



EMI - TEST REPORT

- FCC 15.247 -

Type / Model Name : ARU4-ELC-U6 and ARU4-RS2-U6

Product Description : UHF RFID Reader

Applicant : KATHREIN Sachsen GmbH

Address : Lindenstrasse 6
D – 09241 Mühlau

Manufacturer : KATHREIN Sachsen GmbH

Address : Lindenstrasse 6
D – 09241 Mühlau

Licence holder : KATHREIN Sachsen GmbH

Address : Lindenstrasse 6
D – 09241 Mühlau

Test Result according to the standards listed in clause 1 test standards:

POSITIVE

Test Report No. : T39472-00-00HU

21. April 2015

Date of issue



Deutsche
Akkreditierungsstelle
D-PL-12030-01-01
D-PL-12030-01-02

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test results
without the written permission of the test laboratory.

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1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15, Subpart A - General (October, 2014)

Part 15, Subpart A, Section 15.31	Measurement standards
Part 15, Subpart A, Section 15.33	Frequency range of radiated measurements
Part 15, Subpart A, Section 15.35	Measurement detector functions and bandwidths

FCC Rules and Regulations Part 15, Subpart B - Unintentional Radiators (October, 2014)

Part 15, Subpart B, Section 15.107	AC Line conducted emissions,
Part 15, Subpart B, Section 15.109	Radiated emissions, general requirements

FCC Rules and Regulations Part 15, Subpart C - Intentional Radiators (October, 2014)

Part 15, Subpart C, Section 15.203	Antenna requirement
Part 15, Subpart C, Section 15.204	External radio frequency power amplifiers and antenna modifications
Part 15, Subpart C, Section 15.205	Restricted bands of operation
Part 15, Subpart C, Section 15.207	Conducted limits
Part 15, Subpart C, Section 15.209	Radiated emission limits, general requirements
Part 15, Subpart C, Section 15.247	Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz and 5725 - 5850 MHz

FCC Rules and Regulations Part 1, Subpart I - Procedures Implementing the National Environmental Policy Act of 1969

Part 1, Subpart I, Section 1.1310	Radiofrequency radiation exposure limits
Part 1, Subpart 2, Section 2.1093	Radiofrequency radiation exposure evaluation: portable device

OET Bulletin 65, 65A, 65B, 65C Edition 97-01, August 1997 – Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.

ANSI C63.10: 2009	Testing Unlicensed Wireless Devices
ANSI C95.1:1992	IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz
CISPR 16-4-2: 2003	Uncertainty in EMC measurement
CISPR 22: 2005 EN 55022: 2006	Information technology equipment

2 SUMMARY

GENERAL REMARKS:

The frequency range was scanned from 9 kHz to 10 GHz.

All emissions not reported in this test report were more than 10 dB below the specified limit.

The EuT is a frequency hopping system using 52 channels in the frequency band from 902 to 928 MHz.

The device transmits to each antenna in turn (not all at the same time). This function is controlled via software from the manufacturer and can not be changed from the user.

ARU4-ELC-U6:

All tests were performed with the following antenna type and power supply:

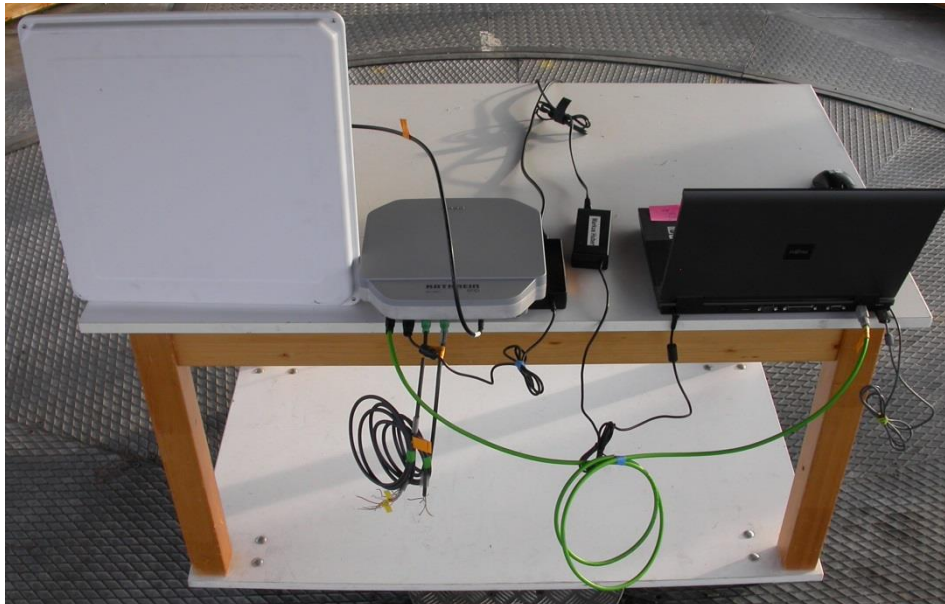
- Antenna: 52010252 Wi-Ra Antenna 40°/40°, linear, FCC (Antenna Gain 13 dBi)
- Power supply: GS90A24, S/N: EB3B92208

ARU4-RS2-U6:

Partly test was performed with the following antenna type and power supply:

- Antenna: Internal (Antenna Gain < 6.0 dBi)
- Power supply: GS90A24, S/N: EB3B92208

Test Setup ARU4-ELC-U6:



FCC ID: WJ9-ARU4ELCU6**Test Setup ARU4-RS2-U6:**

For detailed information about the UHF RFID Reader and the antennas please refer to the user manual.

The EuT is declared as Class B digital device.

It is not possible to set the EuT only in receiving mode.

FINAL ASSESSMENT:

The equipment under test **fulfills** the EMI requirements cited in clause 1 test standards.

Date of receipt of test sample : acc. to storage records

Testing commenced on : 23. March 2015

Testing concluded on : 26. March 2015

Checked by:



Klaus Gegenfurtner
I confirm the correctness
and integrity of this
documents
2015.04.21 08:38:41
+02'00'

Klaus Gegenfurtner
Teamleader Radio

Tested by:



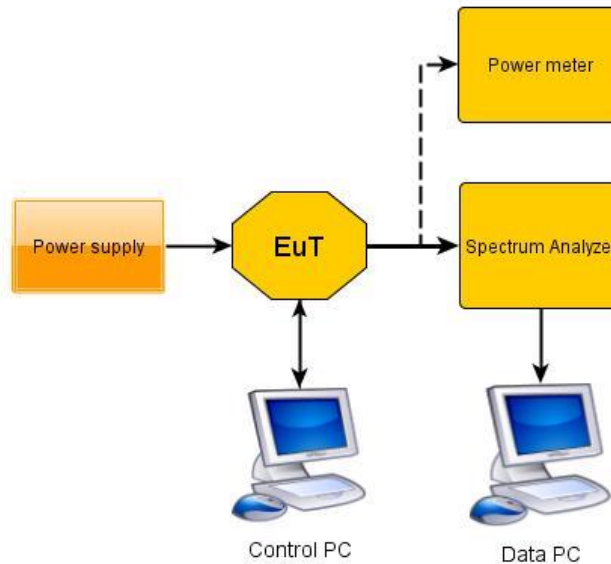
Markus Huber
I'm the author of
this document
2015.04.21
08:27:30 +02'00'

Markus Huber

3 EQUIPMENT UNDER TEST

3.1 Photo documentation of the EUT – Detailed photos see Attachment A

3.2 Test setup



3.3 Power supply system utilised

Power supply voltage: : 100-240 V / 50-60 Hz / 1 ϕ , 24.0 V DC

3.4 Short description of the EUT

The EuT is a UHF RFID reader system. It can read active and passive Tags in the frequency range from 902 to 928 MHz.

Number of tested samples: 1
Serial number: Prototype

EUT operation mode:

The equipment under test was operated during the measurement under the following conditions:

- TAG reading mode supplying 30.0 dBm

- TAG reading mode supplying 23.0 dBm

- Standby mode

-

FCC ID: WJ9-ARU4ELCU6**EUT configuration:**

The following peripheral devices and interface cables were connected during the measurements:

- | | |
|----------------------------|---|
| - <u>Test software</u> | Model : <u>Supplied by manufacturer</u> |
| - <u>Lap Top</u> | Model : <u>Supplied by CSA Group Bayern GmbH</u> |
| - <u>Antenna</u> | Model : <u>52010252 Wi-Ra Antenna 40°/40°, linear FCC</u> |
| - <u>Power supply</u> | Model : <u>GS90A24, S/N: EB3B92208</u> |
| - _____ | Model : _____ |
| - _____ | Model : _____ |
| - _____ | Model : _____ |
| - _____ | Model : _____ |
| - customer specific cables | |

4 TEST ENVIRONMENT

4.1 Address of the test laboratory

**CSA Group Bayern GmbH
Ohmstrasse 1-4
94342 STRASSKIRCHEN
GERMANY**

4.2 Statement regarding the usage of logos in test reports

The accreditation and notification body logos displayed in this test report are only valid for standards listed in the accreditation or notification scope of CSA Group Bayern GmbH.

4.3 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature: 15-35 ° C

Humidity: 30-60 %

Atmospheric pressure: 86-106 kPa

4.4 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. It is noted that the expanded measurement uncertainty corresponds to the measurement results from the standard measurement uncertainty multiplied by the coverage factor $k = 2$. The true value is located in the corresponding interval with a probability of 95 %. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16-4-2 / 11.2003 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements“ and is documented in the quality system acc. to DIN EN ISO/IEC 17025. For all measurements shown in this report, the measurement uncertainty of the test laboratory, CSA Group Bayern GmbH, is below the measurement uncertainty as defined by CISPR. Therefore, no special measures must be taken into consideration with regard to the limits according to CISPR. 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.

4.5 Measurement Protocol for FCC, VCCI and AUSTEL

4.5.1 GENERAL INFORMATION

4.5.1.1 Test Methodology

Conducted and radiated disturbance testing is performed according to the procedures set out by the International Special Committee on Radio Interference (CISPR) Publication 22, European Standard EN 55022 as shown under section 1 of this report.

The test methods used comply with CISPR Publication 22, EN 55022 - "Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement" and with ANSI C63.10: 2009, Testing Unlicensed Wireless Devices."

In compliance with 47 CFR Part 15 Subpart A, Section 15.38 testing for FCC compliance may be achieved by following the procedures set out in ANSI C63.4 and applying the CISPR 22 limits.

4.5.1.2 Justification

The Equipment Under Test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral using the appropriate impedance characteristic or left unterminated. Where appropriate, cables are manually manipulated with respect to each other thus obtaining maximum disturbances from the unit.

4.5.1.3 Determination of worst case measurement conditions

All cables were connected during the test on both samples.

ARU4-ELC-U6:

All tests were performed with following antenna type and power supply:

- Antenna: 52010252 Wi-Ra Antenna 40°/40°, linear, FCC
- Power supply: GS90A24, S/N: EB3B92208
- All tests were performed with this UHF RFID Reader

ARU4-RS2-U6:

Partly tests were performed with following antenna type and power supply:

- Antenna: Internal
- Power supply: GS90A24, S/N: EB3B92208
- Following test were performed with 30 dBm
 - o Conducted Emissions
 - o Spurious radiated emissions

All conducted test were performed with the GS90A24 supply and an external 20 dB/50 W attenuator (02-02/50-14-016) and antenna cable (02-02/50-14-002).

FCC ID: WJ9-ARU4ELCU6

Declaration of the manufacturer:

device: RFID Reader
devicename: ARU-RS2-U6
articlenumber: 52010122-A00
manufacturer: Kathrein Sachsen GmbH

compare partslist: *ARU4-ELC-U6vsARU-RS2-U6.xls*

date: 17.03.2015

To derive the ARU-RS2-U6 (52010122) from the ARU4-ELC-U6 (52010271) the device was electrically changed according to the following list:

- the modul 168b075 (embeded linux with ethernet interface) was replaced by the Module 136b302 (RS232 - interface)
- the GPIO modul 136b278 and the connector where cancelled from the partslist
- the number of antenna connectors was reduced from 4 to 1
- the coding of the COM port was changed

There are no changes made at the rf modul. Neither frequency nor gain where subject to the above mentioned changes to derive the 52010122 from the 52010271. The radio module of both readers is identical.

FCC ID: WJ9-ARU4ELCU6

5 TEST CONDITIONS AND RESULTS

5.1 Conducted emissions

For test instruments and accessories used see section 6 Part A 4.

5.1.1 Description of the test location

Test location: Shielded Room S2

5.1.2 Photo documentation of the test set-up

ARU4-ELC-U6:



ARU4-RS2-U6:



FCC ID: WJ9-ARU4ELCU6

5.1.3 Applicable standard

According to FCC Part 15C, Section 15.207(a):

Except as shown in paragraphs (b) and (c) of this Section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of Emission (MHz)	Conducted Limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency

5.1.4 Description of Measurement

The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi-peak detection and a line impedance stabilization network (LISN) with 50 Ω/50 μH (CISPR 16) characteristics. Table top equipment is placed on a non-conducting table 80 centimetres above the floor and is positioned 40 centimetres from the vertical ground plane (wall) of the screen room. If the minimum limit margin appears to be less than 20 dB with a peak mode measurement, the emissions are remeasured using a tuned receiver with quasi-peak and average detection and recorded.

To convert between dBμV and μV, the following conversions apply:

$$\text{dB}\mu\text{V} = 20 \log \mu\text{V}$$

$$\mu\text{V} = 10^{(\text{dB}\mu\text{V}/20)}$$

5.1.5 Test result

ARU4-ELC-U6:

Frequency range: 0.15 MHz - 30 MHz
Min. limit margin 13.26 dB at 0.462 MHz

ARU4-RS2-U6:

Frequency range: 0.15 MHz - 30 MHz
Min. limit margin 13.57 dB at 0.453 MHz

The requirements are **FULFILLED**.

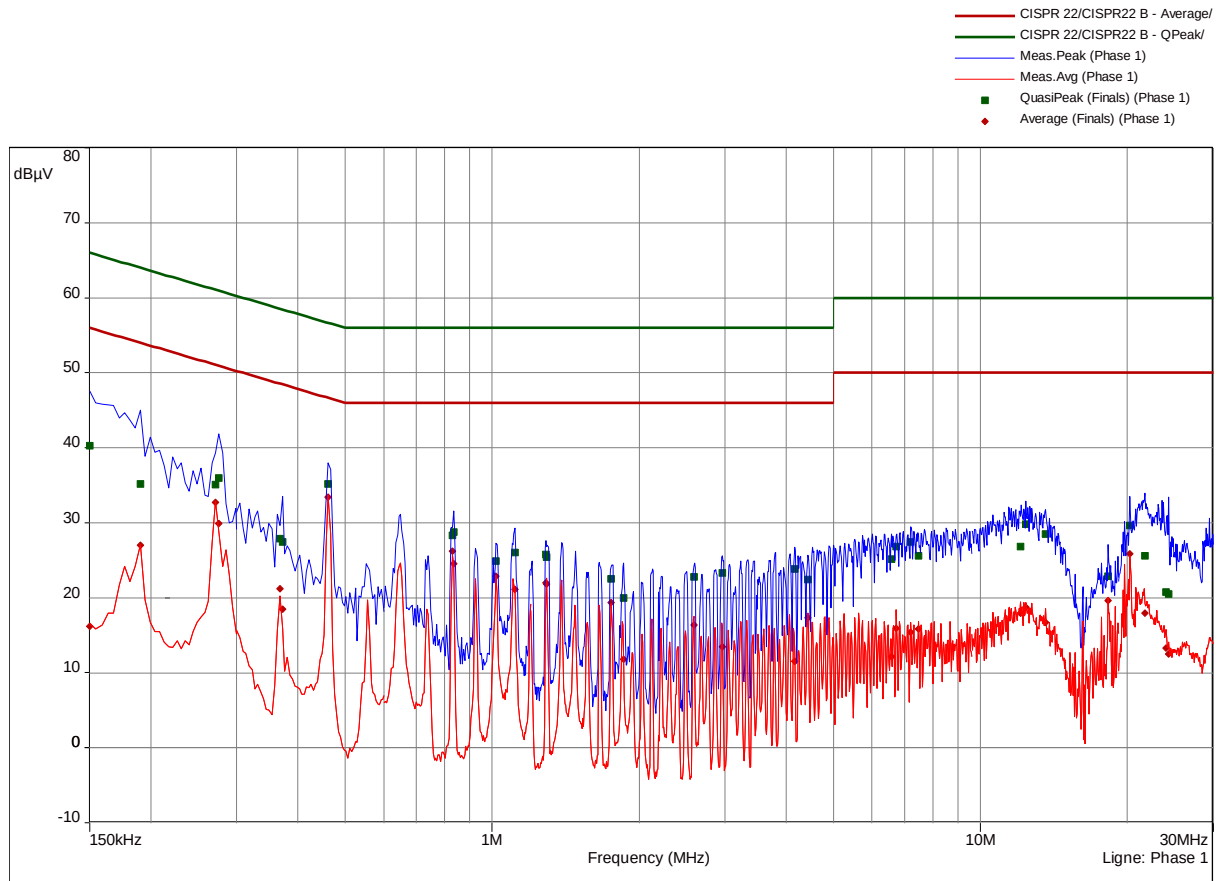
Remarks: For detailed test result please refer to following test protocols.

