 (dB μ V/m)	Limit (μ Volt/meter)	Limit (dB μ V/m)	Margin (dB)
2397,00	17,16	500	54,00	36,84
2485,80	15,00	500	54,00	39,00

Band-edge compliance, lower band edge, (Peak)

Model SPZB32W1A2.1 provided with RAINSON Antenna

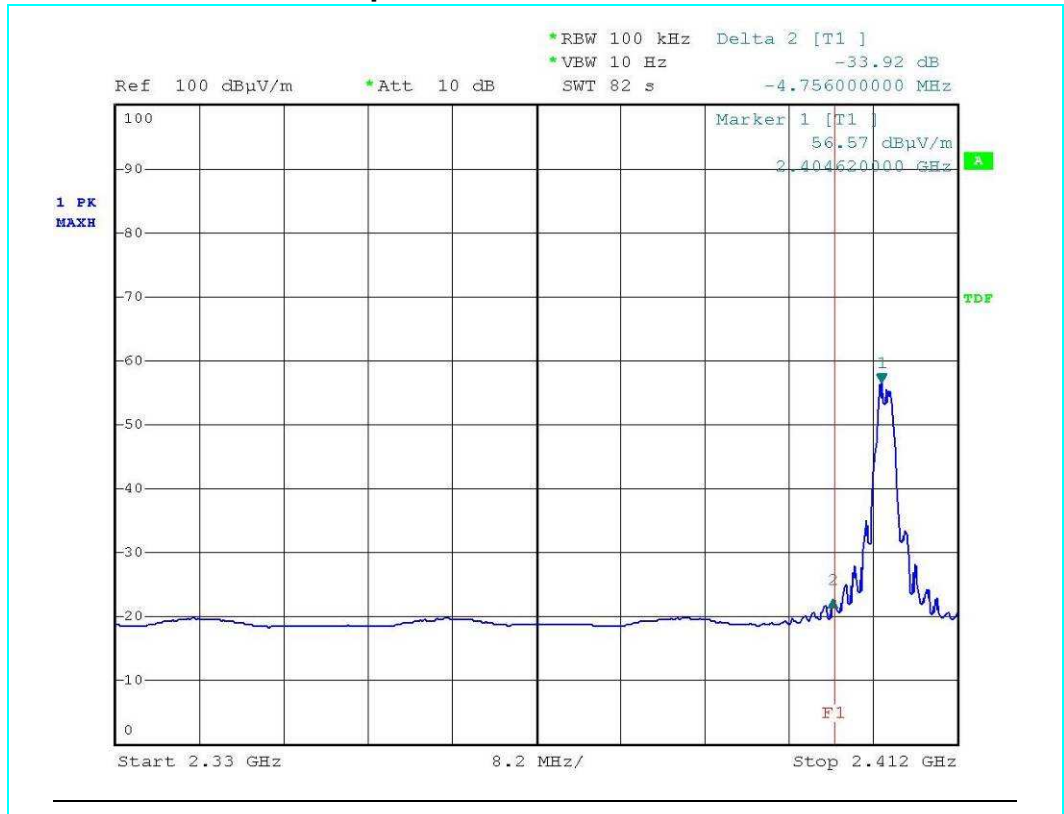


All out of band spurious emissions are more 20 dB below the in band power of the fundamental.

Band-edge compliance to radiated emission test				
Band edge	Different to the signal peak (dB)	Field strength measured (dBμV/m)	Field strength at the band-edge (dBμV/m) (peak detector)	Peak Limit at the band-edge (dBμV/m)
Lower (2399,86 MHz)	44,21	90,26	46,05	74,00
Within the limit				

Band-edge compliance, lower band edge, (Average)

Model SPZB32W1A2.1 provided with RAINSON Antenna

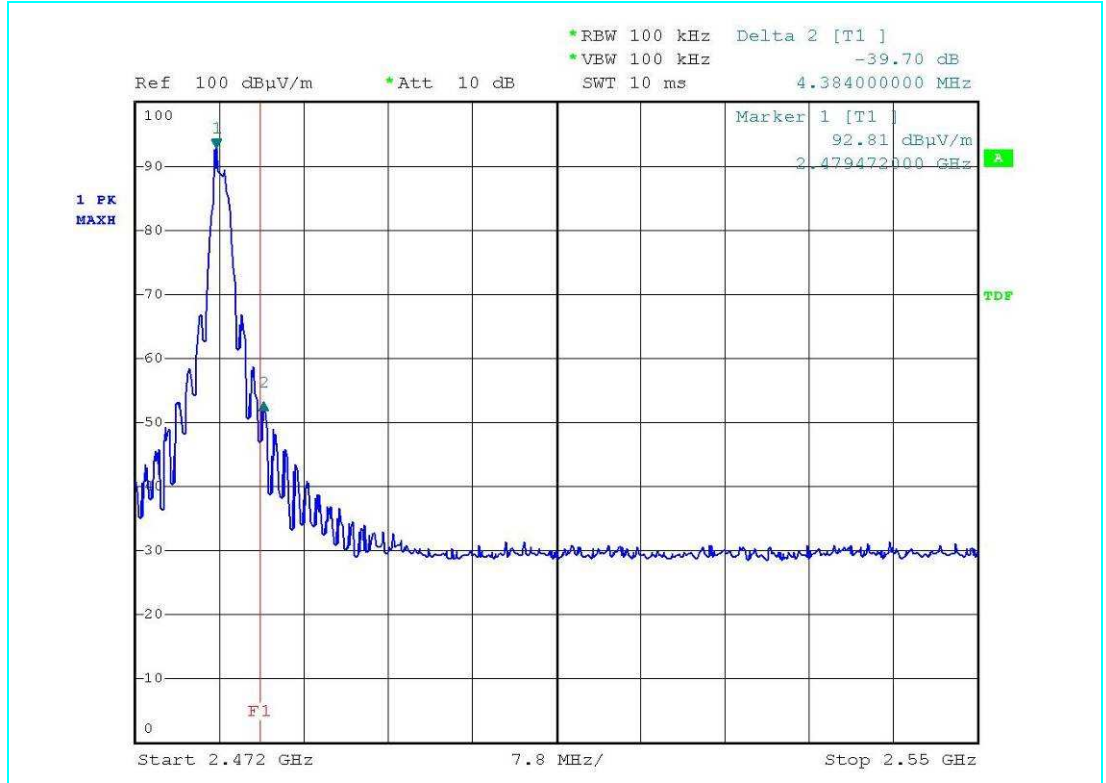


All out of band spurious emissions are more 20 dB below the in band power of the fundamental.

Band-edge compliance to radiated emission test				
Band edge	Different to the signal peak (dB)	Field strength measured (dBµV/m)	Field strength at the band-edge (dBµV/m) (average detector)	Average Limit at the band-edge (dBµV/m)
Lower (2399,86 MHz)	33,92	56,57	22,65	54,00
Within the limit				

Band-edge compliance, upper band edge, (Peak)