FCC ID: WJ9-ARU4ELCU6

5.1.6 Test protocol

Test point: L1
Operation mode: Tag reading mode
Remarks: ARU4-ELC-U6

Result: Passed



CISPR 22/CISPR22B

freq	SR	QP	margin	limit	AV	margin	limit	line	corr
MHz		dB(μV)	dB	dB	dB(μV)	dB	dB		dB
0.15	1	40.27	25.73	66.00	16.16	39.84	56.00	Phase 1	9.84
0.1905	1	35.18	28.83	64.01	26.98	27.04	54.01	Phase 1	9.83
0.2715	1	35.07	26.00	61.07	32.72	18.36	51.07	Phase 1	9.82
0.276	1	35.97	24.97	60.94	29.87	21.06	50.94	Phase 1	9.82
0.3675	2	27.86	30.69	58.56	21.23	27.33	48.56	Phase 1	9.81
0.372	2	27.44	31.02	58.46	18.46	30.00	48.46	Phase 1	9.81
0.462	2	35.20	21.46	56.66	33.40	13.26	46.66	Phase 1	9.81
0.8295	3	28.31	27.69	56.00	26.23	19.77	46.00	Phase 1	9.80
0.834	3	28.79	27.21	56.00	24.53	21.47	46.00	Phase 1	9.81

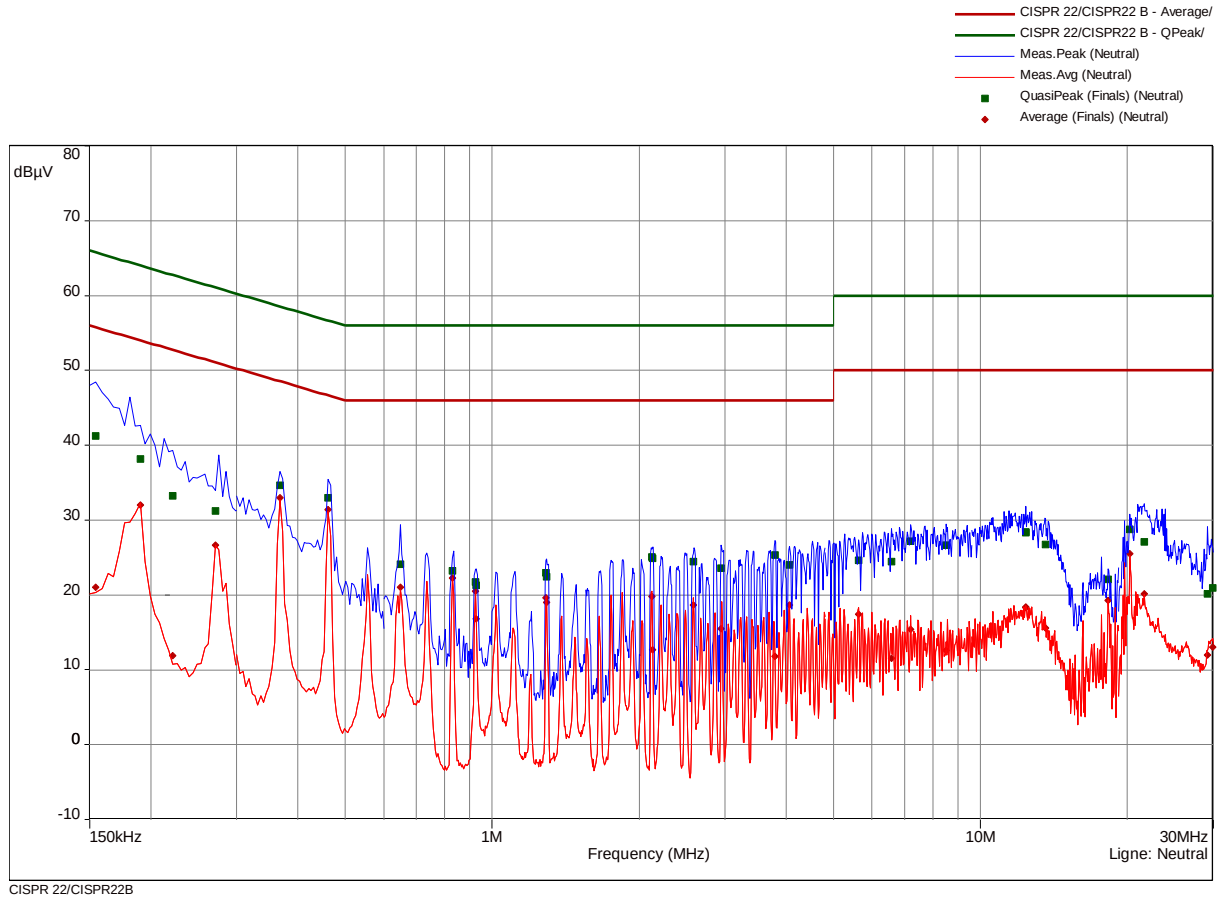
FCC ID: WJ9-ARU4ELCU6

freq MHz	SR	QP dB(μV)	margin dB	limit dB	AV dB(μV)	margin dB	limit dB	line	corr dB
1.0185	3	24.90	31.10	56.00	22.90	23.10	46.00	Phase 1	9.81
1.113	3	26.06	29.94	56.00	21.14	24.86	46.00	Phase 1	9.81
1.29	4	25.80	30.20	56.00	22.04	23.96	46.00	Phase 1	9.79
1.2945	4	25.40	30.60	56.00	21.81	24.19	46.00	Phase 1	9.79
1.7535	4	22.53	33.47	56.00	19.38	26.62	46.00	Phase 1	9.79
1.857	4	19.95	36.05	56.00	11.79	34.21	46.00	Phase 1	9.80
2.589	5	22.78	33.22	56.00	16.35	29.65	46.00	Phase 1	9.79
2.9625	5	23.33	32.67	56.00	13.51	32.49	46.00	Phase 1	9.79
4.1685	5	23.88	32.12	56.00	11.53	34.47	46.00	Phase 1	9.81
4.4295	5	22.46	33.54	56.00	17.35	28.65	46.00	Phase 1	9.81
6.5775	6	25.19	34.81	60.00	12.18	37.82	50.00	Phase 1	9.84
6.7305	6	26.79	33.21	60.00	15.95	34.05	50.00	Phase 1	9.84
7.203	6	27.43	32.57	60.00	15.38	34.62	50.00	Phase 1	9.85
7.4685	6	25.59	34.41	60.00	15.88	34.12	50.00	Phase 1	9.85
12.075	7	26.81	33.19	60.00	17.95	32.05	50.00	Phase 1	9.98
12.3855	7	29.86	30.14	60.00	18.75	31.25	50.00	Phase 1	10.00
13.5915	7	28.51	31.49	60.00	16.69	33.31	50.00	Phase 1	10.05
18.2445	7	22.88	37.12	60.00	19.59	30.41	50.00	Phase 1	10.25
20.2575	8	29.69	30.31	60.00	25.88	24.12	50.00	Phase 1	10.34
21.6975	8	25.57	34.43	60.00	17.92	32.08	50.00	Phase 1	10.34
24.0105	8	20.76	39.24	60.00	13.31	36.69	50.00	Phase 1	10.34
24.258	8	20.48	39.52	60.00	12.52	37.48	50.00	Phase 1	10.34

FCC ID: WJ9-ARU4ELCU6

Test point: N
Operation mode: Tag reading mode supplying
Remarks: ARU4-ELC-U6

Result: Passed



CISPR 22/CISPR22B

freq MHz	SR	QP dB(μV)	margin dB	limit dB	AV dB(μV)	margin dB	limit dB	line	corr dB
0.1545	9	41.24	24.51	65.75	21.06	34.70	55.75	Neutral	9.84
0.1905	9	38.14	25.87	64.01	32.00	22.01	54.01	Neutral	9.85
0.222	9	33.23	29.51	62.74	11.93	40.81	52.74	Neutral	9.84
0.2715	9	31.25	29.83	61.07	26.62	24.45	51.07	Neutral	9.83
0.3675	10	34.69	23.87	58.56	32.97	15.58	48.56	Neutral	9.81
0.462	10	33.00	23.66	56.66	31.38	15.27	46.66	Neutral	9.81
0.6495	11	24.13	31.87	56.00	21.02	24.98	46.00	Neutral	9.81
0.8295	11	23.21	32.79	56.00	22.23	23.77	46.00	Neutral	9.80
0.924	11	21.76	34.24	56.00	20.50	25.50	46.00	Neutral	9.81
0.9285	11	21.26	34.74	56.00	16.85	29.15	46.00	Neutral	9.81

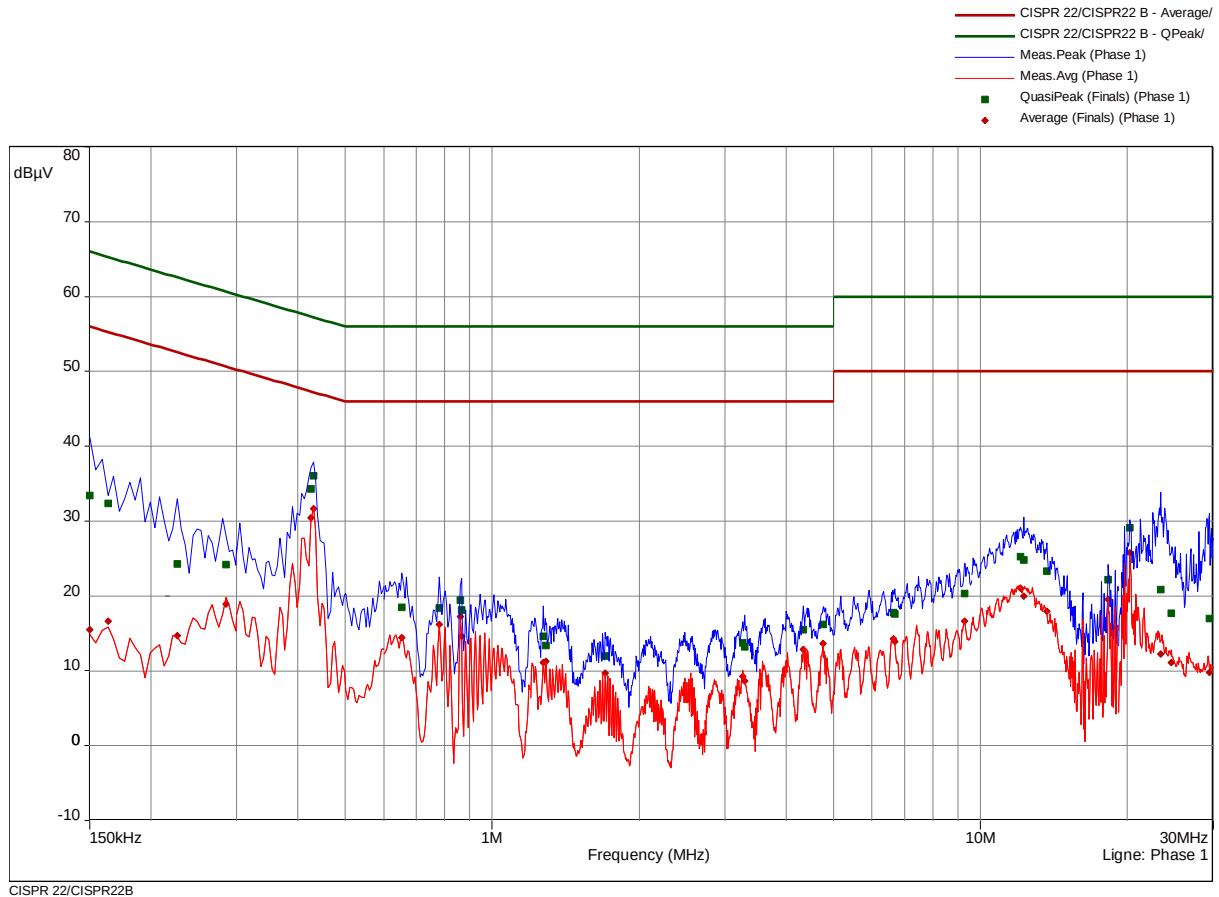
FCC ID: WJ9-ARU4ELCU6

freq MHz	SR	QP dB(μV)	margin dB	limit dB	AV dB(μV)	margin dB	limit dB	line	corr dB
1.29	12	23.00	33.00	56.00	19.62	26.38	46.00	Neutral	9.79
1.2945	12	22.43	33.57	56.00	19.02	26.98	46.00	Neutral	9.79
2.1225	12	25.05	30.95	56.00	19.78	26.22	46.00	Neutral	9.80
2.1315	12	24.91	31.09	56.00	12.70	33.30	46.00	Neutral	9.80
2.5845	13	24.46	31.54	56.00	18.70	27.30	46.00	Neutral	9.79
2.9445	13	23.58	32.42	56.00	15.51	30.49	46.00	Neutral	9.79
3.795	13	25.31	30.69	56.00	11.81	34.19	46.00	Neutral	9.81
4.0605	13	23.99	32.01	56.00	18.65	27.35	46.00	Neutral	9.80
5.6235	14	24.62	35.38	60.00	17.41	32.59	50.00	Neutral	9.81
6.573	14	24.47	35.53	60.00	11.54	38.46	50.00	Neutral	9.81
7.1985	14	27.22	32.78	60.00	15.44	34.56	50.00	Neutral	9.82
8.5125	14	26.70	33.30	60.00	12.63	37.37	50.00	Neutral	9.81
12.372	15	28.30	31.70	60.00	18.33	31.67	50.00	Neutral	9.87
12.3765	15	28.39	31.61	60.00	18.37	31.63	50.00	Neutral	9.87
13.5825	15	26.72	33.28	60.00	15.56	34.44	50.00	Neutral	9.90
18.2445	15	22.05	37.95	60.00	19.27	30.73	50.00	Neutral	10.05
20.2575	16	28.79	31.21	60.00	25.51	24.49	50.00	Neutral	10.12
21.6615	16	27.12	32.88	60.00	20.19	29.81	50.00	Neutral	10.06
29.199	16	20.19	39.81	60.00	11.98	38.02	50.00	Neutral	9.74
29.9325	16	20.98	39.02	60.00	13.00	37.00	50.00	Neutral	9.71

FCC ID: WJ9-ARU4ELCU6

Test point: L1
Operation mode: Standby mode
Remarks: ARU4-ELC-U6

Result: Passed



freq	SR	QP	margin	limit	AV	margin	limit	line	corr
MHz		dB(μV)	dB	dB	dB(μV)	dB	dB		dB
0.15	1	33.45	32.55	66.00	15.54	40.46	56.00	Phase 1	9.84
0.1635	1	32.36	32.93	65.28	16.63	38.66	55.28	Phase 1	9.84
0.2265	1	24.29	38.29	62.58	14.73	37.84	52.58	Phase 1	9.83
0.285	1	24.19	36.48	60.67	18.93	31.74	50.67	Phase 1	9.82
0.426	2	34.35	22.98	57.33	30.43	16.90	47.33	Phase 1	9.81
0.4305	2	36.02	21.22	57.24	31.64	15.60	47.24	Phase 1	9.81
0.654	3	18.48	37.52	56.00	14.43	31.57	46.00	Phase 1	9.81
0.78	3	18.41	37.59	56.00	16.20	29.80	46.00	Phase 1	9.80
0.861	3	19.49	36.51	56.00	17.21	28.79	46.00	Phase 1	9.81
0.8655	3	18.13	37.87	56.00	14.59	31.41	46.00	Phase 1	9.81

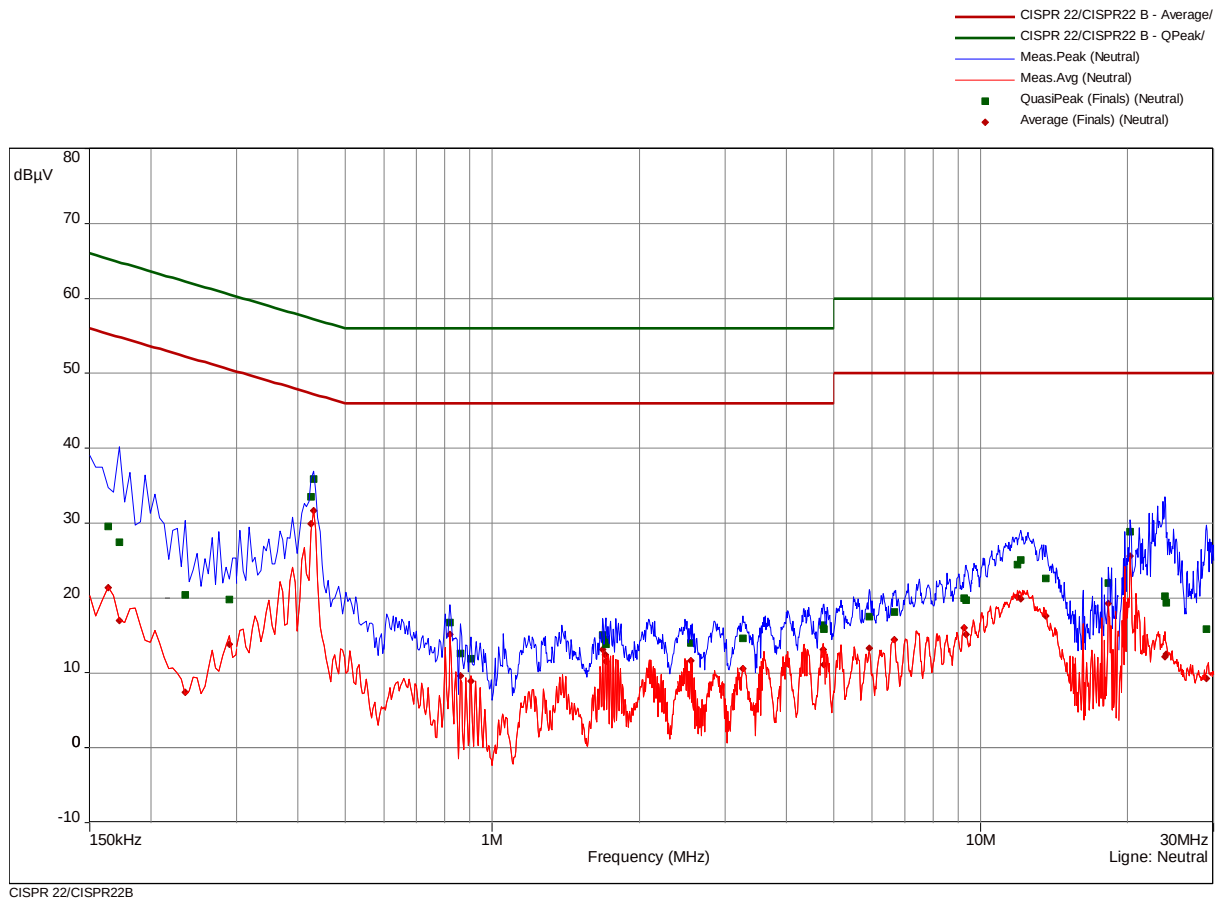
FCC ID: WJ9-ARU4ELCU6

freq MHz	SR	QP dB(μV)	margin dB	limit dB	AV dB(μV)	margin dB	limit dB	line	corr dB
1.272	4	14.64	41.36	56.00	11.08	34.92	46.00	Phase 1	9.79
1.29	4	13.40	42.60	56.00	11.30	34.70	46.00	Phase 1	9.79
1.704	4	11.95	44.05	56.00	9.67	36.33	46.00	Phase 1	9.79
3.264	5	13.72	42.28	56.00	9.29	36.71	46.00	Phase 1	9.81
3.2865	5	13.22	42.78	56.00	8.61	37.39	46.00	Phase 1	9.81
4.335	5	15.53	40.47	56.00	12.86	33.14	46.00	Phase 1	9.81
4.7625	5	16.18	39.82	56.00	13.62	32.38	46.00	Phase 1	9.82
6.6315	6	17.77	42.23	60.00	14.30	35.70	50.00	Phase 1	9.84
6.672	6	17.65	42.35	60.00	13.92	36.08	50.00	Phase 1	9.84
9.282	6	20.35	39.65	60.00	16.64	33.36	50.00	Phase 1	9.88
12.075	7	25.22	34.78	60.00	21.02	28.98	50.00	Phase 1	9.98
12.2595	7	24.84	35.16	60.00	19.94	30.06	50.00	Phase 1	9.99
13.6635	7	23.29	36.71	60.00	17.92	32.08	50.00	Phase 1	10.05
18.2445	7	22.14	37.86	60.00	19.51	30.49	50.00	Phase 1	10.25
20.2575	8	29.10	30.90	60.00	25.81	24.19	50.00	Phase 1	10.34
23.4075	8	20.82	39.18	60.00	12.24	37.76	50.00	Phase 1	10.34
24.618	8	17.65	42.35	60.00	11.07	38.93	50.00	Phase 1	10.35
29.4195	8	16.95	43.05	60.00	9.75	40.25	50.00	Phase 1	10.34

FCC ID: WJ9-ARU4ELCU6

Test point: N
Operation mode: Standby mode
Remarks: ARU4-ELC-U6

Result: Passed



freq	SR	QP	margin	limit	AV	margin	limit	line	corr
MHz		dB(μV)	dB	dB	dB(μV)	dB	dB		dB
0.1635	9	29.60	35.68	65.28	21.39	33.90	55.28	Neutral	9.84
0.1725	9	27.42	37.42	64.84	17.00	37.84	54.84	Neutral	9.85
0.2355	9	20.39	41.86	62.25	7.41	44.84	52.25	Neutral	9.84
0.2895	9	19.78	40.76	60.54	13.83	36.71	50.54	Neutral	9.82
0.426	10	33.55	23.78	57.33	29.88	17.45	47.33	Neutral	9.81
0.4305	10	35.85	21.39	57.24	31.67	15.57	47.24	Neutral	9.81
0.8205	11	16.76	39.24	56.00	15.16	30.84	46.00	Neutral	9.80
0.861	11	12.56	43.44	56.00	9.63	36.37	46.00	Neutral	9.81
0.906	11	11.92	44.08	56.00	8.91	37.09	46.00	Neutral	9.81

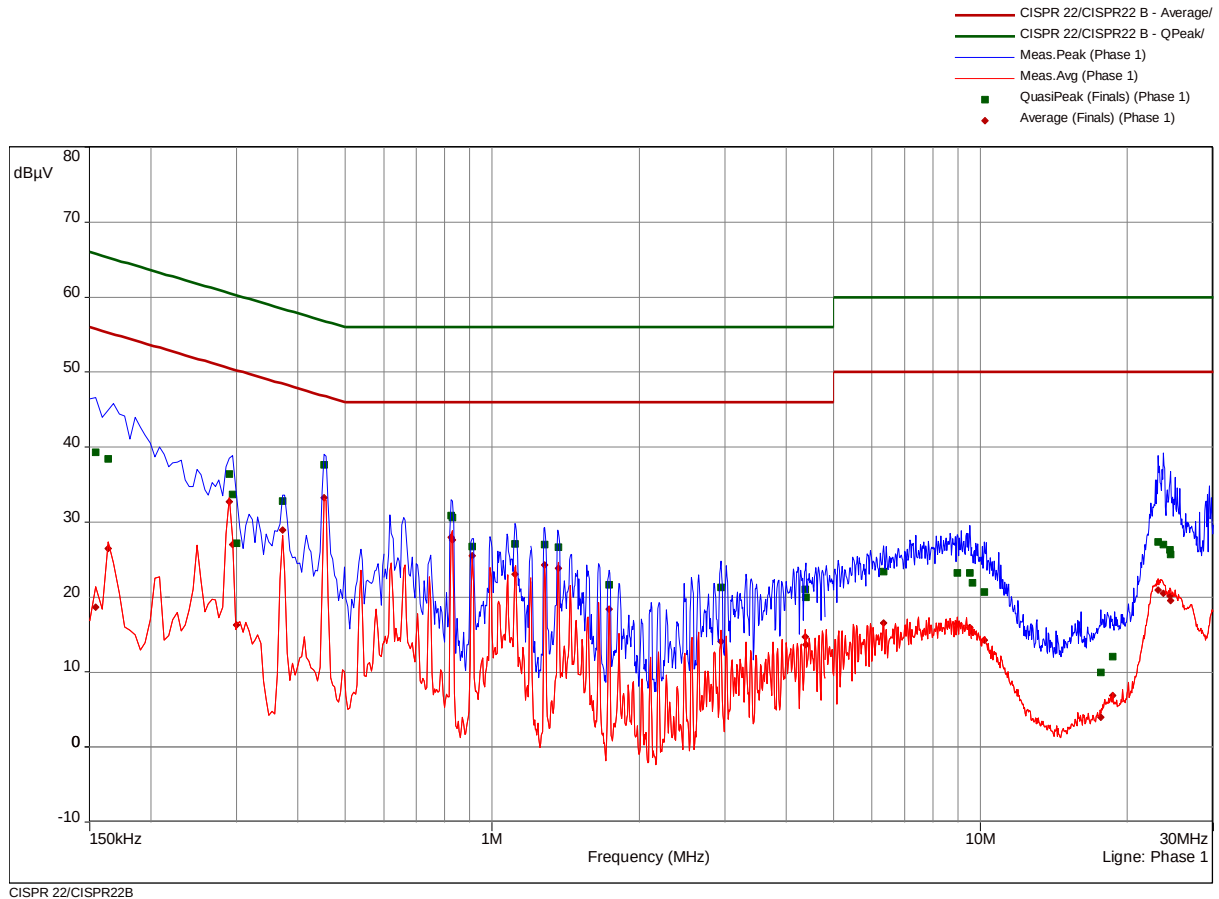
FCC ID: WJ9-ARU4ELCU6

freq MHz	SR	QP dB(μV)	margin dB	limit dB	AV dB(μV)	margin dB	limit dB	line	corr dB
1.686	12	15.01	40.99	56.00	13.09	32.91	46.00	Neutral	9.79
1.704	12	14.45	41.55	56.00	12.40	33.60	46.00	Neutral	9.79
1.7085	12	13.79	42.21	56.00	11.53	34.47	46.00	Neutral	9.79
2.5485	13	14.02	41.98	56.00	11.58	34.42	46.00	Neutral	9.79
3.264	13	14.61	41.39	56.00	10.62	35.38	46.00	Neutral	9.80
4.767	13	16.38	39.62	56.00	13.13	32.87	46.00	Neutral	9.81
4.7805	13	15.88	40.12	56.00	11.14	34.86	46.00	Neutral	9.81
5.916	14	17.54	42.46	60.00	13.33	36.67	50.00	Neutral	9.82
6.654	14	18.09	41.91	60.00	14.49	35.51	50.00	Neutral	9.81
9.264	14	20.00	40.00	60.00	16.06	33.94	50.00	Neutral	9.82
9.3495	14	19.71	40.29	60.00	15.18	34.82	50.00	Neutral	9.82
11.9085	15	24.48	35.52	60.00	20.19	29.81	50.00	Neutral	9.86
12.066	15	25.05	34.95	60.00	19.86	30.14	50.00	Neutral	9.87
13.605	15	22.64	37.36	60.00	17.64	32.36	50.00	Neutral	9.90
18.2445	15	21.98	38.02	60.00	19.25	30.75	50.00	Neutral	10.05
20.2575	16	28.84	31.16	60.00	25.57	24.43	50.00	Neutral	10.12
23.817	16	20.24	39.76	60.00	12.17	37.83	50.00	Neutral	9.97
24.015	16	19.36	40.64	60.00	12.50	37.50	50.00	Neutral	9.96
28.992	16	15.84	44.16	60.00	9.27	40.73	50.00	Neutral	9.75

FCC ID: WJ9-ARU4ELCU6

Test point L1
Operation mode: Tag reading mode
Remarks: ARU4-RS2-U6

Result: Passed



freq	SR	QP	margin	limit	AV	margin	limit	line	corr
MHz		dB(μV)	dB	dB	dB(μV)	dB	dB		dB
0.1545	1	39.30	26.45	65.75	18.65	37.11	55.75	Phase 1	9.84
0.1635	1	38.42	26.86	65.28	26.45	28.83	55.28	Phase 1	9.84
0.2895	1	36.38	24.16	60.54	32.76	17.78	50.54	Phase 1	9.82
0.294	1	33.72	26.69	60.41	27.04	23.37	50.41	Phase 1	9.82
0.3	2	27.18	33.07	60.24	16.29	33.95	50.24	Phase 1	9.82
0.372	2	32.81	25.64	58.46	28.93	19.52	48.46	Phase 1	9.81
0.453	2	37.66	19.16	56.82	33.25	13.57	46.82	Phase 1	9.81
0.825	3	30.91	25.09	56.00	27.96	18.04	46.00	Phase 1	9.80
0.8295	3	30.64	25.36	56.00	27.66	18.34	46.00	Phase 1	9.80
0.9105	3	26.76	29.24	56.00	25.49	20.51	46.00	Phase 1	9.81

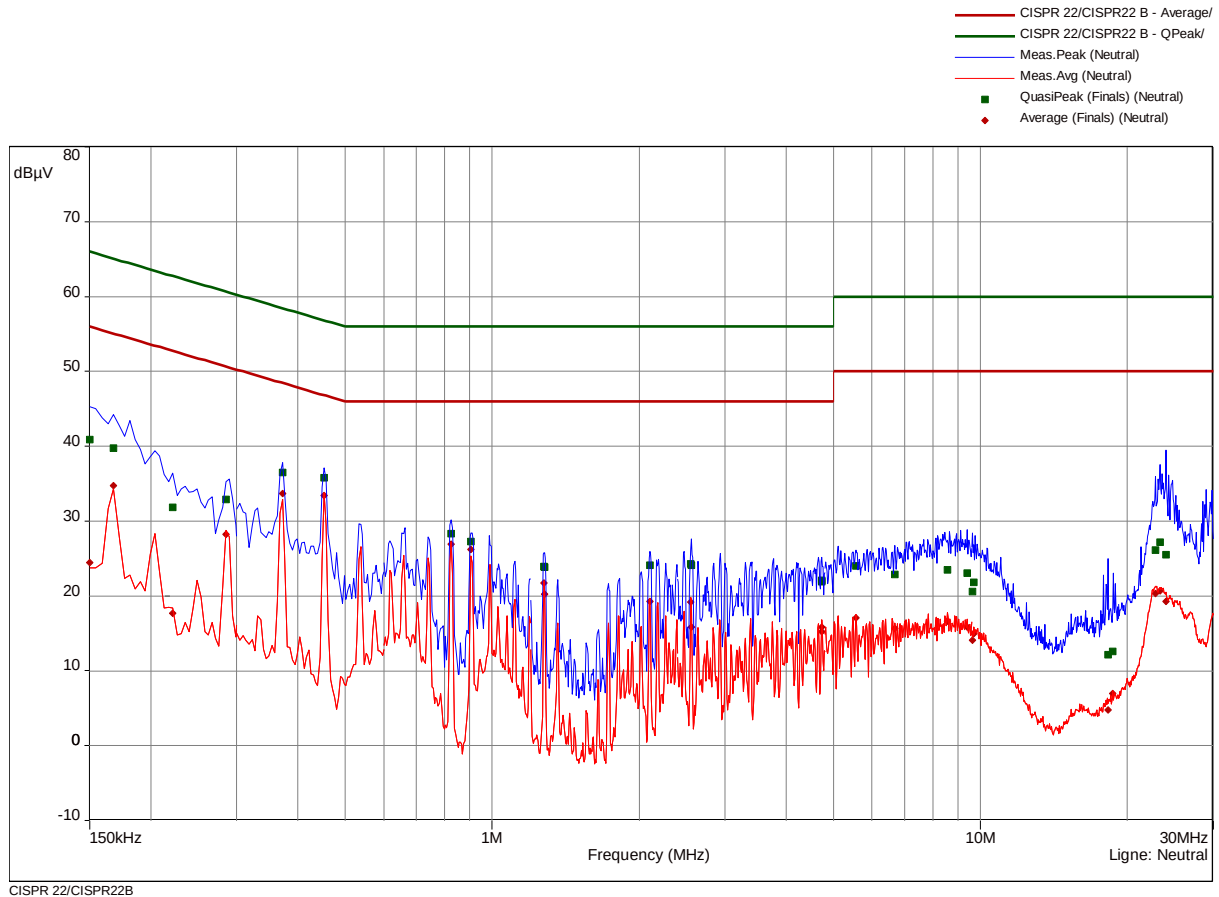
FCC ID: WJ9-ARU4ELCU6

freq MHz	SR	QP dB(μV)	margin dB	limit dB	AV dB(μV)	margin dB	limit dB	line	corr dB
1.113	3	27.14	28.86	56.00	23.09	22.91	46.00	Phase 1	9.81
1.281	4	27.04	28.96	56.00	24.32	21.68	46.00	Phase 1	9.79
1.3665	4	26.68	29.32	56.00	23.82	22.18	46.00	Phase 1	9.79
1.7355	4	21.68	34.32	56.00	18.38	27.62	46.00	Phase 1	9.79
2.94	5	21.28	34.72	56.00	14.10	31.90	46.00	Phase 1	9.79
4.3755	5	21.03	34.97	56.00	14.68	31.32	46.00	Phase 1	9.81
4.389	5	19.99	36.01	56.00	13.63	32.37	46.00	Phase 1	9.81
6.33	6	23.44	36.56	60.00	16.52	33.48	50.00	Phase 1	9.83
8.976	6	23.24	36.76	60.00	16.49	33.51	50.00	Phase 1	9.88
9.5115	6	23.22	36.78	60.00	15.94	34.06	50.00	Phase 1	9.89
9.6225	7	21.87	38.13	60.00	15.34	34.66	50.00	Phase 1	9.89
10.194	7	20.72	39.28	60.00	14.24	35.76	50.00	Phase 1	9.91
17.637	7	9.99	50.01	60.00	4.01	45.99	50.00	Phase 1	10.22
18.6855	7	12.07	47.93	60.00	6.88	43.12	50.00	Phase 1	10.27
23.1285	8	27.33	32.67	60.00	20.94	29.06	50.00	Phase 1	10.33
23.673	8	27.05	32.95	60.00	20.49	29.51	50.00	Phase 1	10.34
24.429	8	26.27	33.73	60.00	20.13	29.87	50.00	Phase 1	10.34
24.51	8	25.67	34.33	60.00	19.57	30.43	50.00	Phase 1	10.35

FCC ID: WJ9-ARU4ELCU6

Test point: N
 Operation mode: Tag reading mode
 Remarks: ARU4-RS2-U6

Result: Passed



freq MHz	SR	QP dB(μV)	margin dB	limit dB	AV dB(μV)	margin dB	limit dB	line	corr dB
0.15	9	40.89	25.11	66.00	24.49	31.51	56.00	Neutral	9.84
0.168	9	39.71	25.35	65.06	34.72	20.34	55.06	Neutral	9.84
0.222	9	31.88	30.86	62.74	17.67	35.08	52.74	Neutral	9.84
0.285	9	32.88	27.79	60.67	28.27	22.40	50.67	Neutral	9.82
0.372	10	36.49	21.97	58.46	33.71	14.74	48.46	Neutral	9.81
0.453	10	35.79	21.03	56.82	33.45	13.37	46.82	Neutral	9.81
0.825	11	28.31	27.69	56.00	26.94	19.06	46.00	Neutral	9.80
0.906	11	27.31	28.69	56.00	26.18	19.82	46.00	Neutral	9.81