Model SPZB32W1A2.1 provided with RAINSUN Antenna

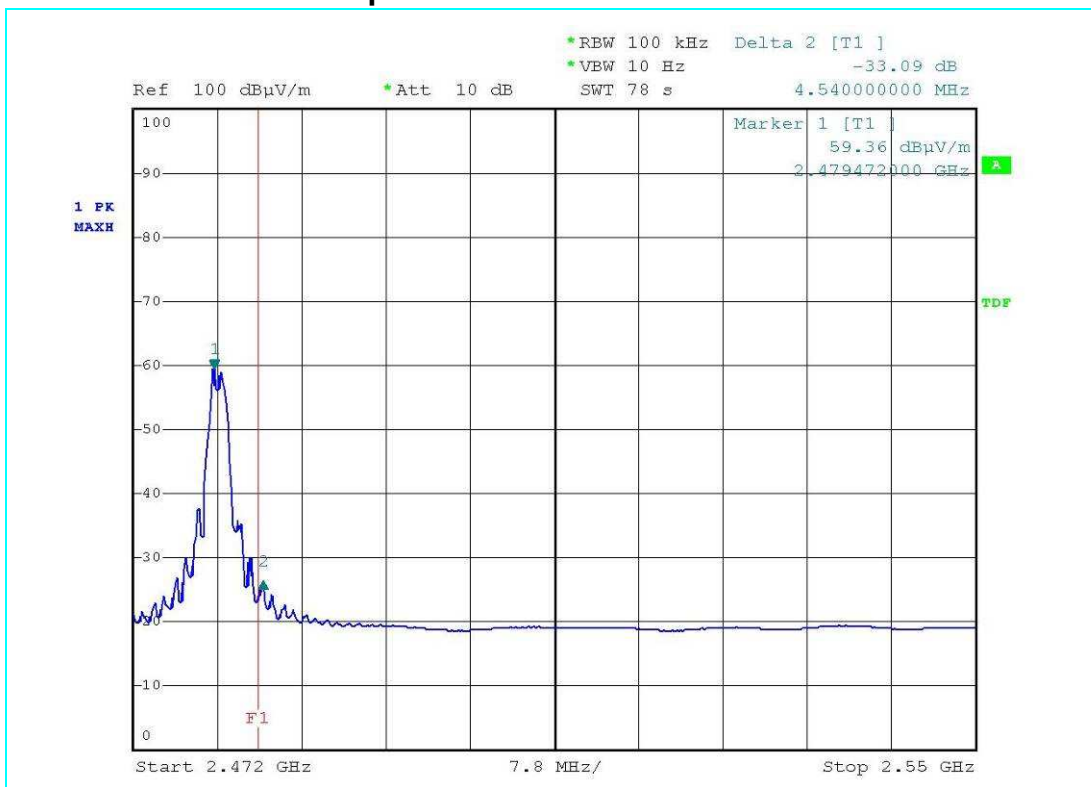


All out of band spurious emissions are more 20 dB below the in band power of the fundamental.

Band-edge compliance to radiated emission test				
Band edge	Different to the signal peak (dB)	Field strength measured (dBµV/m)	Field strength at the band-edge (dBµV/m) (peak detector)	Peak Limit at the band-edge (dBµV/m)
Upper (2483,85 MHz)	39,70	92,81	53,11	74,00
Within the limit				

Band-edge compliance, upper band edge, (Average)

Model SPZB32W1A2.1 provided with RAINSUN Antenna



All out of band spurious emissions are more 20 dB below the in band power of the fundamental.

Band-edge compliance to radiated emission test				
Band edge	Different to the signal peak (dB)	Field strength measured (dBμV/m)	Field strength at the band-edge (dBμV/m) (average detector)	Average Limit at the band-edge (dBμV/m)
Upper (2484,01 MHz)	33,09	59,36	26,27	54,00
Within the limit				

Spurious Emission in restricted band near 2400-2483.5 MHz

Model SPZB32W1A2.1 provided with RAINSUN Antenna

PEAK DETECTOR

Frequency (MHz)	Measured Level (dB μ V/m)	Limit (μ Volt/meter)	Limit (dB μ V/m)	Margin (dB)
2397,00	42,84	5000	74,00	31,16
2485,80	48,15	5000	74,00	25,85

AVERAGE DETECTOR

Frequency (MHz)	PK level – 28,40 (dB μ V/m)	Limit (μ Volt/meter)	Limit (dB μ V/m)	Margin (dB)
2397,00	14,44	500	54,00	39,56
2485,80	19,75	500	54,00	34,25

TEST No.7	Title	47CFR Part 15 Ref. Section
		“Conducted Emissions outside the band 2400-2483.5 MHz“
TEST SET-UP & REQUIREMENTS	Spectrum analyzer settings	
	Span	/
	Resolution (or IF) Bandwidth (RBW)	100 kHz
	Video (or Average) Bandwidth (VBW)	300 kHz
	Sweep time	as necessary to capture the entire dwell time per hopping channel
	Detector function	Peak
	Trace	max hold
	Attenuator	/
	LIMIT	20 dB below from Conducted peak of RF or limit specified in section 15.209 for Restricted Band.

The transmitter output was connected to the spectrum analyzer through an oportune RF attenuator.

The measure has been executed with the lowest transmit channel, the highest transmit channel and one located somewhere in the middle of the band.

Tested samples

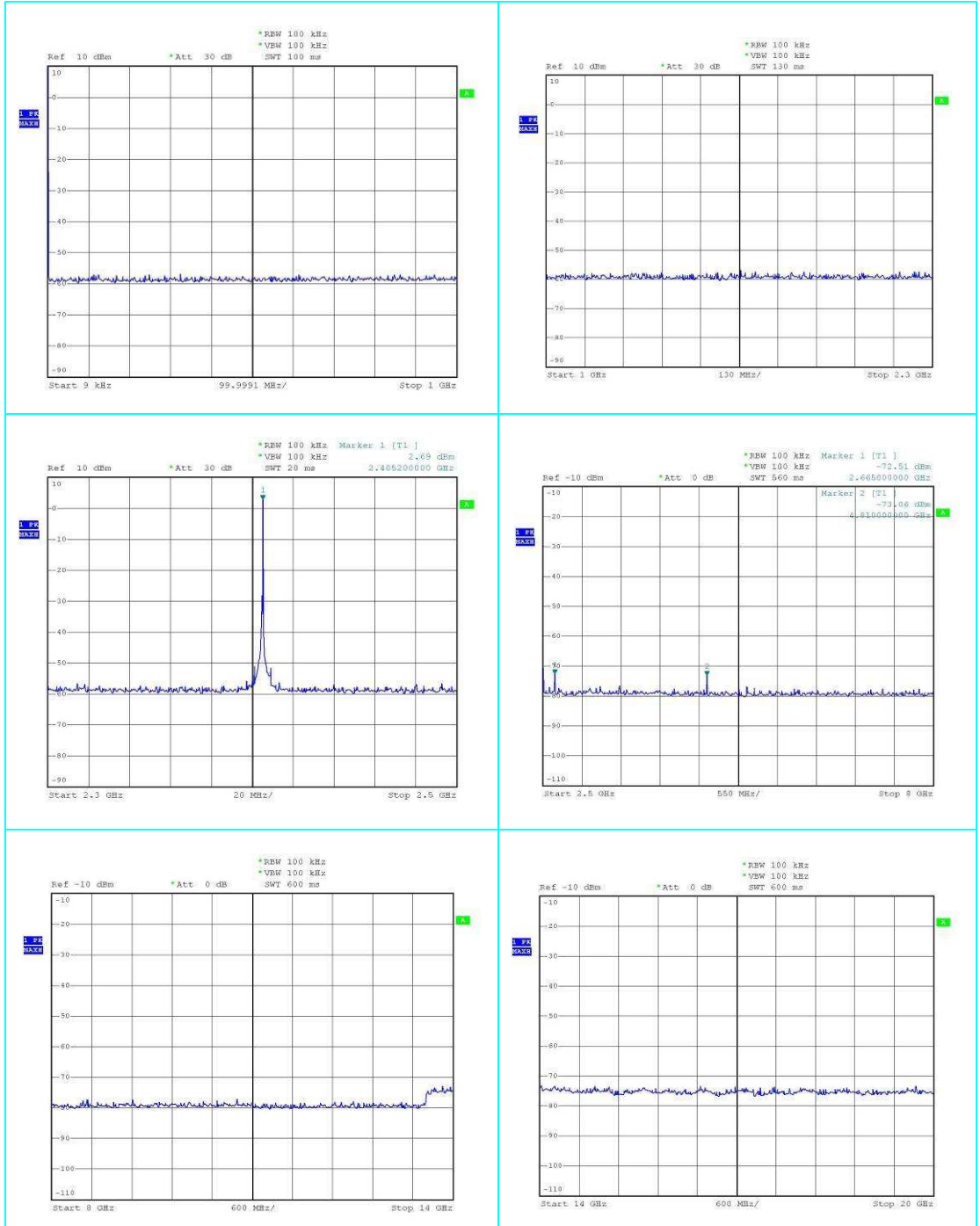
SAMPLE
1) Model SPZB32W1C2.1 provided with ANTENOVA Antenna
2) Model SPZB32W1A2.1 provided with RAINSUN Antenna

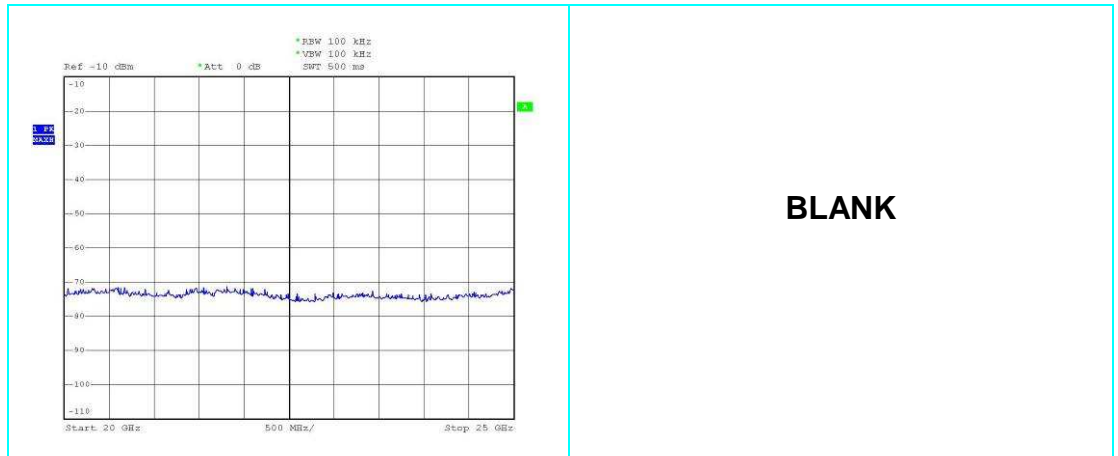
Test Result:

Within the specifications

The Test results is identical for both the models type SPZB32W1C2.1 and SPZB32W1A2.1

Test Result: Conducted measure (channel 11)





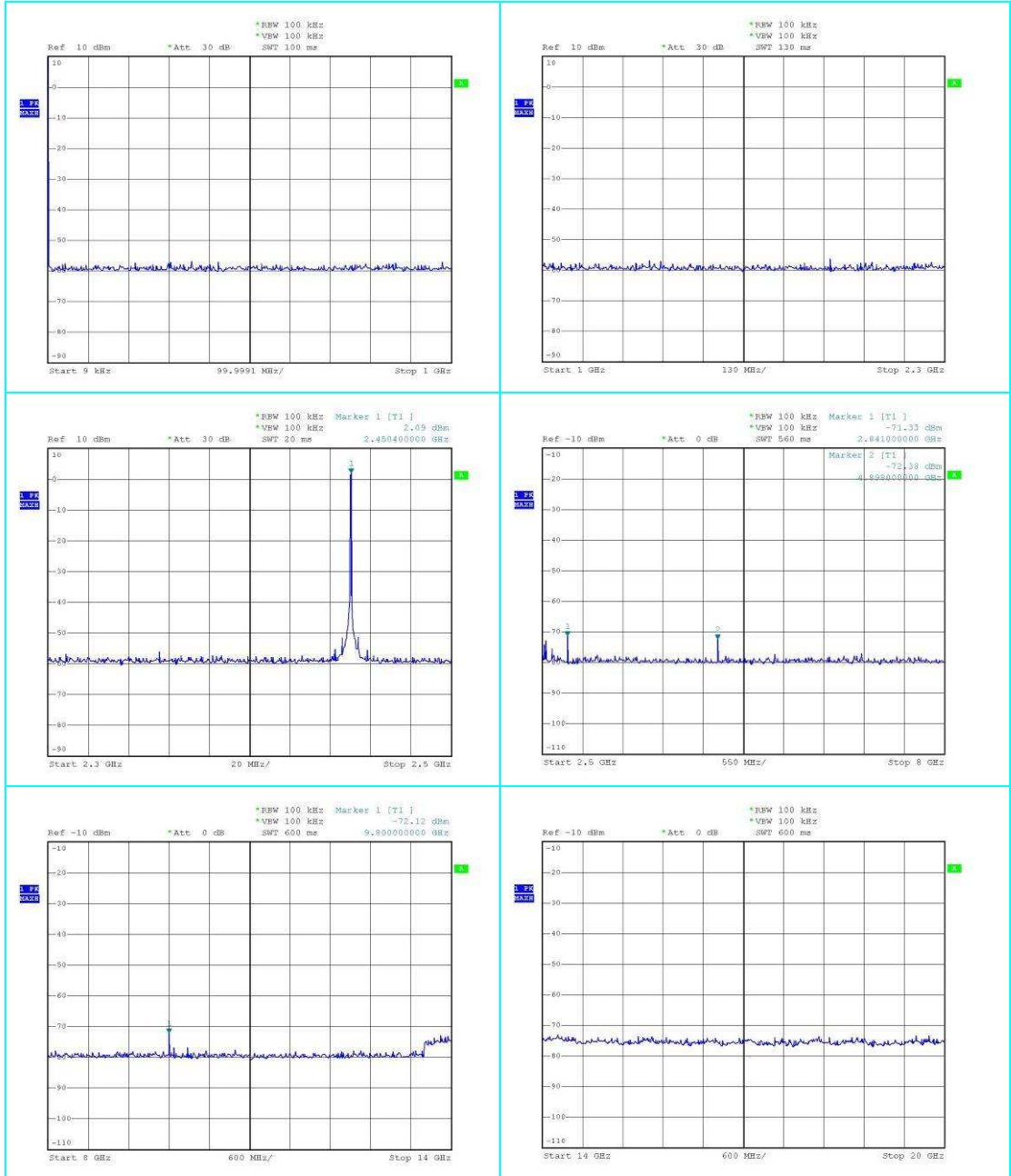
All out of band spurious emissions are more 20dB below the in band power of the fundamental.

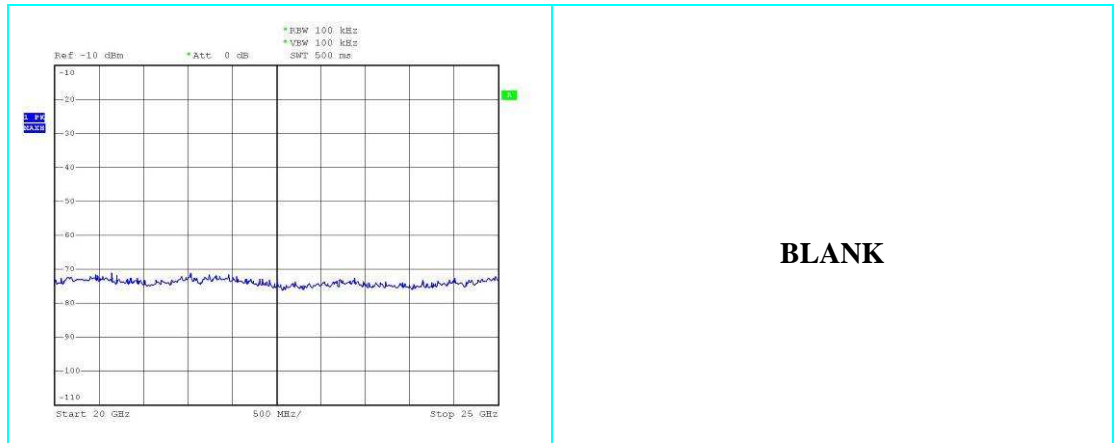
Channel n°11: 2405,00 MHz

PEAK RESULT

Frequency (MHz)	Measured Level (dBm)	Limit (dBm) Fundamental value - 20dB	Margin (dB)
2405,20 (fundamental)	+2,69	-----	-----
2665,00	-72,51	-17,31	55,20
4810,00	-73,06	-17,31	55,75

Conducted measure (channel 20)