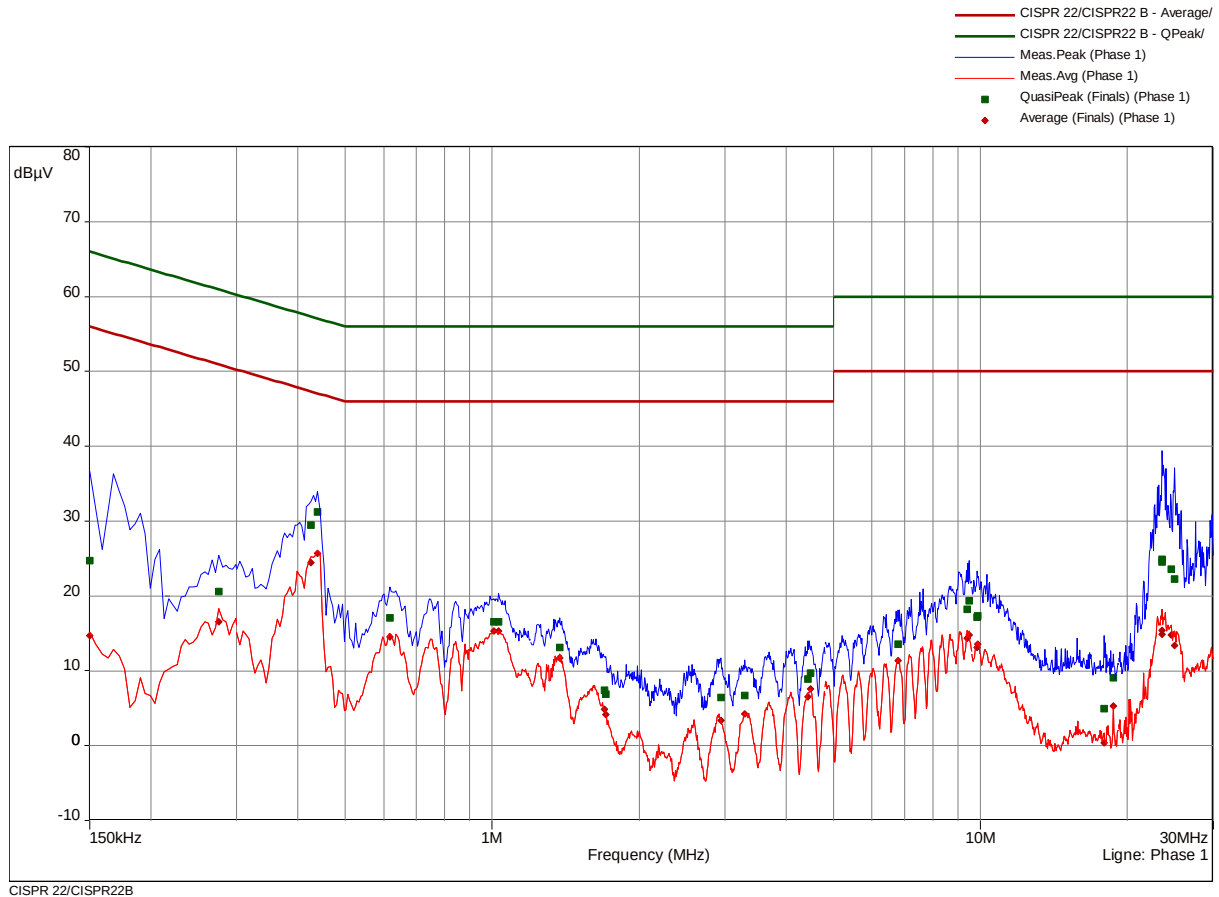
FCC ID: WJ9-ARU4ELCU6

freq MHz	SR	QP dB(μV)	margin dB	limit dB	AV dB(μV)	margin dB	limit dB	line	corr dB
1.2765	12	23.91	32.09	56.00	21.73	24.27	46.00	Neutral	9.79
1.281	12	23.83	32.17	56.00	20.22	25.78	46.00	Neutral	9.79
2.1045	12	24.13	31.87	56.00	19.25	26.75	46.00	Neutral	9.80
2.553	13	24.31	31.69	56.00	19.20	26.80	46.00	Neutral	9.79
2.562	13	24.11	31.89	56.00	15.89	30.11	46.00	Neutral	9.79
4.731	13	22.09	33.91	56.00	15.23	30.77	46.00	Neutral	9.81
4.74	13	21.92	34.08	56.00	15.81	30.19	46.00	Neutral	9.81
5.5605	14	24.04	35.96	60.00	17.11	32.89	50.00	Neutral	9.81
6.681	14	22.91	37.09	60.00	15.69	34.31	50.00	Neutral	9.81
8.5665	14	23.48	36.52	60.00	16.64	33.36	50.00	Neutral	9.81
9.3945	14	23.02	36.98	60.00	15.86	34.14	50.00	Neutral	9.82
9.6225	15	20.57	39.43	60.00	14.06	35.94	50.00	Neutral	9.83
9.699	15	21.78	38.22	60.00	15.00	35.00	50.00	Neutral	9.83
18.24	15	12.12	47.88	60.00	4.75	45.25	50.00	Neutral	10.05
18.663	15	12.62	47.38	60.00	6.95	43.05	50.00	Neutral	10.07
22.7955	16	26.12	33.88	60.00	20.30	29.70	50.00	Neutral	10.01
23.349	16	27.19	32.81	60.00	20.70	29.30	50.00	Neutral	9.99
24.0195	16	25.56	34.44	60.00	19.23	30.77	50.00	Neutral	9.96

FCC ID: WJ9-ARU4ELCU6

Test point: L1
Operation mode: Standby mode
Remarks: ARU4-RS2-U6

Result: Passed



freq	SR	QP	margin	limit	AV	margin	limit	line	corr
MHz		dB(μV)	dB	dB	dB(μV)	dB	dB		dB
0.15	1	24.76	41.24	66.00	14.71	41.29	56.00	Phase 1	9.84
0.276	1	20.63	40.31	60.94	16.53	34.40	50.94	Phase 1	9.82
0.426	2	29.43	27.90	57.33	24.48	22.85	47.33	Phase 1	9.81
0.4395	2	31.19	25.88	57.07	25.71	21.37	47.07	Phase 1	9.81
0.618	3	17.10	38.90	56.00	14.54	31.46	46.00	Phase 1	9.81

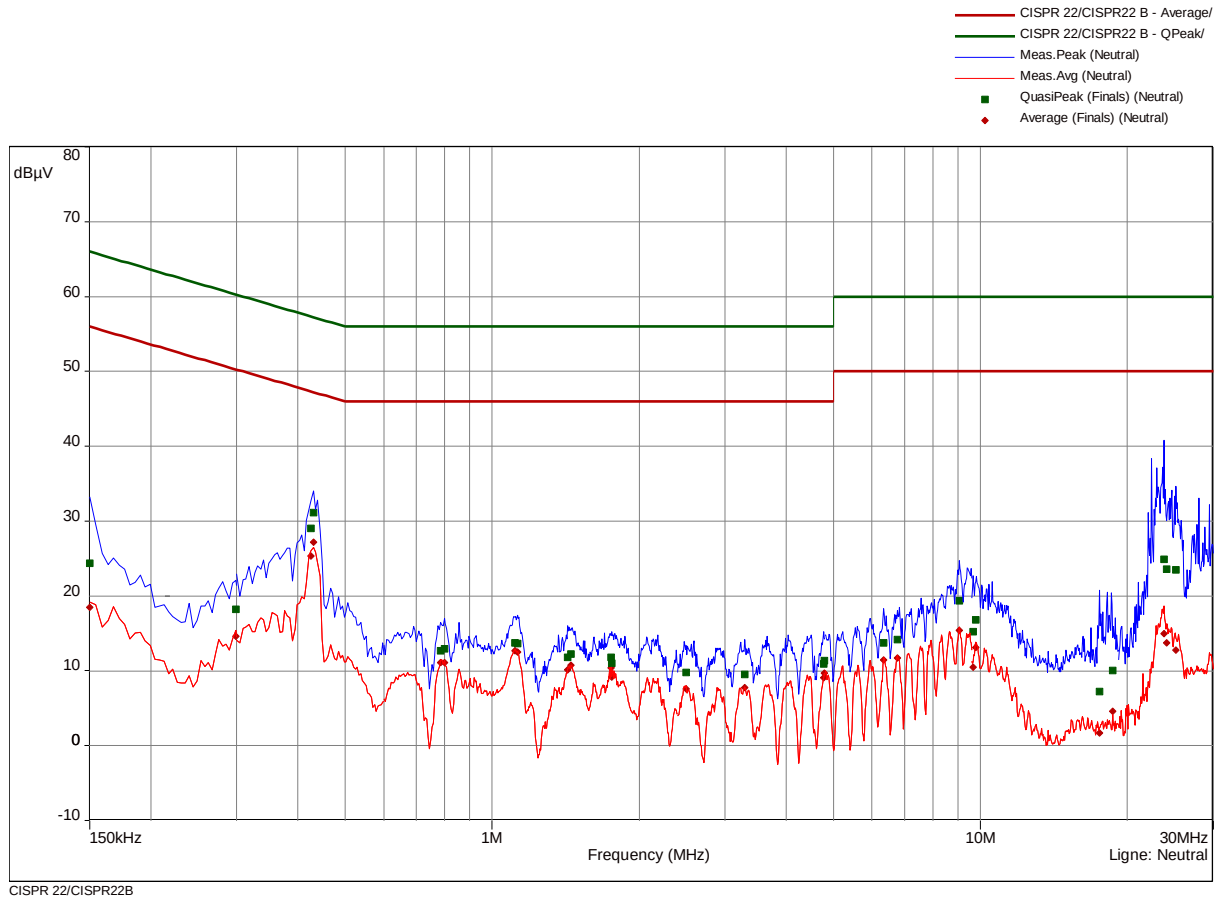
FCC ID: WJ9-ARU4ELCU6

freq MHz	SR	QP dB(μV)	margin dB	limit dB	AV dB(μV)	margin dB	limit dB	line	corr dB
1.0095	3	16.53	39.47	56.00	15.36	30.64	46.00	Phase 1	9.81
1.032	3	16.52	39.48	56.00	15.32	30.68	46.00	Phase 1	9.81
1.3755	4	13.15	42.85	56.00	11.68	34.32	46.00	Phase 1	9.79
1.6995	4	7.41	48.59	56.00	4.84	41.16	46.00	Phase 1	9.79
1.7085	4	6.87	49.13	56.00	4.12	41.88	46.00	Phase 1	9.79
2.94	5	6.43	49.57	56.00	3.39	42.61	46.00	Phase 1	9.79
3.2955	5	6.75	49.25	56.00	4.22	41.78	46.00	Phase 1	9.81
4.4295	5	8.93	47.07	56.00	6.57	39.43	46.00	Phase 1	9.81
4.4835	5	9.67	46.33	56.00	7.61	38.39	46.00	Phase 1	9.81
6.7755	6	13.60	46.40	60.00	11.34	38.66	50.00	Phase 1	9.84
9.3855	6	18.18	41.82	60.00	14.31	35.69	50.00	Phase 1	9.89
9.4755	6	19.39	40.61	60.00	14.82	35.18	50.00	Phase 1	9.89
9.834	7	17.18	42.82	60.00	13.12	36.88	50.00	Phase 1	9.90
9.87	7	17.37	42.63	60.00	13.53	36.47	50.00	Phase 1	9.90
17.9205	7	4.95	55.05	60.00	0.36	49.64	50.00	Phase 1	10.23
18.7305	7	9.06	50.94	60.00	5.27	44.73	50.00	Phase 1	10.27
23.5515	8	24.91	35.09	60.00	15.39	34.61	50.00	Phase 1	10.34
23.5875	8	24.56	35.44	60.00	14.85	35.15	50.00	Phase 1	10.34
24.6135	8	23.58	36.42	60.00	14.81	35.19	50.00	Phase 1	10.35
24.978	8	22.23	37.77	60.00	13.40	36.60	50.00	Phase 1	10.36

FCC ID: WJ9-ARU4ELCU6

Test point: N
Operation mode: Standby mode
Remarks: ARU4-RS2-U6

Result: Passed



freq	SR	QP	margin	limit	AV	margin	limit	line	corr
MHz		dB(μV)	dB	dB	dB(μV)	dB	dB		dB
0.15	9	24.37	41.63	66.00	18.51	37.49	56.00	Neutral	9.84
0.2985	9	18.23	42.05	60.28	14.58	35.70	50.28	Neutral	9.82
0.426	10	29.04	28.29	57.33	25.31	22.02	47.33	Neutral	9.81
0.4305	10	31.11	26.14	57.24	27.19	20.05	47.24	Neutral	9.81
0.7845	11	12.66	43.34	56.00	11.14	34.86	46.00	Neutral	9.80
0.798	11	12.94	43.06	56.00	11.12	34.88	46.00	Neutral	9.80

FCC ID: WJ9-ARU4ELCU6

freq MHz	SR	QP dB(μV)	margin dB	limit dB	AV dB(μV)	margin dB	limit dB	line	corr dB
1.113	11	13.76	42.24	56.00	12.71	33.29	46.00	Neutral	9.81
1.1265	11	13.66	42.34	56.00	12.48	33.52	46.00	Neutral	9.80
1.4295	12	11.78	44.22	56.00	10.17	35.83	46.00	Neutral	9.78
1.452	12	12.26	43.74	56.00	10.71	35.29	46.00	Neutral	9.78
1.7535	12	11.84	44.16	56.00	10.42	35.58	46.00	Neutral	9.79
1.758	12	11.05	44.95	56.00	9.20	36.80	46.00	Neutral	9.79
2.4945	13	9.75	46.25	56.00	7.61	38.39	46.00	Neutral	9.79
3.291	13	9.56	46.44	56.00	7.74	38.26	46.00	Neutral	9.80
4.7805	13	10.93	45.07	56.00	9.05	36.95	46.00	Neutral	9.81
4.7985	13	11.33	44.67	56.00	9.66	36.34	46.00	Neutral	9.81
6.3435	14	13.76	46.24	60.00	11.43	38.57	50.00	Neutral	9.81
6.753	14	14.18	45.82	60.00	11.72	38.28	50.00	Neutral	9.81
9.066	14	19.33	40.67	60.00	15.43	34.57	50.00	Neutral	9.82
9.6765	15	15.23	44.77	60.00	10.51	39.49	50.00	Neutral	9.83
9.78	15	16.79	43.21	60.00	13.12	36.88	50.00	Neutral	9.83
17.547	15	7.26	52.74	60.00	1.71	48.29	50.00	Neutral	10.02
18.681	15	10.07	49.93	60.00	4.61	45.39	50.00	Neutral	10.07
23.7945	16	24.92	35.08	60.00	14.93	35.07	50.00	Neutral	9.97
24.0825	16	23.58	36.42	60.00	13.74	36.26	50.00	Neutral	9.96
25.1625	16	23.53	36.47	60.00	12.80	37.20	50.00	Neutral	9.92

FCC ID: WJ9-ARU4ELCU6**5.2 20 dB bandwidth**

For test instruments and accessories used see section 6 Part MB.

5.2.1 Description of the test location

Test location: Shielded room S4

5.2.2 Photo documentation of the test set-up**5.2.1 Applicable standard**

According to FCC Part 15C, Section 15.247(a):

Frequency hopping systems shall have hopping carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

5.2.2 Description of Measurement

The bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio of -20 dB. The reference level is the level of the highest amplitude signal observed from the transmitter at either the fundamental frequency or the first-order modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical.

FCC ID: WJ9-ARU4ELCU6

5.2.3 Test result

Power setting 30.0 dBm:
Antenna gain < 6 dBi

Channel No.	-20 dB Bandwidth below peak (kHz)
CH 1 (902.25 MHz)	84.60
CH 25 (914.75 MHz)	84.60
CH 52 (927.75 MHz)	84.60

Power setting 23.0 dBm:
Worst case antenna gain 13 dBi:

Channel No.	-20 dB Bandwidth below peak (kHz)
CH 1 (902.25 MHz)	84.60
CH 25 (914.75 MHz)	84.60
CH 52 (927.75 MHz)	85.20

Bandwidth limit according to FCC Part15C, Section 15.247(a):

Frequency (MHz)	Hopping channels	Limit -20 db bandwidth (kHz)
902-928	≥ 50	< 250

The requirements are **FULFILLED**.

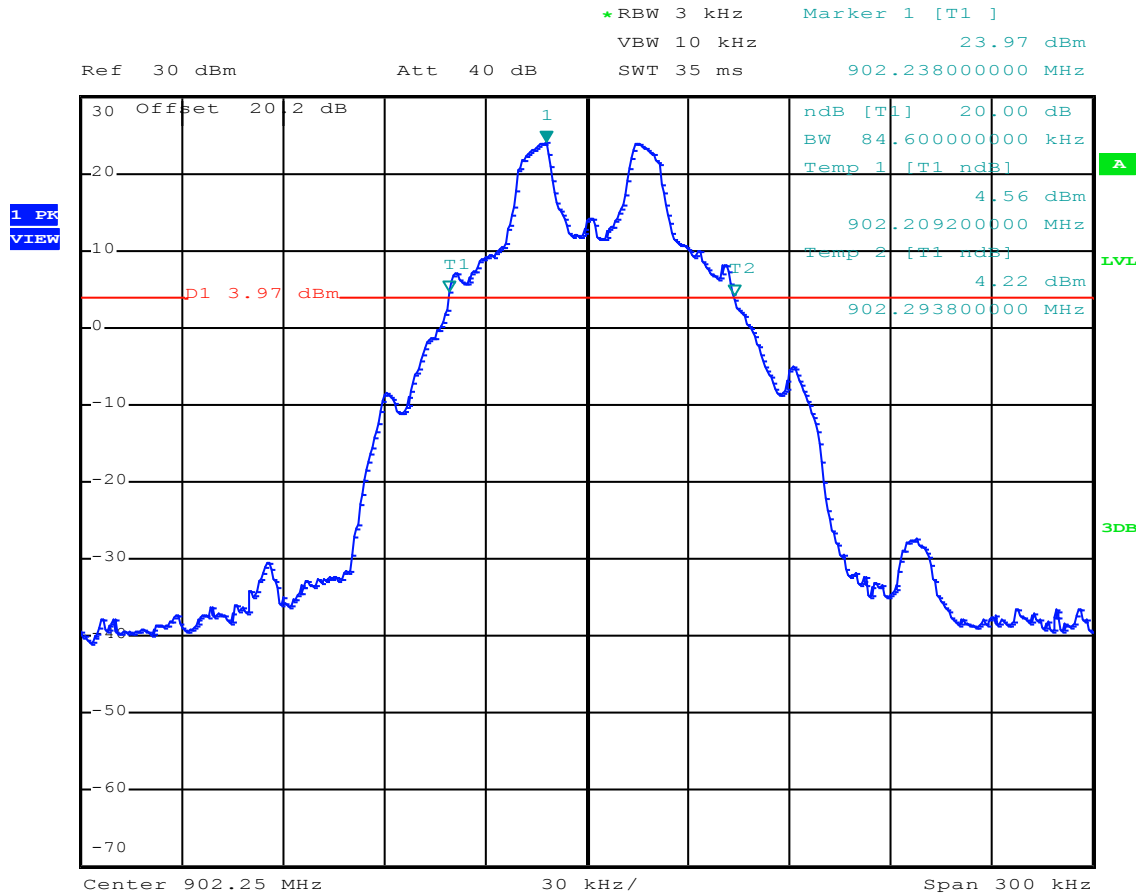
Remarks: For detailed test result please refer to following test protocol.