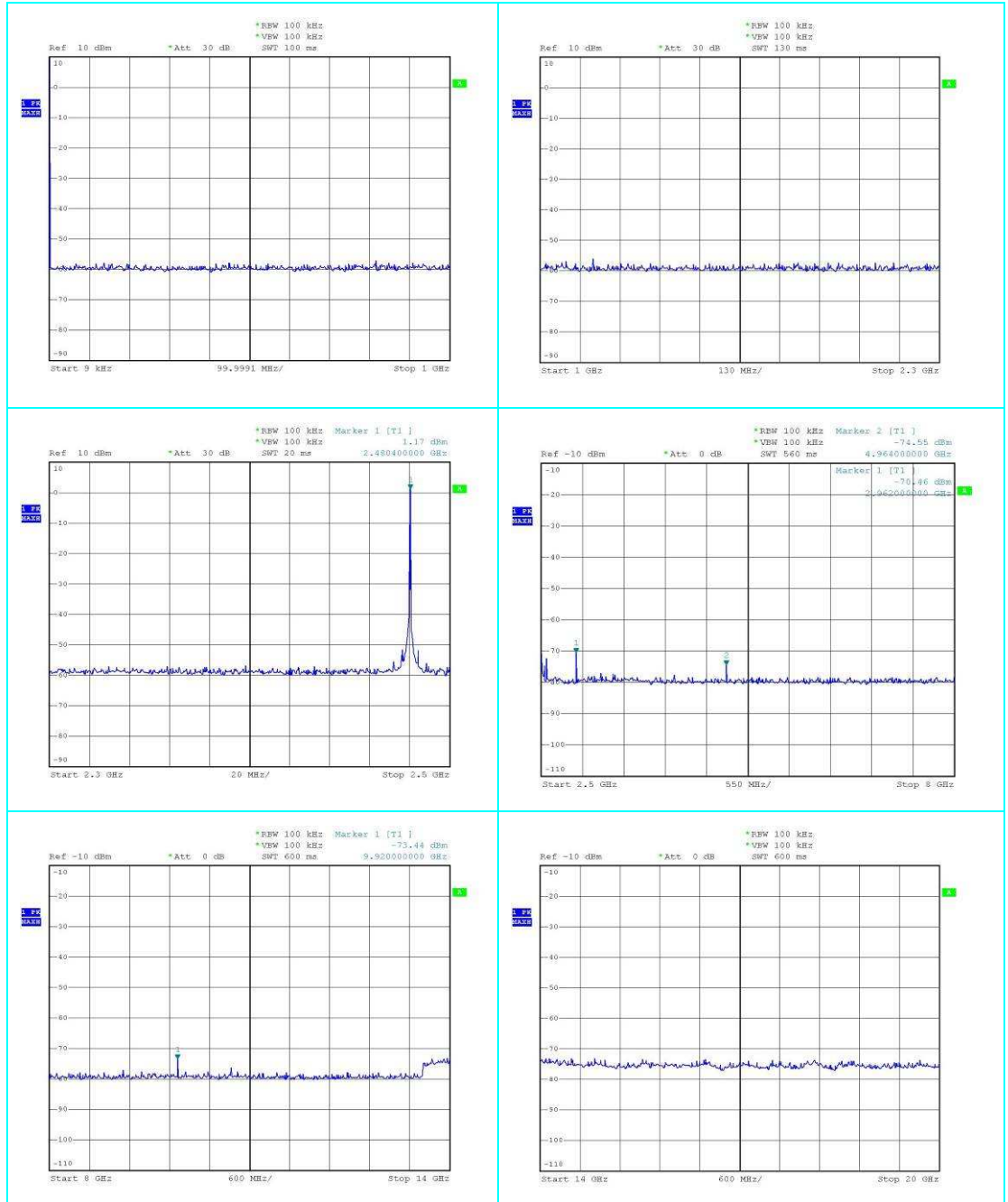
All out of band spurious emissions are more 20dB below the in band power of the fundamental.

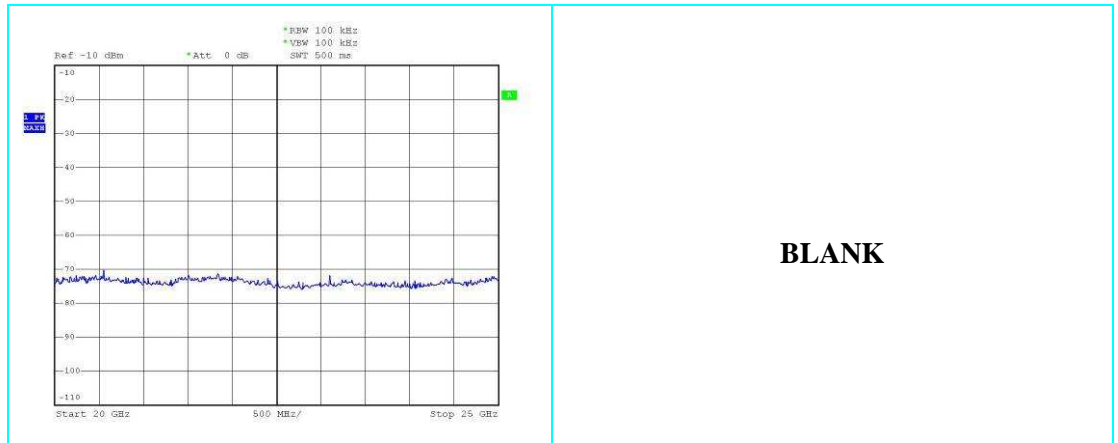
Channel n°20: 2450,00 MHz

PEAK RESULT

Frequency (MHz)	Measured Level (dBm)	Limit (dBm) Fundamental value – 20dB	Margin (dB)
2450,40 (fundamental)	+2,09	-----	-----
2841,00	-71,33	-17,91	53,42
4898,00	-72,38	-17,91	54,47
9800,00	-72,12	-17,91	54,21

Conducted measure (channel 26)





All out of band spurious emissions are more 20dB below the in band power of the fundamental.

Channel n°26: 2480,00 MHz

PEAK RESULT

Frequency (MHz)	Measured Level (dBm)	Limit (dBm) Fundamental value – 20dB	Margin (dB)
2480,40 (fundamental)	+1,17	-----	-----
2962,00	-70,46	-18,83	51,63
4964,00	-74,55	-18,83	55,72
9920,00	-73,44	-18,83	54,61

TEST No.8	Title	47CFR Part 15 Ref. Section
		“ Transmitter Power Spectral Density”
TEST SET-UP & REQUIREMENTS	Spectrum analyzer settings	
	Span	3 MHz
	Resolution (or IF) Bandwidth (RBW)	3 kHz
	Video (or Average) Bandwidth (VBW)	30 kHz
	Sweep time	340 ms
	Detector function	Peak
	Trace	max hold
	Attenuator	/
	LIMIT	8 dBm

The transmitter output was connected to the spectrum analyzer through a test fixture (radio frequency coupling device associated with the dedicated antenna of the equipment under test)

After trace stabilisation the marker shall be set on the signal peak. The indicated level is the power spectral density.

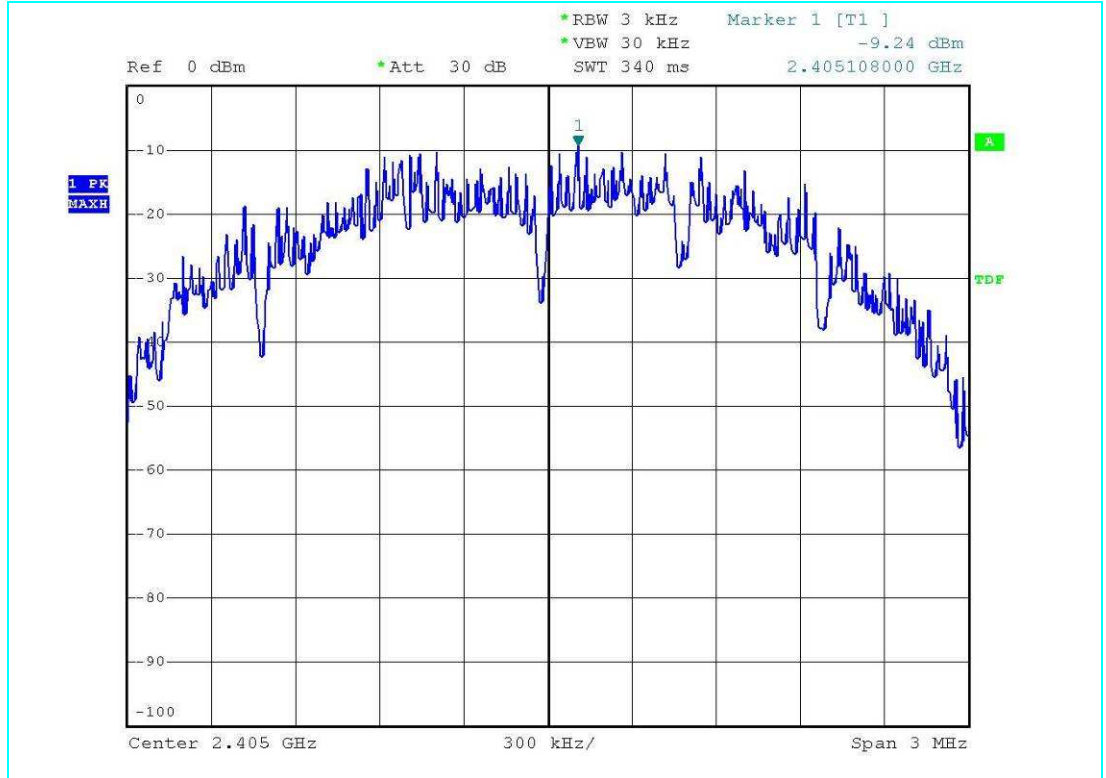
Test Result:

Channel (No.)	Power spectral density (dBm)	Plot (No.)
11	-9,24	1
20	-9,67	2
26	-10,99	3

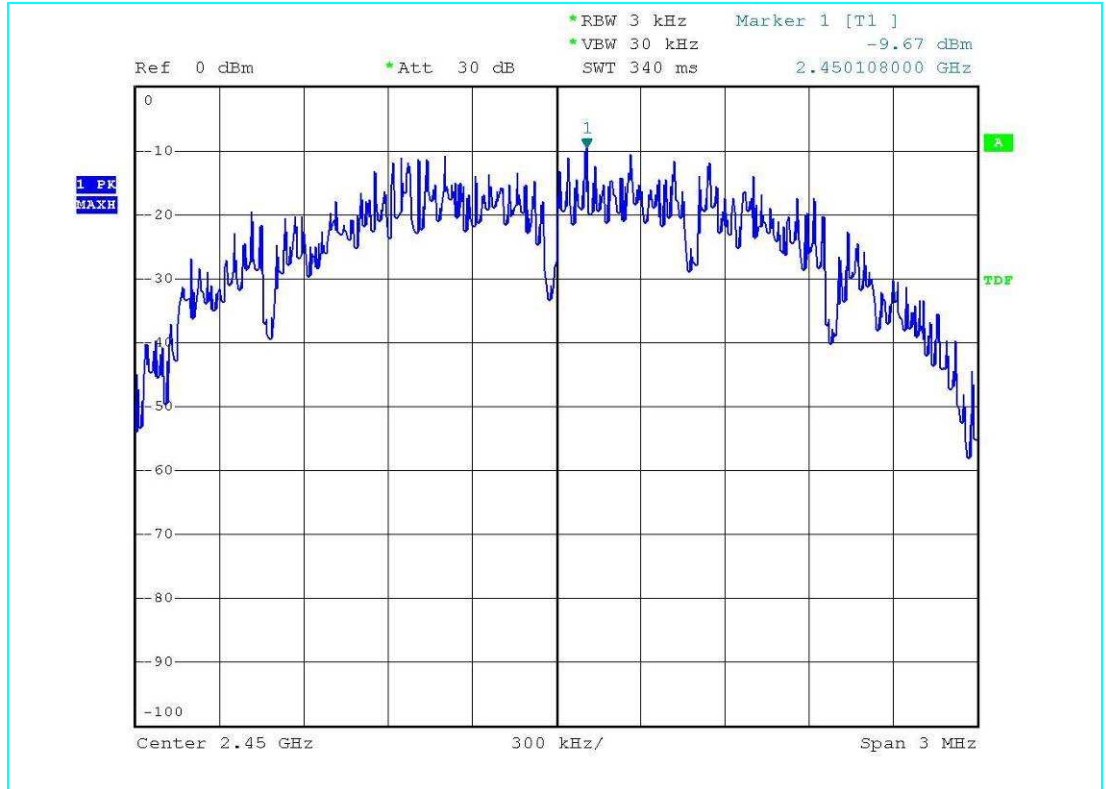
Within the specifications

The Test results is identical for both the models type SPZB32W1C2.1 and SPZB32W1A2.1

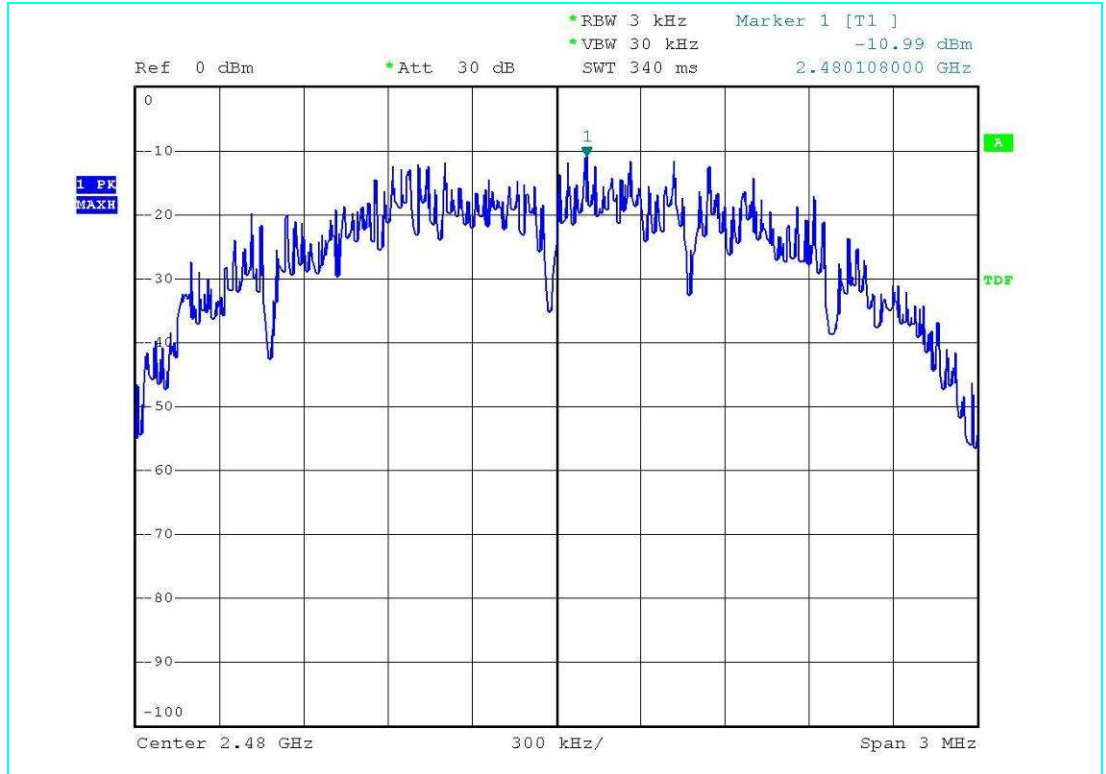
Plot No. 1:



Plot No. 2:



Plot No. 3:



TEST No.9	Title	47CFR Part 15 Ref. Section
	“RF Exposure Evaluation“	15.247 (i)
TEST SET-UP & REQUIREMENTS	Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines. See § 1.1307(b)(1) of this Chapter.	
	EUT classification (fixed, mobile or portable devices)	Fixed, mobile or portable
	LIMITS	See table below

Limit for maximum permissible Exposure (MPE)

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm ²)	Average Time (minutes)
(A) Limits for Occupational/Controlled Exposure				
0.3÷3.0	614	1.63	(100)*	6
3.0÷30	1842/f	4.89/f	(900/f ²)*	6
30÷300	61.4	0.163	1.0	6
300÷1500	--	--	f/300	6
1500÷100,000	--	--	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3÷3.0	614	1.63	(100)*	30
3.0÷30	824/f	2.19/f	(180/f ²)*	30
30÷300	27.5	0.073	0.2	30
300÷1500	--	--	f/1500	30
1500÷100,000	--	--	1.0	30
F = Frequency in MHz *Plane-wave equivalent power density				

The distance from the device's transmitting antenna where the exposure level reaches the maximum permitted limit is calculated using the general equation:

$$S = P \cdot G / 4\pi R^2$$

Where:

S = Power Density (mW/cm²)

P = Conducted power (mW)

G = Linear power gain relative to isotropic radiator (numeric gain)

R = Distance (cm)

RF Exposure evaluation Distance:

Channel (No.)	Frequency (MHz)	Output power to antenna (dBm)	Power density @ 20 cm (mW/cm ²)	Distance where the exposure level reaches the limit (cm)	Limits (mW/cm ²)
11	2405,00	2,77	0,000025	0,500	1
20	2450,00	2,22	0,000022	0,470	1
26	2480,00	1,42	0,000018	0,428	1

Test Result:

The EUT operates at low power level so it does not exceed the Commission's RF exposure guidelines limits; furthermore, Spread spectrum transmitters operate according to the Section 15.247 are categorically excluded from routine environmental evaluation.

RF exposure limit warning or SAR test are not required.

The Test results is identical for both the models type SPZB32W1C2.1 and SPZB32W1A2.1

6 ADDITIONAL TECHNICAL INFORMATION

6.1 ELECTROMAGNETICALLY RELEVANT COMPONENTS:

Components	N°	Manufacturer	Type – Technical data
Radio Module			
See Technical document			
Host Equipment			
Test Jig		STM	/

6.2 RFI SUPPRESSION DEVICES:

Components	N°	Manufacturer	Type – Technical data
None			

6.3 EMI PROTECTION DEVICES:

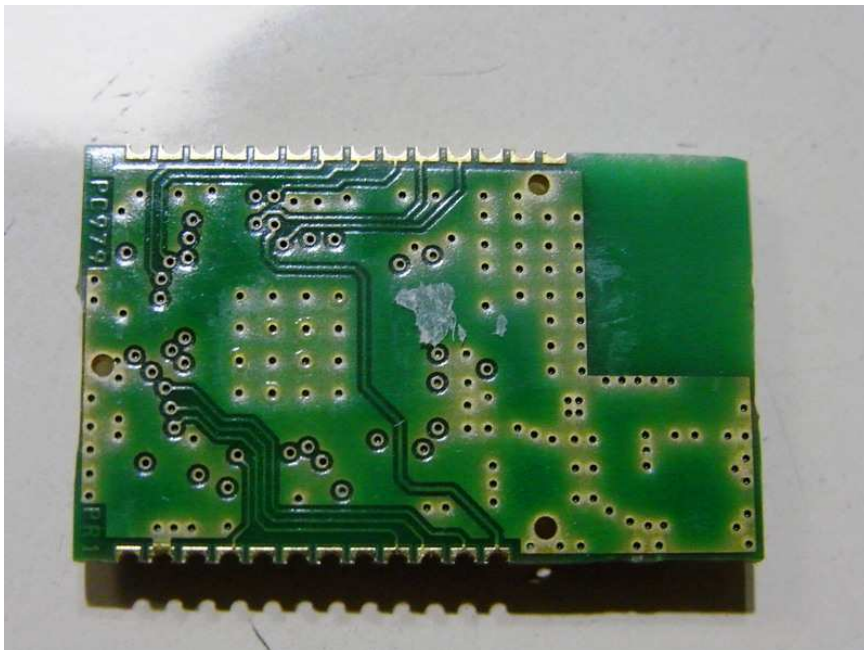
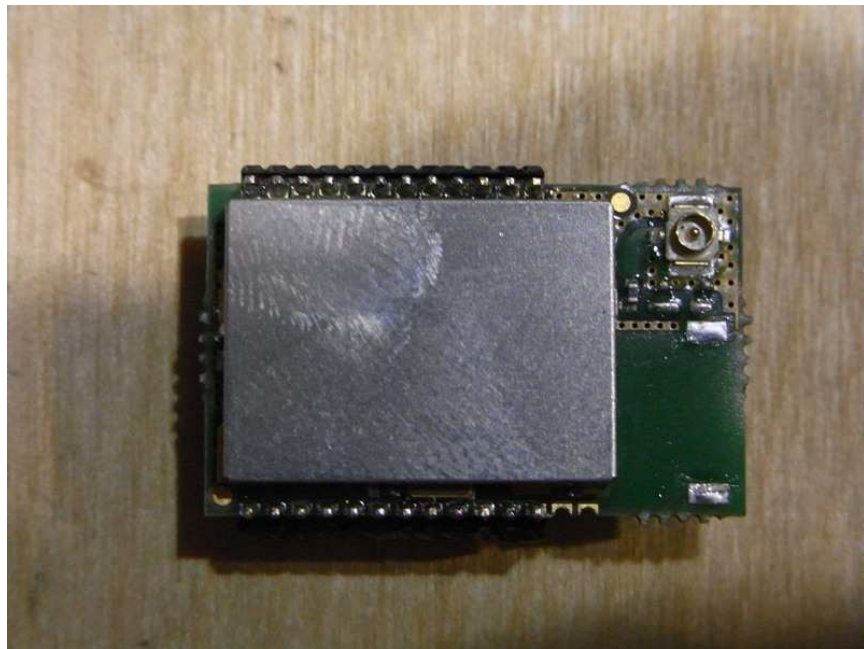
Components	N°	Manufacturer	Type – Technical data
None			

7 TECHNICAL DOCUMENTATION

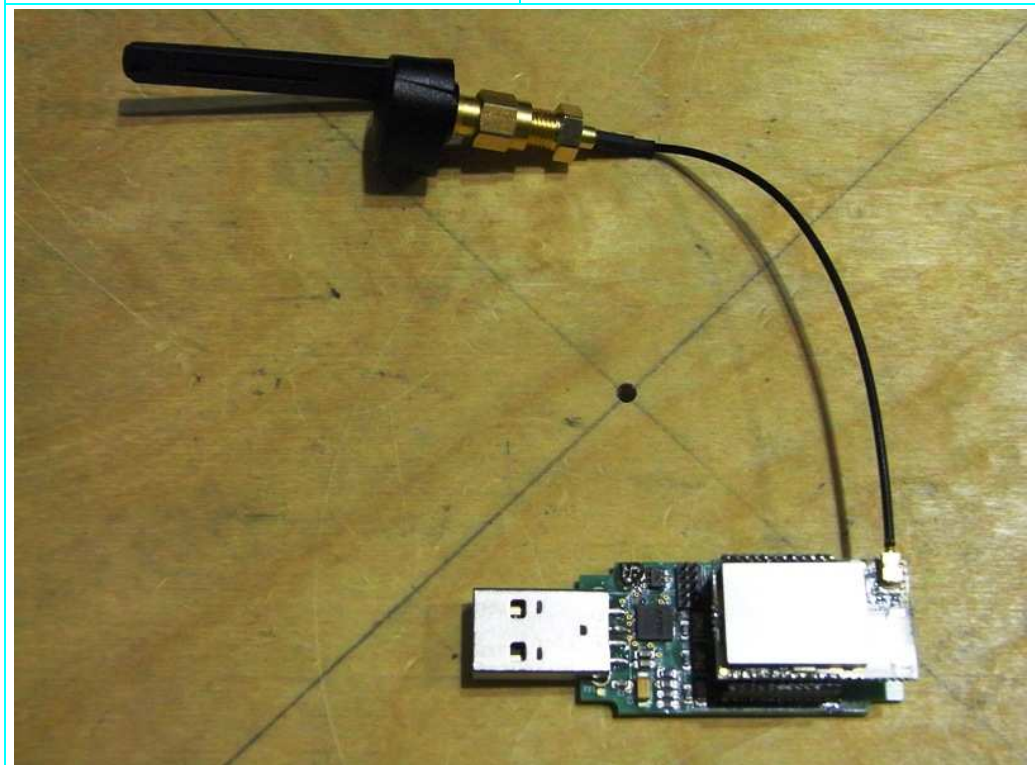
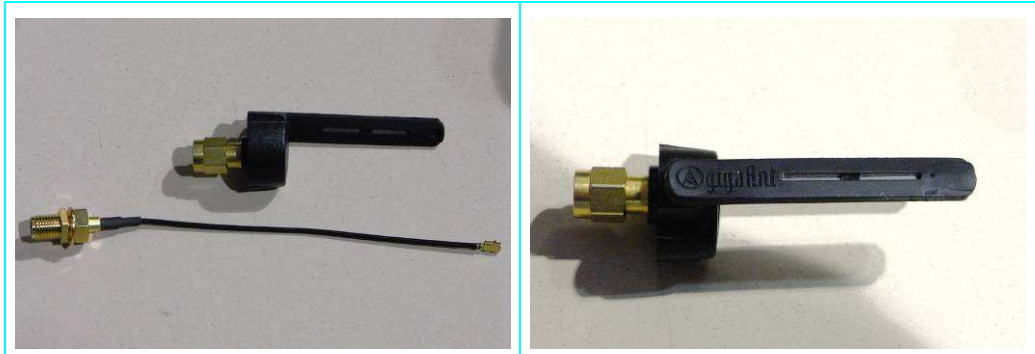
DOCUMENT	REFERENCE
Bill of materials	SPZB32W1A2.1 – Doc. No° 8286190A - Rev. A 31/08/2010 SPZB32W1C2.1 – Doc. No° 8286192A - Rev. A 31/08/2010
Electronic diagram	SPZB32W1x2.1 – Doc. No° 8286196A - Rev. A 31/08/2010
Manual	SPZB32W1A2.1 / SPZB32W1C2.1