Test was performed with ARU4-ELC-U6 sample with two power settings.

FCC ID: WJ9-ARU4ELCU6

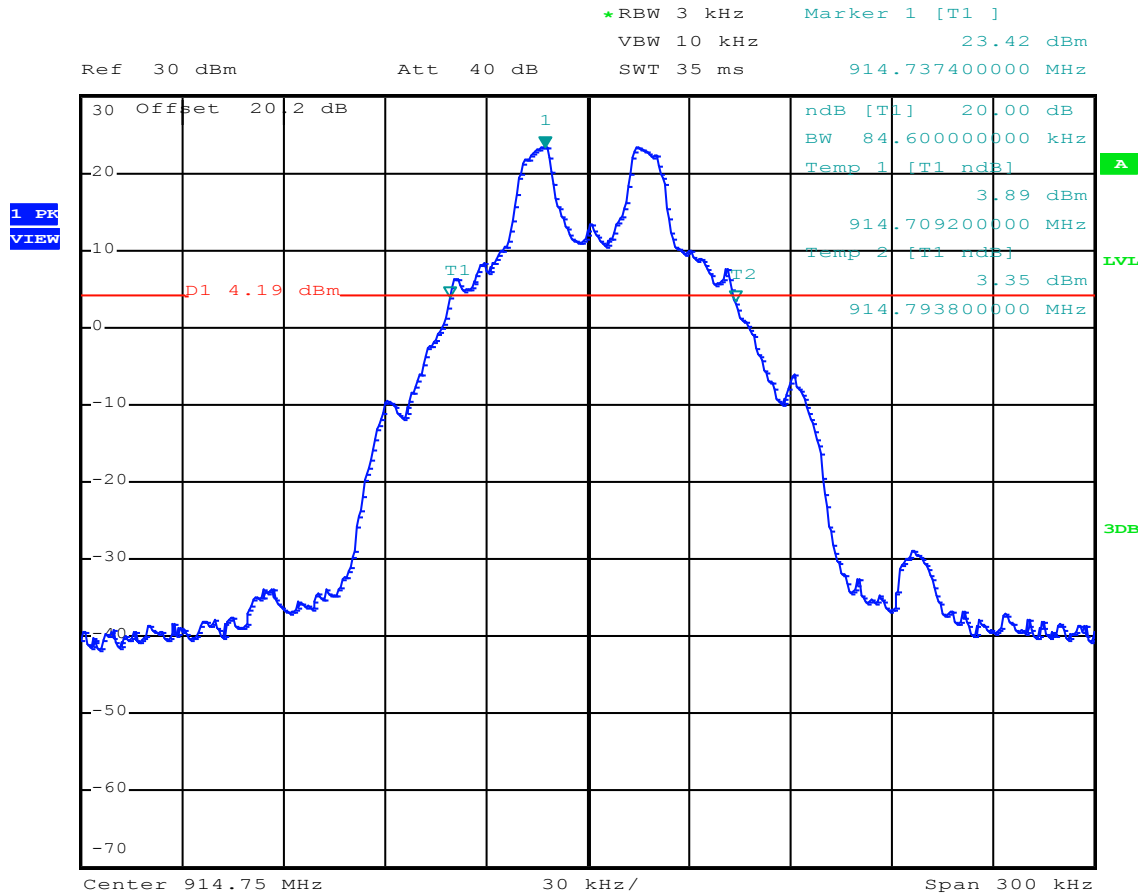
5.2.4 Test protocol

30 dBm
Channel 1
902.25 MHz



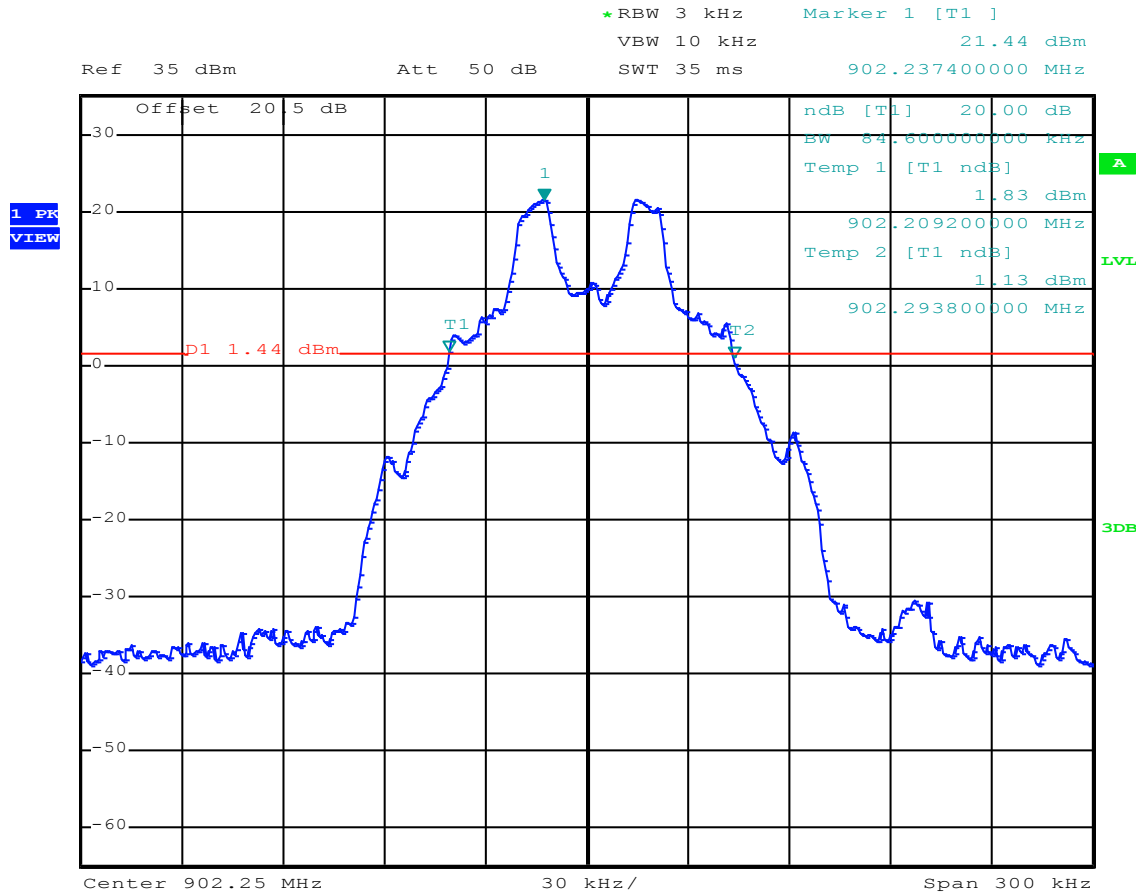
FCC ID: WJ9-ARU4ELCU6

30 dBm
Channel 25
914.75 MHz



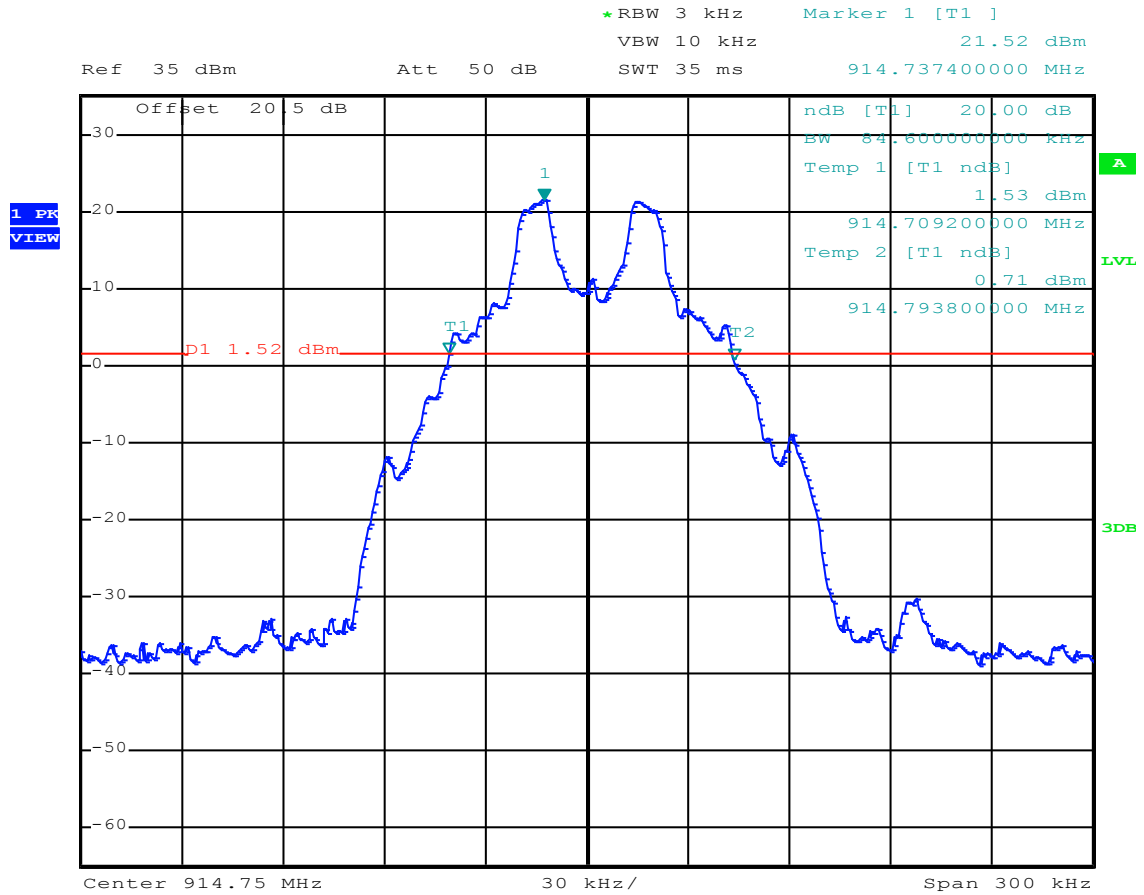
FCC ID: WJ9-ARU4ELCU6

23 dBm
Channel 1
902.25 MHz



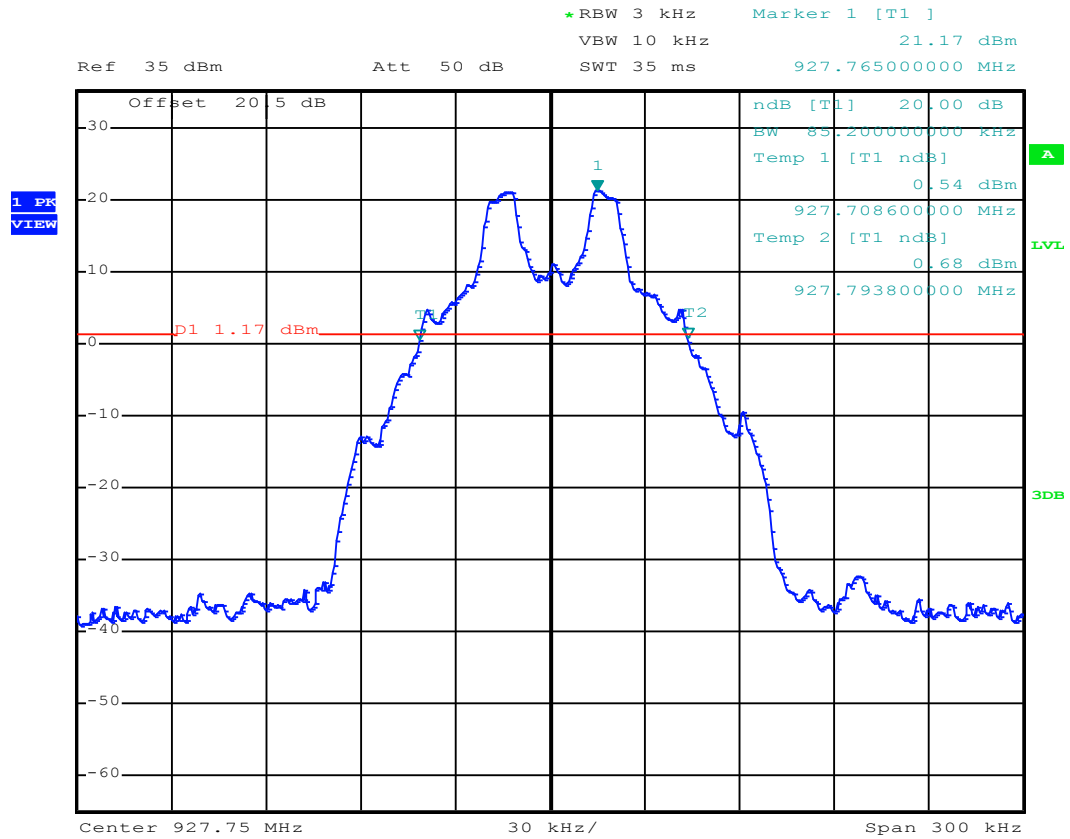
FCC ID: WJ9-ARU4ELCU6

23 dBm
Channel 25
914.75 MHz



FCC ID: WJ9-ARU4ELCU6

23 dBm
Channel 52
927.75 MHz



FCC ID: WJ9-ARU4ELCU6

5.3 Maximum peak conducted output power

For test instruments and accessories used see section 6 Part CPC 2.

5.3.1 Description of the test location

Test location: Shielded room S4

5.3.2 Photo documentation of the test set-up



5.3.3 Applicable standard

According to FCC Part 15C, Section 15.247(b)(2):

For frequency hopping systems operating in the 902-928 MHz band the maximum peak conducted output power shall not exceed the limit of 1 watt for systems employing at least 50 hopping channels.

The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5.3.4 Description of Measurement

A spectrum analyzer is connected to the output of the transmitter via a suitable attenuator while EUT was operating in transmit mode using the assigned frequency.

Spectrum analyser settings:

RBW	300 kHz	Sweep time	5 ms (Auto)
VBW	1 MHz	Power Mode	Max. hold
Detector	Peak	Span	25 0 kHz

FCC ID: WJ9-ARU4ELCU6

5.3.5 Test result

- a.) Power setting 30.0 dBm
Antenna gain: < 6.0 dBi

Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Delta (dB)
1	902.25	28.58	30.0	-1.42
25	914.75	28.32	30.0	-1.68
52	927.75	28.03	30.0	-1.97

Note: Test cable loss and fixed attenuation of 20 dB are included in the analyzer reading (Transducer factor).

- b.) Power setting 23.0 dBm
Worst case antenna gain: 13.0 dBi

Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Delta (dB)
1	902.25	21.68	30.0	-8.32
25	914.75	21.54	30.0	-8.46
52	927.75	20.31	30.0	-9.69

Note: Test cable loss and fixed attenuation of 20 dB are included in the analyzer reading (Transducer factor).

Peak Power Limit according to FCC Part 15C, Section 15.247(b)(2):

Frequency (MHz)	Hopping channels	Hop. CH carrier frequ. separation	Peak Power Limit	
			(dBm)	(W)
902-928	≥ 50		30	1.0

The requirements are **FULFILLED**.

Remarks: The conducted output power has been reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. Refer to 5.3.5 b.) above.

FCC ID: WJ9-ARU4ELCU6**5.4 Spurious RF conducted emissions**

For test instruments and accessories used see section 6 Part SEC1, SEC2 and SEC3.

5.4.1 Description of the test location

Test location: Shielded room S4

5.4.2 Photo documentation of the test set-up**5.4.3 Applicable standard**

According to FCC Part 15C, Section 15.247(d):

In any 100 kHz bandwidth outside the frequency band 902 to 928 MHz, the digitally modulated radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or an radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required.

In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limit specified in Section 15.209(a).

5.4.4 Description of Measurement

A spectrum analyzer is connected to the output of the transmitter via a suitable attenuator while EUT was operating in transmit mode at the assigned frequency.

Spectrum analyzer settings:

RBW	100 kHz
VBW	300 kHz
Detector	Max. peak
Trace:	Max. hold
Sweep time	auto

FCC ID: WJ9-ARU4ELCU6**5.4.5 Test result**

Power setting 30.0 dBm

Hopping frequency from 902.25 to 927.75 MHz, max. level 30.00 dBm			
Frequency (MHz)	Peak power * (dBm)	Limit (-20 dB) (dBm)	Delta (dB)
7756.0	-55.29	8.65	-63.94

* Fixed attenuation of 20 dB is included in the Peak power.

The requirements are **FULFILLED**.

Remarks: All spurious emissions falling in restricted bands have been measured radiated.

For detailed results please refer to following test protocols.

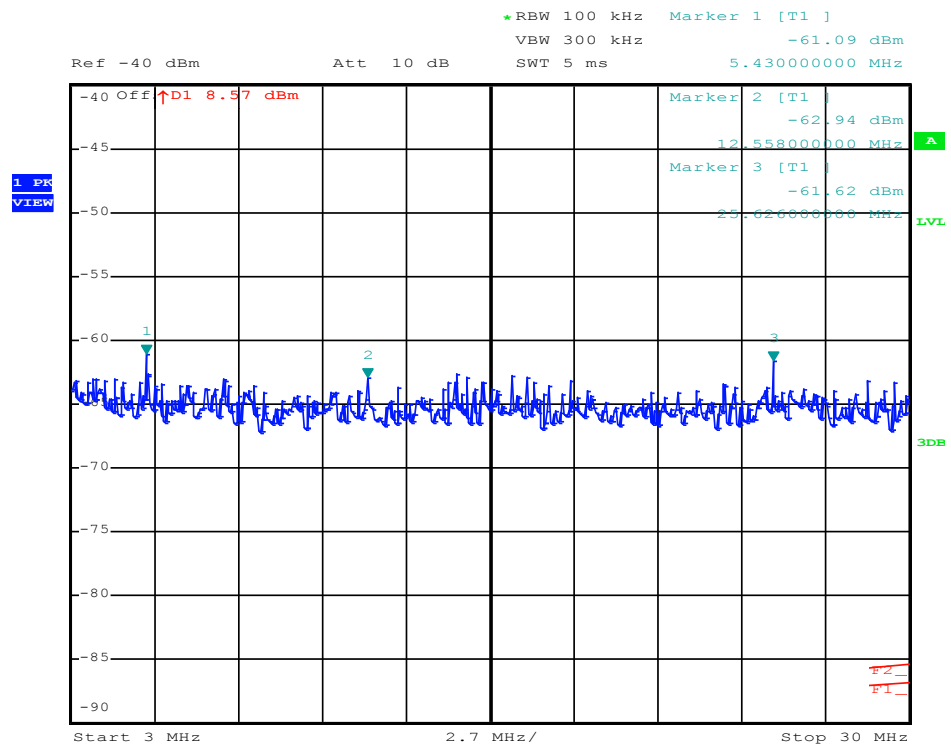
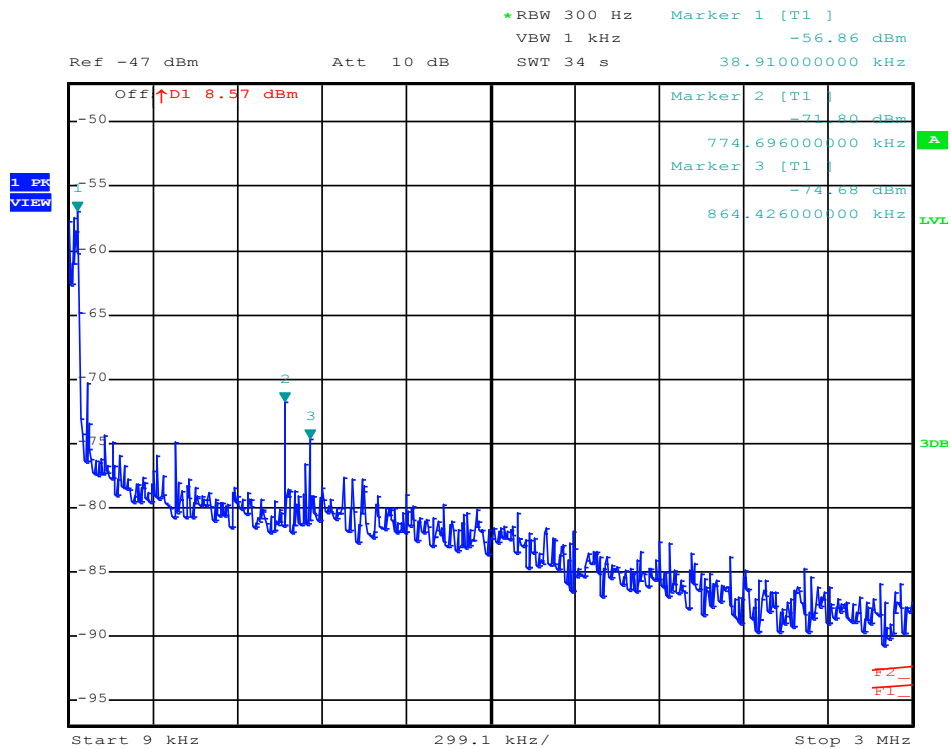
In the frequency range from 9 kHz to 30 MHz no emissions could be measured.

Test was performed in frequency hopping mode from 902.25 to 927.75 MHz.

This mode represents the worst case mode of the EuT.

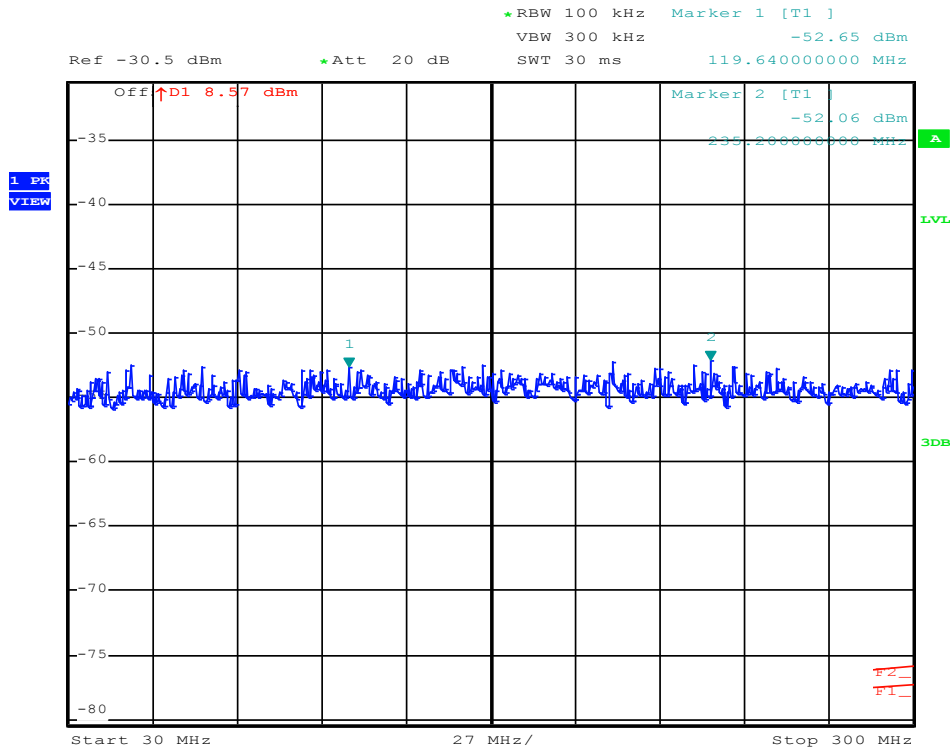
FCC ID: WJ9-ARU4ELCU6

Conducted RF emission from 9 kHz to 30 MHz

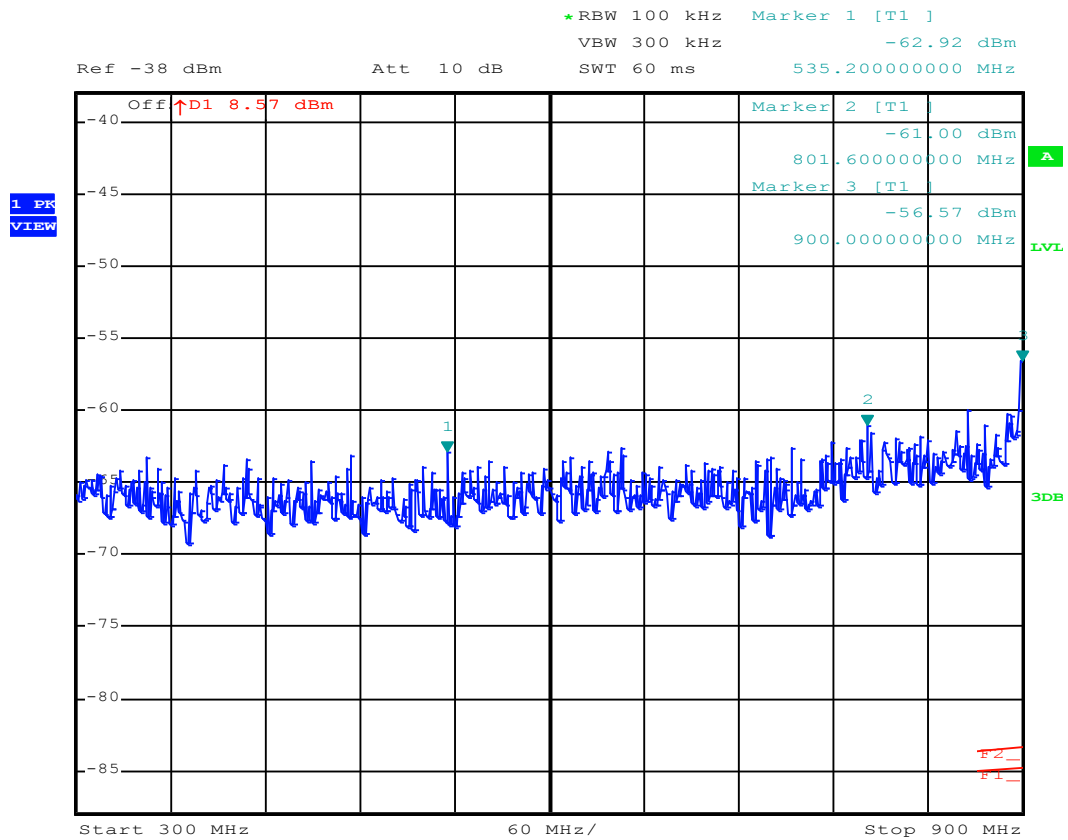


FCC ID: WJ9-ARU4ELCU6

Conducted RF emission from 30 to 1000 MHz

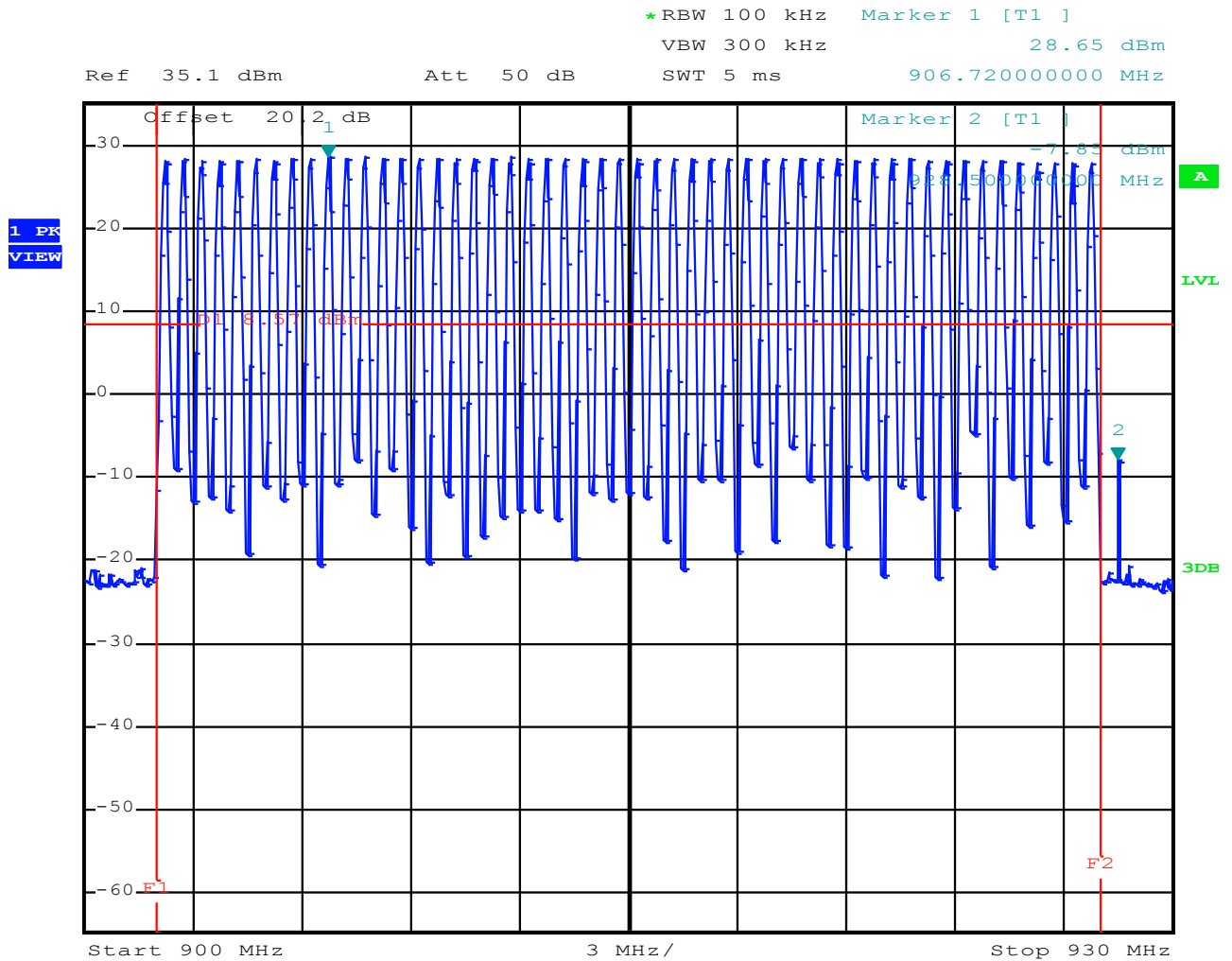


Note: Signal level No.1 is located in restricted band.



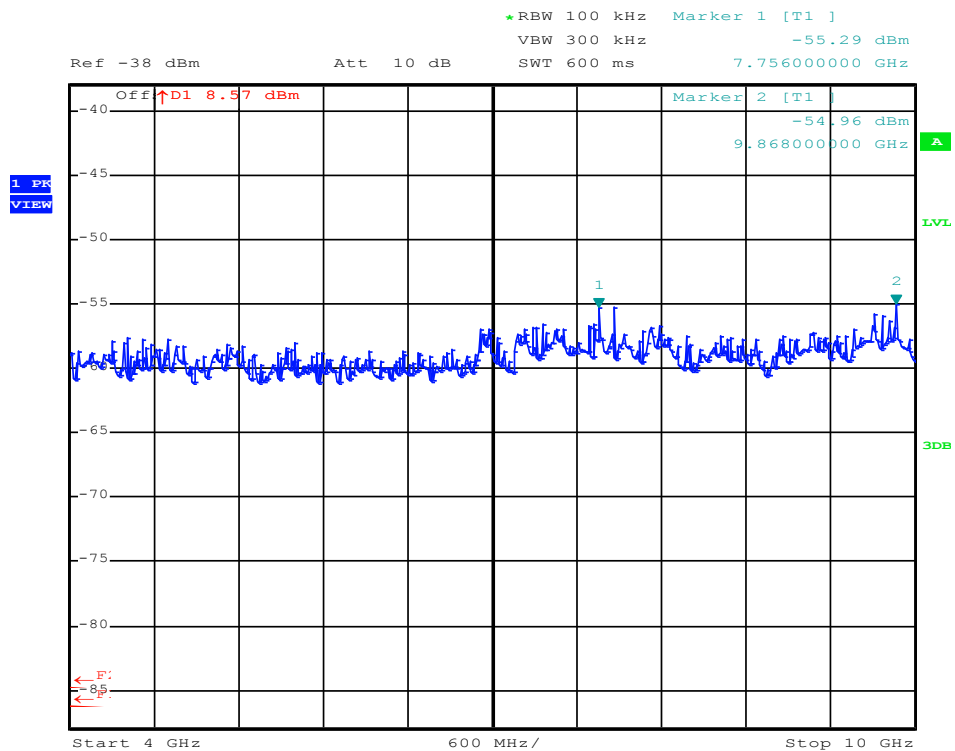
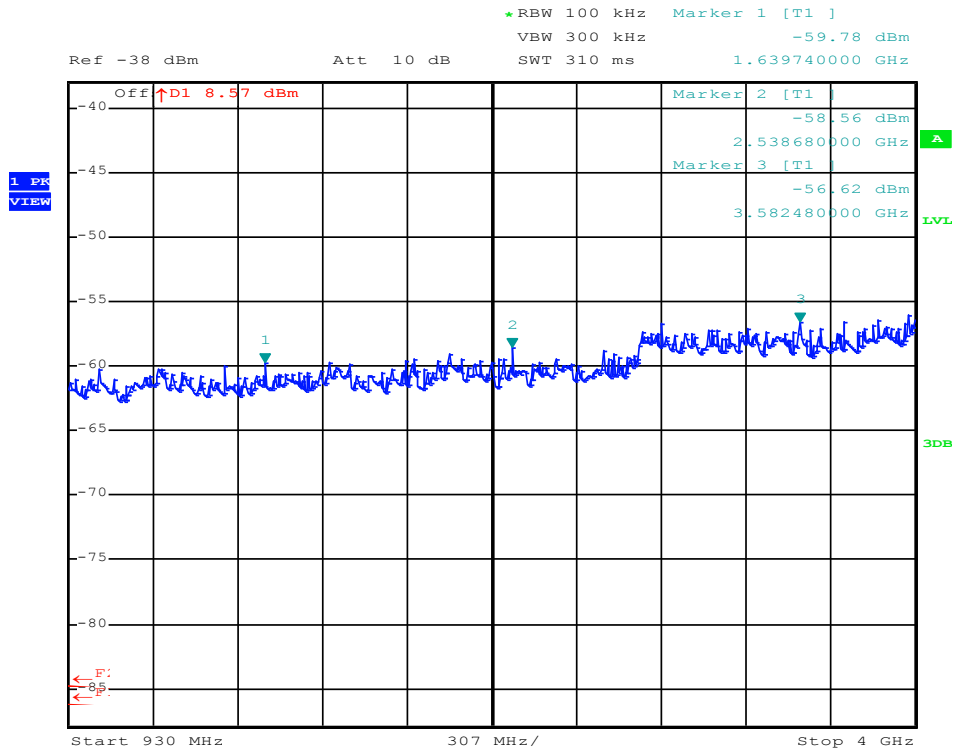
FCC ID: WJ9-ARU4ELCU6

Conducted RF emission from 30 to 1000 MHz
(Band edge)



FCC ID: WJ9-ARU4ELCU6

Conducted RF emission from 1 to 10 GHz



FCC ID: WJ9-ARU4ELCU6**5.5 Spurious radiated emissions**

For test instruments and accessories used see section 6 Part **SER 1**, **SER 2**, **SER 3**.