8 PHOTOGRAPHIC DOCUMENTATION

8.1 EUT IDENTIFICATION

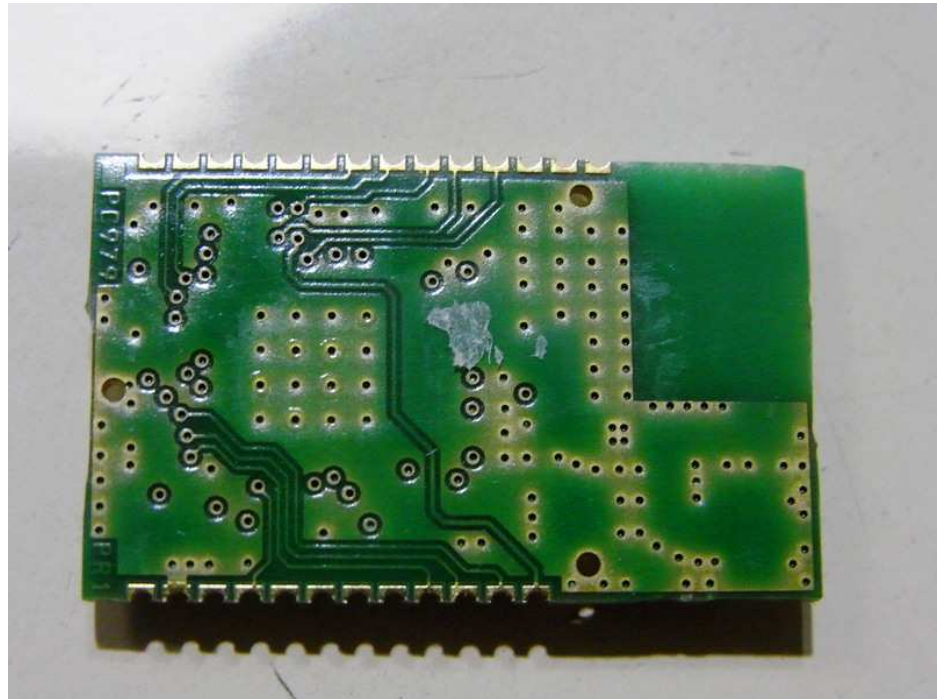
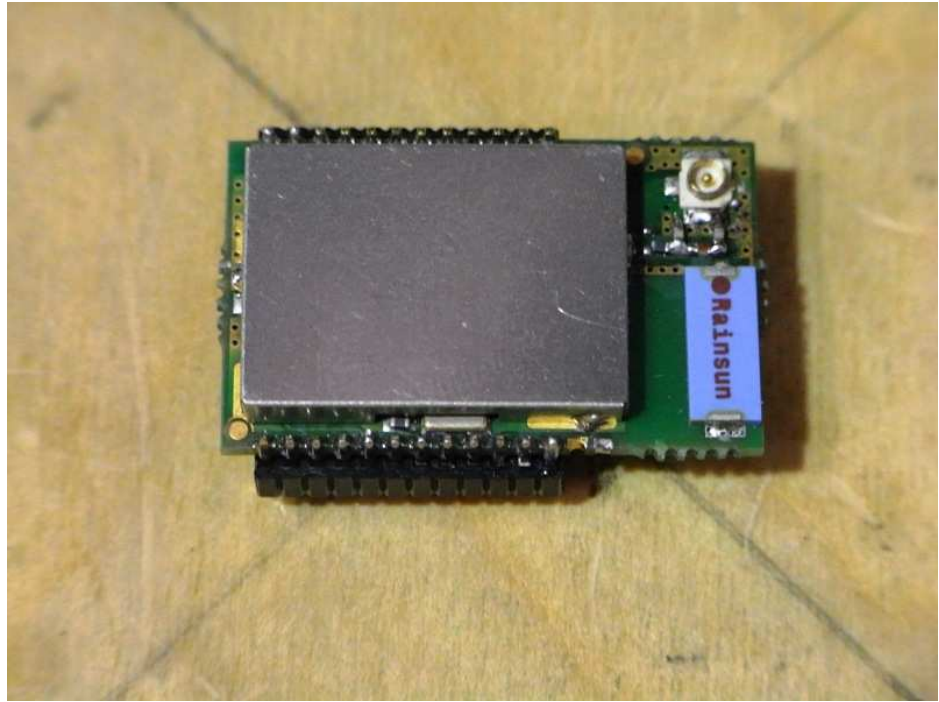