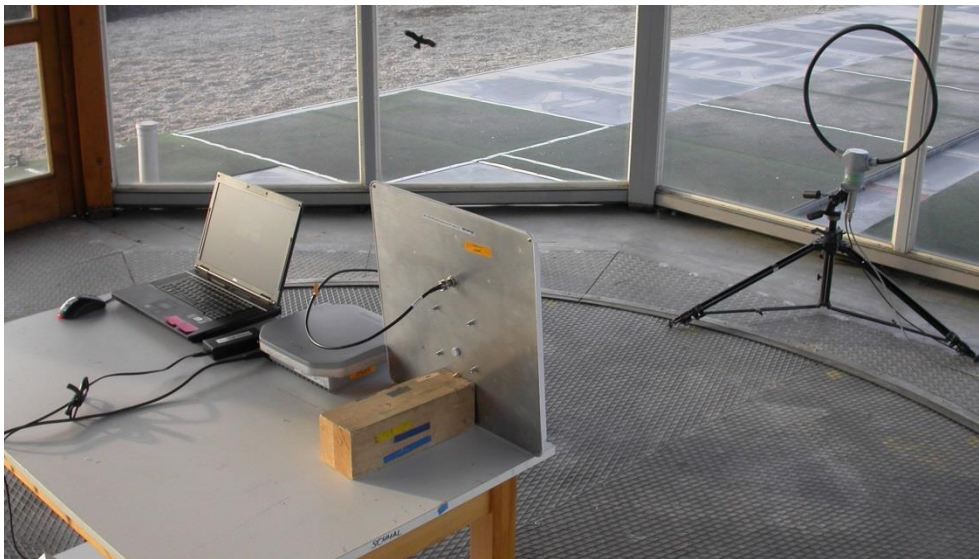
5.5.1 Description of the test location

Test location: OATS1
Test distance: 3 metres

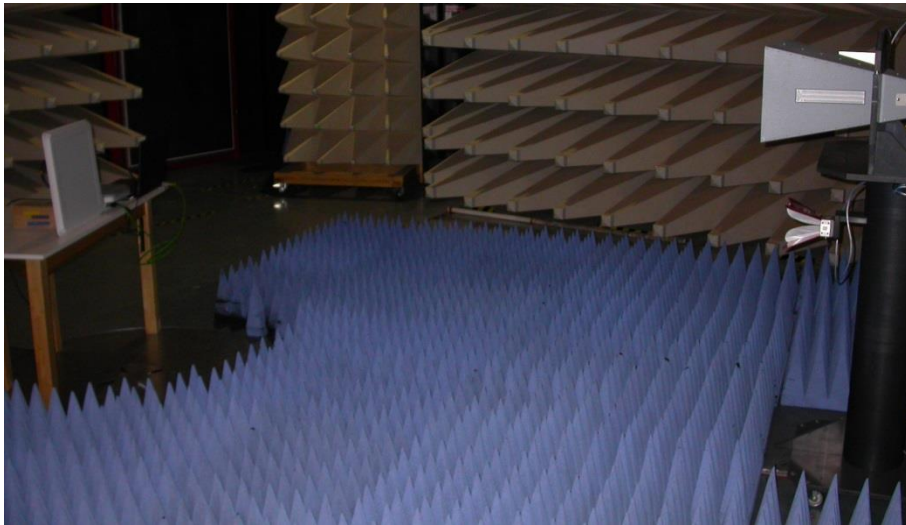
Test location: Anechoic Chamber A1
Test distance: 3 metres

5.5.2 Photo documentation of the test set-up

ARU4-ELC-U6:

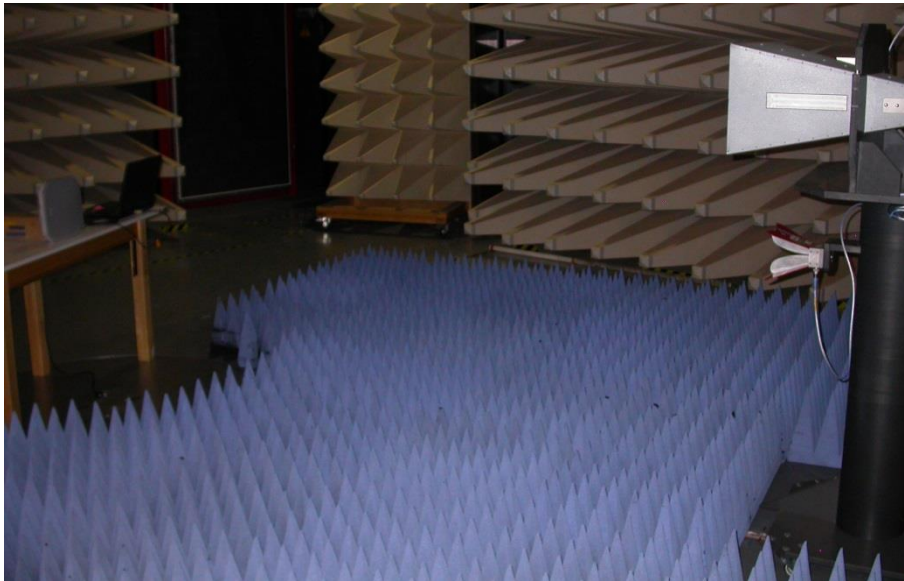


FCC ID: WJ9-ARU4ELCU6



ARU4-RS2-U6:



FCC ID: WJ9-ARU4ELCU6**5.5.3 Applicable standard**

According to FCC Part 15, Section 15.247(d):

In any 100 kHz bandwidth outside the frequency bands 902 to 928 MHz, the digitally modulated radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or an radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limit specified in Section 15.209(a) (see Section 15.205(c)).

5.5.4 Description of Measurement

Radiated spurious emissions from the EUT are measured in the frequency range of 9 kHz to 1000 MHz using a tuned receiver and appropriate broadband linear polarized antennas. The measurements are made with 120 kHz bandwidth and quasi-peak detection (200 Hz, 9 kHz up to 30 MHz). The EUT was placed on a 1.0 X 1.5 metres non-conducting table 80 centimetres above the ground plane. The set up of the equipment under test will be in accordance to ANSI C63.4. The antenna was positioned 3 metres horizontally from the EUT. To locate maximum emissions from the EUT the antenna is shifted in height from 1 to 4 metres, after the EUT is rotated 360 degrees. The measurement scan is made in horizontal and vertical polarization of the antenna.

For the radiated measurement up from 1 GHz to maximum frequency as specified in Section 15.33, a spectrum analyzer and appropriate linear polarized antennas are used. The EUT is placed on a 1.0 X 1.5 metres non-conducting table 80 centimetres above the ground plane. The set up of the EUT will be in accordance to ANSI C63.4. The antenna was positioned 3 m horizontally from the EUT. To locate maximum emissions the EUT was rotated 360 degrees in the fully anechoic chamber. The measurement scan is made in horizontal and vertical polarization of the antenna. For testing above 1 GHz, if the emission level of the EUT in peak mode complies with the average limit is 20 dB lower, then testing will be stopped and peak values of the EUT will be reported, otherwise, the emission will be measured in average mode again and reported.

FCC ID: WJ9-ARU4ELCU6

5.5.5 Test result

5.5.5.1 Radiated emission test $f < 1$ GHz

Frequency [kHz]	L: QP [dB μ V]	L: AV [dB μ V]	Bandwidth [kHz]	Correct. [dB]	L: QP [dB μ V/m]	L: AV [dB μ V/m]	Limit [dB μ V/m]	Delta [dB]
536.8	24.1	19.7	9.0	20	44.1	39.7	73.0	-33.3
1073.6	23.4	18.0	9.0	20	43.4	38.0	67.0	-29.0
1342.0	21.6	15.9	9.0	20	41.6	35.9	65.0	-29.1

Frequency [MHz]	L: QP [dB μ V]	Correct. [dB]	L: QP [dB μ V/m]	Limit [dB μ V/m]	Delta [dB]
33.78	3.7	13.4	17.1	40.0	-22.9
118.54	9.3	12.9	22.2	43.5	-21.3
517.43	4.8	21.9	26.7	46.0	-19.3

Note: No unwanted emissions from both EuT's could be measured in the relevant frequency ranges and each antenna with the different power setting. Only ambient noises could be detected!

5.5.5.2 Radiated emission test $f > 1$ GHz

ARU4-RS2-U6:

- Power setting 30.0 dBm
- = Antenna gain: < 6.0 dBi

Frequency (GHz)	L: PK (dB μ V)	L: AV (dB μ V)	Bandwidth (kHz)	Correct. (dB)	L: PK dB(μ V/m)	L: AV dB(μ V/m)	Limit AV dB(μ V/m)	Delta (dB)
2.710	45.2	40.0	1000	3.7	41.5	36.3	54.0	-17.7
2.752	44.9	35.4	1000	3.4	41.5	32.0	54.0	-22.0
3.613	40.1	33.1	1000	2.5	37.6	30.6	54.0	-23.4

ARU4-ELC-U6:

- Power setting 23.0 dBm
- = Antenna gain: 13.0 dBi

Frequency (GHz)	L: PK (dB μ V)	L: AV (dB μ V)	Bandwidth (kHz)	Correct. (dB)	L: PK dB(μ V/m)	L: AV dB(μ V/m)	Limit AV dB(μ V/m)	Delta (dB)
2.710	42.1	39.5	1000	3.7	38.4	35.8	54.0	-18.2
2.752	38.2	32.7	1000	3.4	34.8	29.3	54.0	-24.7
3.613	37.4	30.0	1000	2.5	34.9	27.5	54.0	-26.5

*) Average values were measured with spectrum analyzer by the following settings

RBW: 1 MHz
VBW: 10 Hz
Sweep: Auto

FCC ID: WJ9-ARU4ELCU6

Radiated limits according to FCC Part 15C, Section 15.209(a) for spurious emissions:

Frequency (MHz)	Field strength of spurious emissions		Measurement distance (metres)
	($\mu\text{V/m}$)	dB($\mu\text{V/m}$)	
0.009 - 0.490	2400/F(kHz)		300
0.490 - 1.705	24000/F(kHz)		30
1.705 - 30	30	29.5	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
Above 960	500	54	3

Restricted bands of operation:

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209: (Refer to section 5.5.5.1)

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

The requirements are **FULFILLED**.

Remarks: During the test the EUT was set into TX continuous mode with normal modulation.

The measurement was performed up to the 10th harmonic (10000 MHz).

Test was performed in frequency hopping mode from 902.25 to 927.75 MHz.

This mode represents the worst case mode of the EuT.

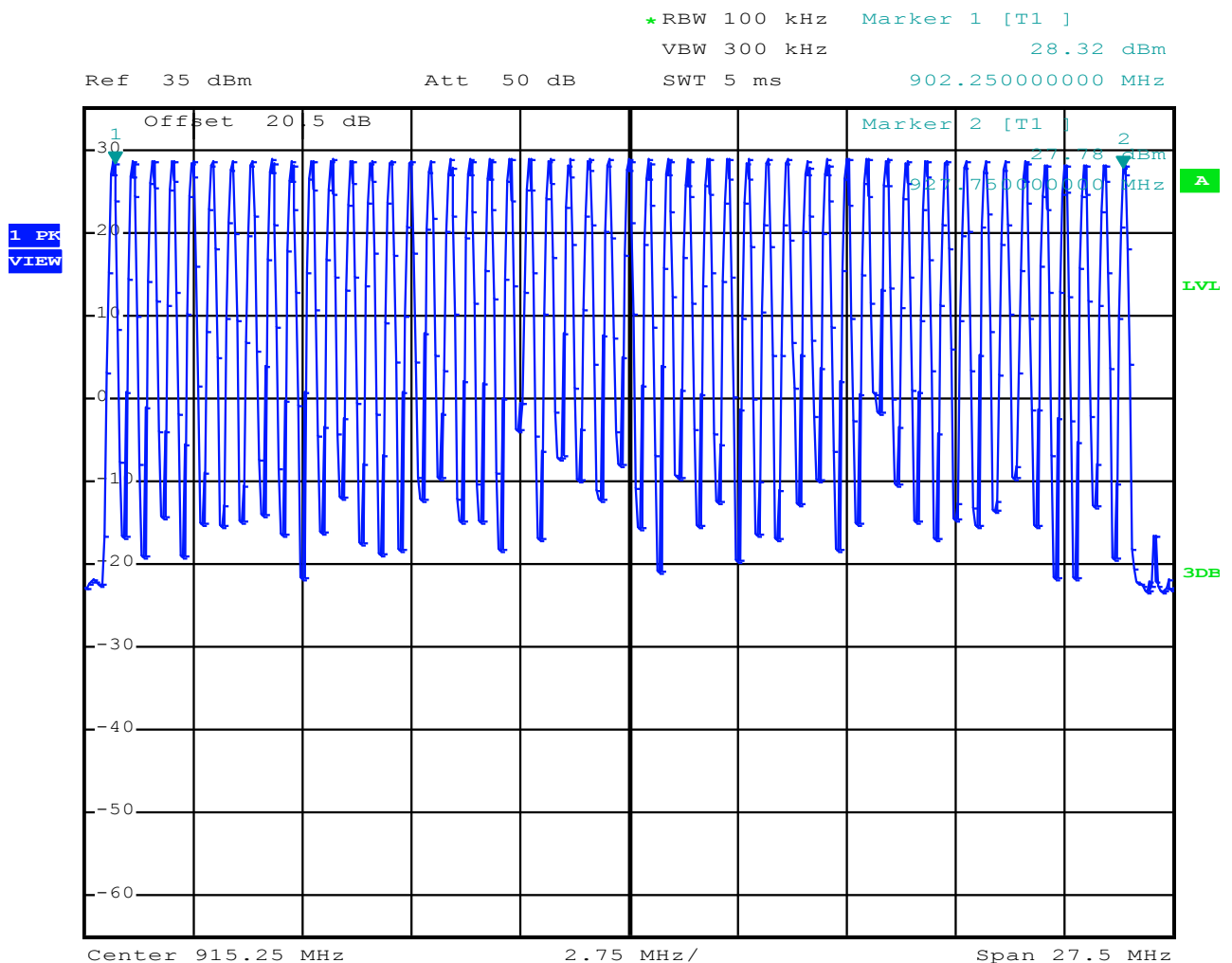
5.6 Hopping sequence

Requirement according to FCC Part 15C, Section 15.247(a):

The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies.

Remarks: The channel is represented by a pseudo-random hopping sequence hopping through the 50
RF-channels.
For detailed information about the hopping sequence, please refer to user manual to the
subpoint "Theory of Operation".

5.6.1 Test protocol



FCC ID: WJ9-ARU4ELCU6**5.7 Equal hopping frequency use**

Requirement according to FCC Part 15C, Section 15.247(a):
Each frequency must be used equally on the average by each transmitter.

Remarks: The device fulfills the requirement according to FCC Part 15C, Section 15.247(a).
The manufacturer declares in the system manual that this function is controlled via software.
For detailed information about the hopping sequence, please refer to user manual to the
subpoint "Theory of Operation".

5.8 Receiver input bandwidth

Requirement according to FCC Part 15C, Section 15.247(a):
The system receivers shall have input bandwidth that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signal.

Remarks: The receiver bandwidth is equal to the transmitter bandwidth in the 50 hopping channel mode.
(Declared by the manufacturer.)
For detailed information about the hopping sequence, please refer to user manual to the
subpoint "Theory of Operation".

FCC ID: WJ9-ARU4ELCU6**5.9 Dwell time**

For test instruments and accessories used see section 6 Part DC.

5.9.1 Description of the test location

Test location: Shielded room S4

5.9.2 Photo documentation of the test set-up**5.9.3 Applicable standard**

According to FCC Part 15, Section 15.247(a)(i):

Frequency hopping systems operating in the 902-928 MHz band: The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period.

5.9.4 Description of Measurement

The measurement was done using a spectrum analyser in time domain function and able to store the maximum time of a period. This time period has been stored and added up the appropriate time intervals the hopping system has applied this channel.

FCC ID: WJ9-ARU4ELCU6**5.9.5 Test result**

Channel frequency (MHz)	Pulse Time (ms)	Number of Bursts (in 1 time period)	Dwell time (ms)
914.75	400	1	400

Requirement according to FCC Part15C, Section 15.247(a):

Frequency (MHz)	Hopping channels	time of one period (s)	Limit dwell time, AV (ms)
902-928	≥ 50	20	< 400

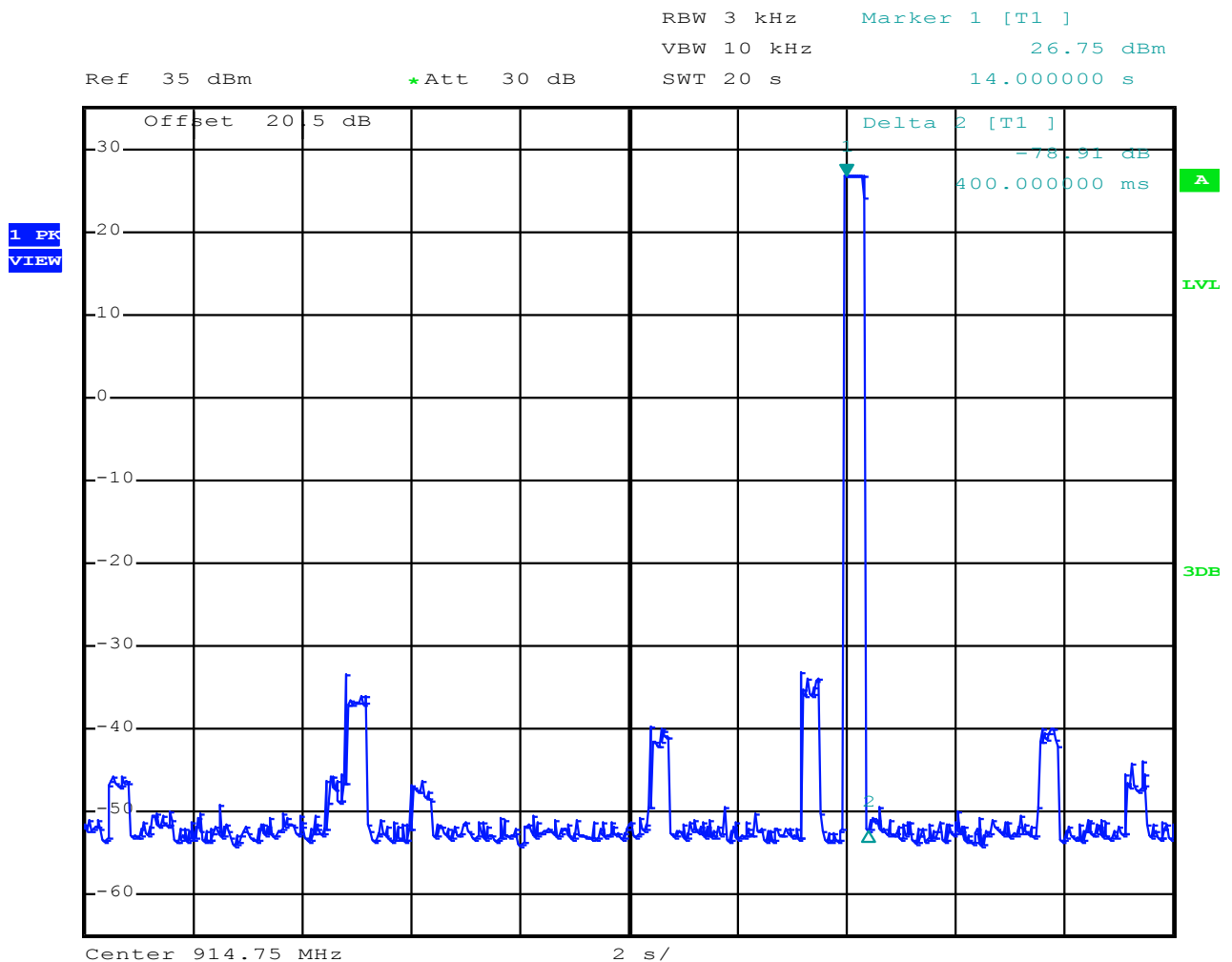
The requirements are **FULFILLED**.