Model SPZB32W1C2.1 provided with ANTENOVA Antenna

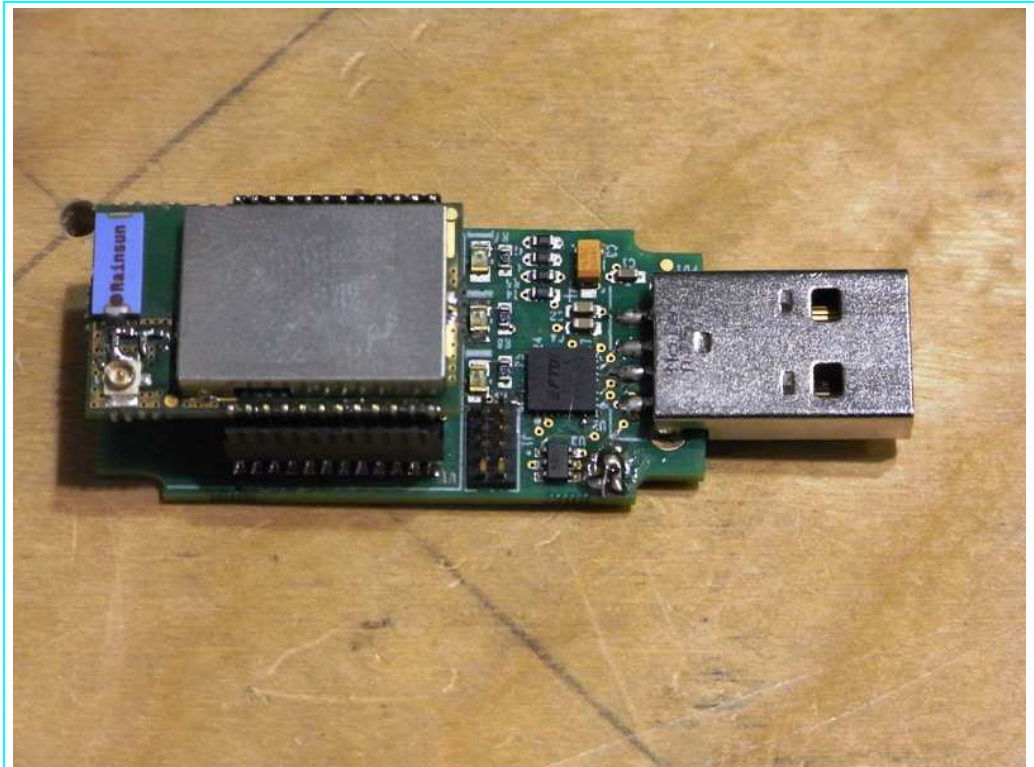


Model SPZB32W1C2.1

Equipment under test identification: Test jig + Radio module



Model SPZB32W1A2.1 provided with RAIN SUN Antenna

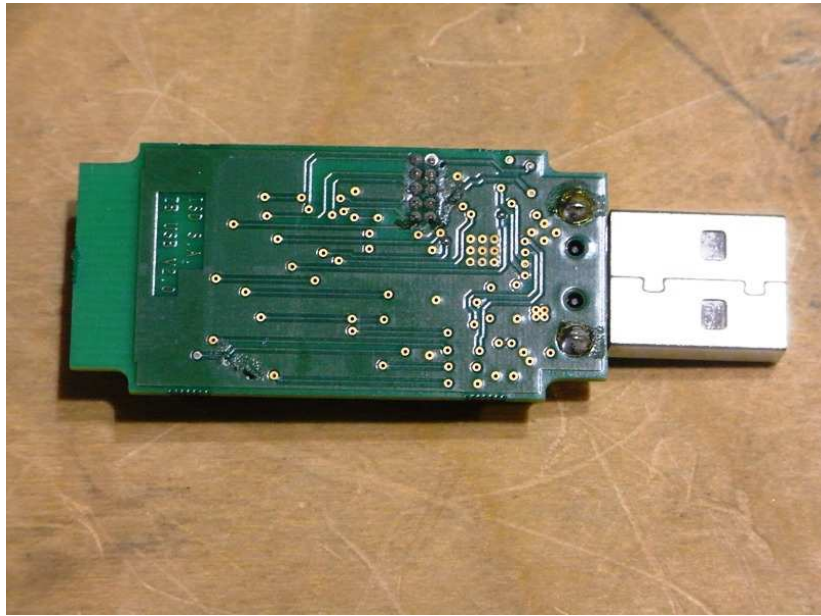


Model SPZB32W1A2.1

Equipment under test identification: Test jig + Radio module

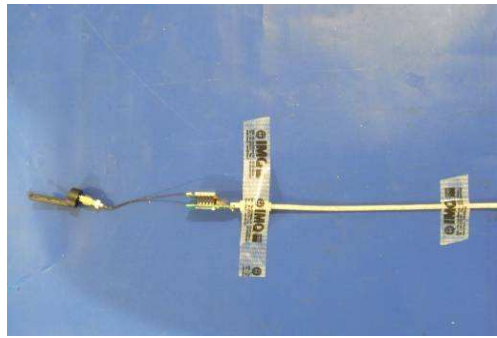


Test jig (front view)



Test jig (rear view)

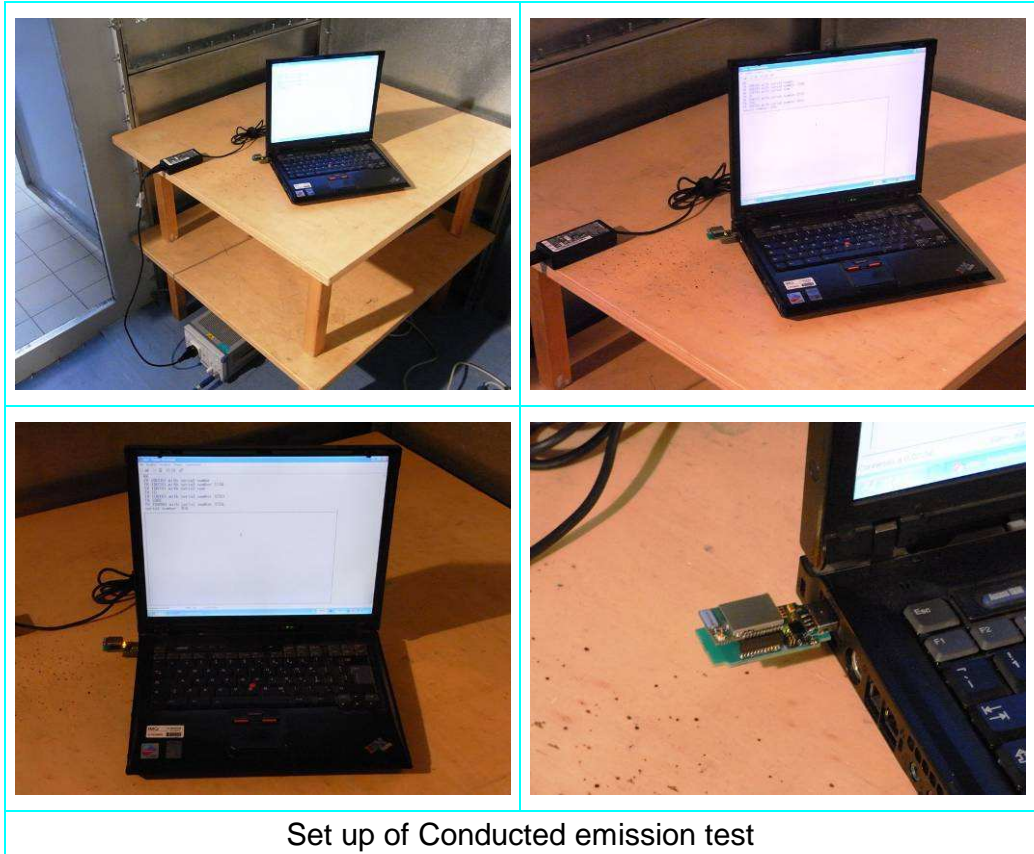
8.2 TEST SET-UP



Set up of Radiated emission test (ANTENNOVA antenna)



Set up of Radiated emission test (RAINSUN antenna)



9 MEASUREMENT AND TEST EQUIPMENT INSTRUMENTATION

Instruments	Manufacturer	Model	IMQ serial number	Calibration data	Calibration interval (Month)
Emi Receiver	Rohde & Schwarz	ESHS	S-03494	05/2010	18
Emi Receiver	Rohde & Schwarz	ESCI	S-04355	01/2010	12
Artificial Mains V-network	Rohde & Schwarz	ESH3-Z5	S-02122	04/2010	12
Spectrum Analyzer	Rohde & Schwarz	FSP40	S-03629	11/2009	24
Loop Antenna	Rohde & Schwarz	HFH2-Z2	S-02508	12/2008	24
Antenna Bilog	ARA	LPD-2513	S-02385	07/2009	24
Antenna ridged horn 1÷18 GHz	Schwarzbeck	BBHA9120D	S-03464	02/2009	24
Antenna ridged horn 15÷40 GHz	Schwarzbeck	BBHA9170	S-03668	05/2010	24
Pre-amplifier 1-26.5 GHz	HP	HP 8449 B	S-03542	07/2010	24
Pre-amplifier 30-1000 MHz	BONN ELEKTRONIK	BLNA	S-04193	12/2008	24
Digital Oscilloscope	Yokogawa	DL7200	S-03745	05/2010	12
Band Reject Filter 2400÷2483 MHz	Wainwright	WRCG2400 / 2483	S-04308	/	/
Highpass Filter 3.4÷18 GHz	Wainwright	WHK3.4/18	S-04309	/	/
Crystal Detector	Agilent	8472B	S-04467	/	/
Software for test automation	Rohde & Schwarz	ES-K1 V.1.60	/	/	/

The IMQ instruments are tested and calibrated according to UNI EN 45001, the IMQ procedure IP-037 "Calibration test equipment and measurement" and according to plans set on IMQ operating instruction IO-FT-034 "Criteria for the calibration of test equipment and measurement" which are an integral part of the Quality Manual of IMQ.