Remarks: For detailed test result please refer to following test protocol.

FCC ID: WJ9-ARU4ELCU6

5.9.6 Test protocol

Time of occupancy (Dwell time)



FCC ID: WJ9-ARU4ELCU6

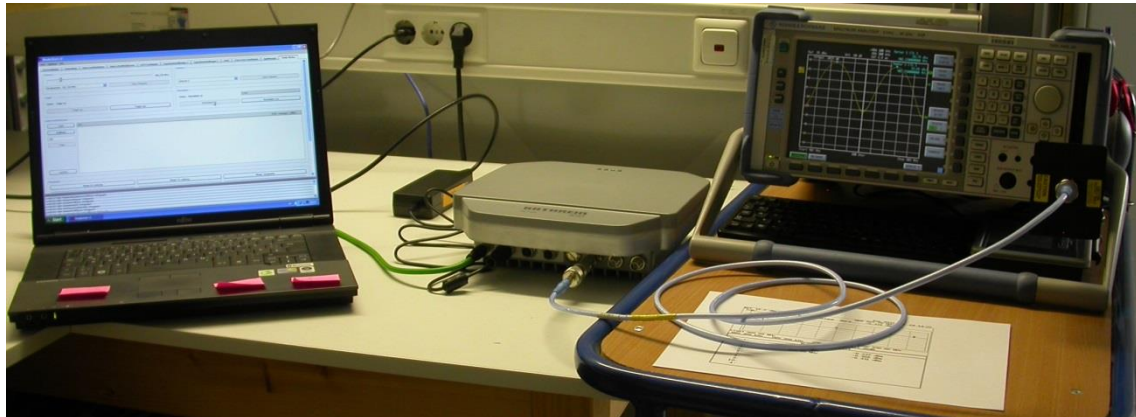
5.10 Channel separation

For test instruments and accessories used see section 6 Part MB.

5.10.1 Description of the test location

Test location: Shielded room S4

5.10.2 Photo documentation of the test set-up



5.10.3 Applicable standard

According to FCC Part 15, Section 15.247(a)(1):

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

5.10.4 Description of Measurement

This measurement was done by using a spectrum analyser. The Span of the analyzer was set wide enough to capture 2 frequencies. The result of the channel separation was compared with the 20 dB bandwidth and recorded.

5.10.5 Test result

Channel 1 (MHz)	Channel 2 (MHz)	Channel separation (kHz)
902.25	902.75	500

FCC ID: WJ9-ARU4ELCU6

Limit according to FCC Part 15C, Section 15.247(a):

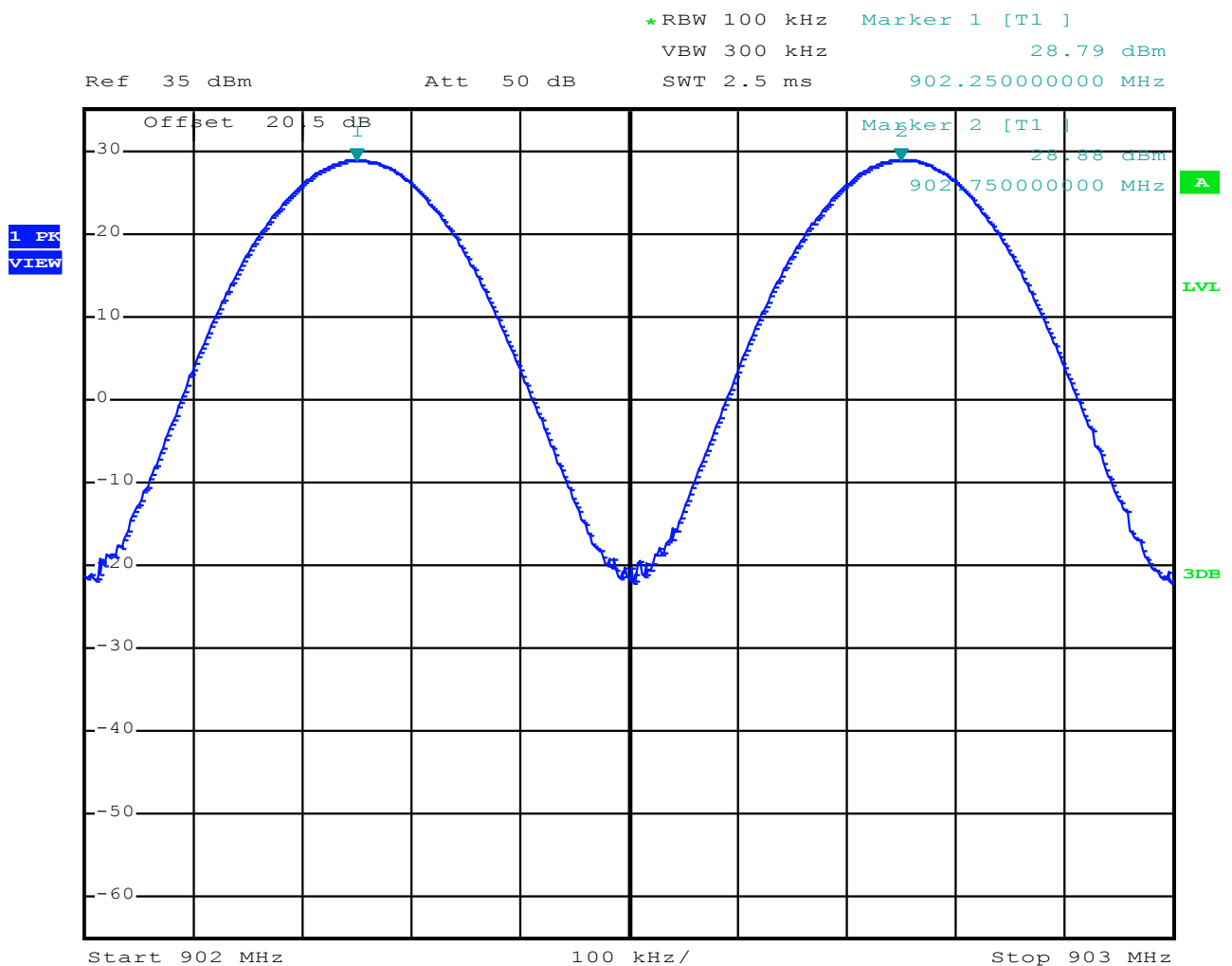
Frequency (MHz)	Hopping channels	Limit channel separation (kHz)
All systems		> 25 kHz or 20 dB bandwidth, which ever is greater
2400-2483.5	≥ 15	

The requirements are **FULFILLED**.

Remarks: For detailed test result please refer to following test protocol.

5.10.6 Test protocol

Channel separation



5.11 Quantity of hopping channels

For test instruments and accessories used see section 6 Part MB.

5.11.1 Description of the test location

Test location: Shielded room S4

5.11.2 Photo documentation of the test set-up



5.11.3 Applicable standard

According to FCC Part 15, Section 15.247(a)(1)(i):

For frequency hopping systems operating in the 902-928 MHz band: If the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies.

5.11.4 Description of Measurement

This measurement was done by using a spectrum analyser. The EuT was transmitting at its maximum data rate. The Span of the analyzer was set wide enough to capture the frequency band from 902-928 MHz.

5.11.5 Test result

Hopping channel frequency range	Quantity of hopping channels value	Quantity of hopping channels minimum limit
902-928 MHz	52	50

FCC ID: WJ9-ARU4ELCU6

Limit according to FCC Part 15C, Section 15.247(1):

Frequency range (MHz)	LIMIT (Quantity of Hopping Channels)			
	20dB Bandwidth < 250kHz	20dB Bandwidth > 250kHz	20dB Bandwidth < 1 MHz	20dB Bandwidth > 1MHz
902 - 928	50	25	---	---

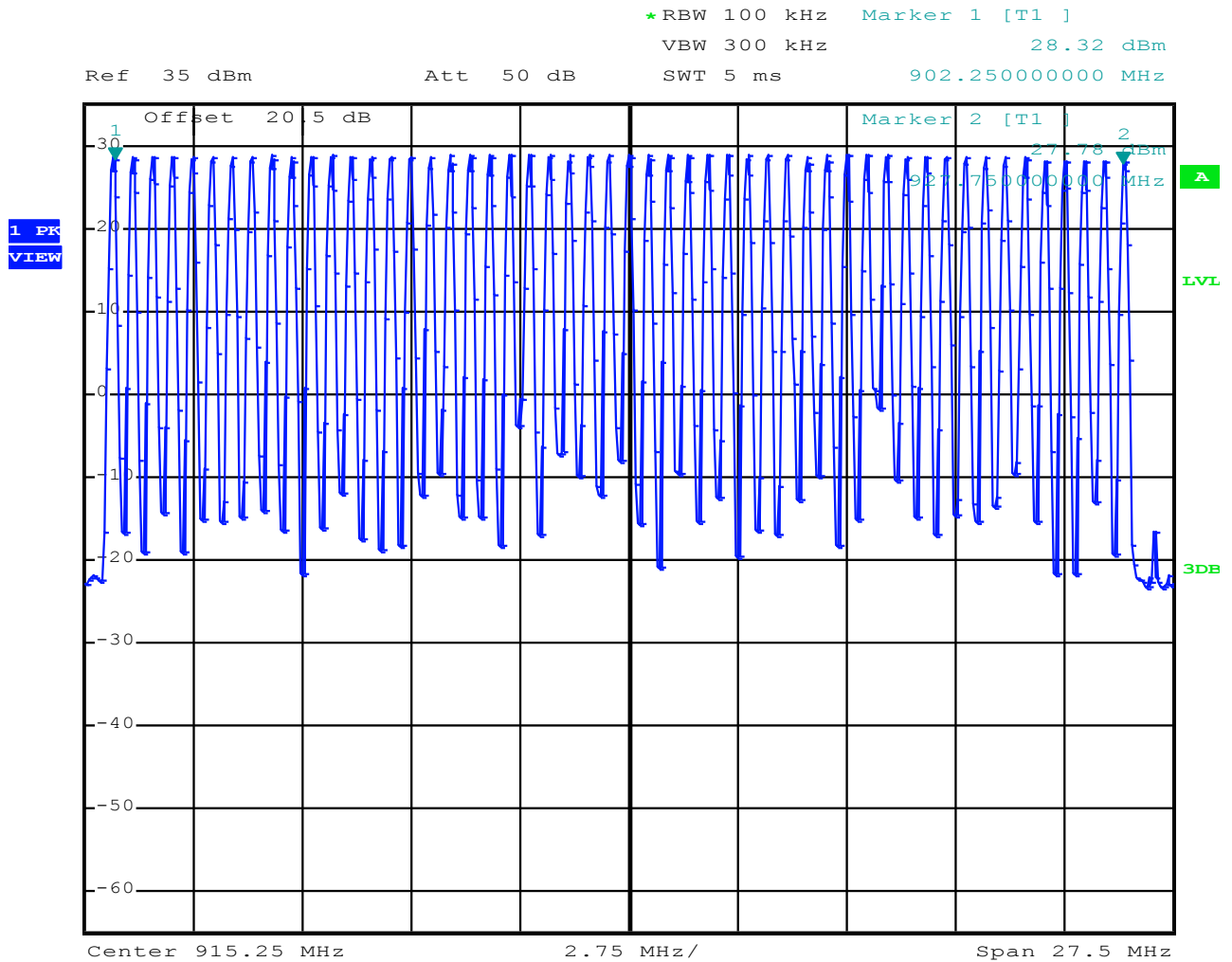
The requirements are **FULFILLED**.

Remarks: For detailed test result please refer to following test protocol.

FCC ID: WJ9-ARU4ELCU6

5.11.6 Test protocol

Quantity of hopping channel



5.12 Antenna application

5.12.1 Applicable standard

According to FCC Part 15C, Section 15.203:

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 that broken antennas can be replaced by the user, but the use of a standard antenna jack is prohibited.

All supplied antennas meet the requirements of part 15.203 and 15.204.

5.12.2 Antenna requirements

According to FCC Part 15C, Section 15.247 (b)(4):

The conducted output power limit specified in paragraph (b) of 15.247 is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from intentional radiator shall be reduced below the stated values in paragraph (b)(1), (b)(2) and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The necessary output power reduction depends on the used antenna type. The value of output power have to be reduced is controlled by firmware of the EUT and will be automatically set by selecting the antenna.

FCC ID: WJ9-ARU4ELCU6**5.13 Maximum permissible exposure (MPE) – See Attachment B**

For test instruments and accessories used see section 6 Part **CPC 2**.

5.13.1 Description of the test location

Test location: None

5.13.2 Applicable standard

According to FCC Part 15, Section 15.247(i):

Systems operating under the provisions of this section shall be operated in a manner that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines.

The test methods used comply with ANSI/IEEE C95.1, "IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz".

This test report shows the compliance with the limits for Maximum Permissible Exposure (MPE) specified in FCC Part 1, Section 1.1310 and the criteria to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in FCC Part 1, Section 1.1307(b).

5.13.3 Description of Measurement

The maximum total power input to the antenna has been measured conducted as described in clause 5.3 of this document. Through the Friis transmission formula, the known maximum gain of the antenna and the maximum power, the MPE can be calculated in a defined distance away from the product.

Friis transmission formula:
$$P_d = \frac{P_{out} * G}{4 * \pi * r^2}$$

where

P_d = power density (mW/cm²)

P_{out} = output power to antenna (mW)

G = gain of antenna (linear scale)

r = distance between antenna and observation point (cm)

Remarks: For detailed test result please refer Attachment B.

FCC ID: WJ9-ARU4ELCU6

6 USED TEST EQUIPMENT AND ACCESSORIES

All test instruments used are calibrated and verified regularly. The calibration history is available on request.

Test ID	Model Type	Equipment No.	Next Calib.	Last Calib.	Next Verif.	Last Verif.
A 4	ESHS 30	02-02/03-05-002	17/07/2015	17/07/2014		
	ESH 2 - Z 5	02-02/20-05-004	18/10/2015	18/10/2013	09/08/2015	09/02/2015
	N-4000-BNC	02-02/50-05-138				
	N-1500-N	02-02/50-05-140				
	ESH 3 - Z 2	02-02/50-05-155	19/11/2015	19/11/2014	19/05/2015	19/11/2014
	SP 103 /3.5-60	02-02/50-05-182				
CPC 2	FSP 30	02-02/11-05-001	20/10/2015	20/10/2014		
	KK-SF104-11SMA-11N-2M	02-02/50-14-002				
	18N50W-20 dB	02-02/50-14-016				
DC	FSP 30	02-02/11-05-001	20/10/2015	20/10/2014		
	KK-SF104-11SMA-11N-2M	02-02/50-14-002				
	18N50W-20 dB	02-02/50-14-016				
MB	FSP 30	02-02/11-05-001	20/10/2015	20/10/2014		
	KK-SF104-11SMA-11N-2M	02-02/50-14-002				
	18N50W-20 dB	02-02/50-14-016				
SEC 1-3	FSP 30	02-02/11-05-001	20/10/2015	20/10/2014		
	WHJS 1000-10EE	02-02/50-05-070				
	KK-SF104-11SMA-11N-2M	02-02/50-14-002				
	18N50W-20 dB	02-02/50-14-016				
SER 1	ESR 7	02-02/03-13-001	03/06/2015	03/06/2014		
	HFH 2 - Z 2	02-02/24-05-020	26/08/2017	26/08/2014	19/01/2016	19/01/2015
	S10162-B	02-02/50-05-031				
	KK-EF393-21N-16	02-02/50-05-033				
	NW-2000-NB	02-02/50-05-113				
SER 2	ESVS 30	02-02/03-05-006	03/07/2015	03/07/2014		
	VULB 9168	02-02/24-05-005	08/04/2015	08/04/2014	12/09/2015	12/03/2015
	S10162-B	02-02/50-05-032				
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
SER 3	FSP 40	02-02/11-11-001	02/10/2015	02/10/2014		
	AFS5-12001800-18-10P-6	02-02/17-06-002				
	AFS4-01000400-10-10P-4	02-02/17-13-002				
	AMF-4F-04001200-15-10P	02-02/17-13-003				
	3117	02-02/24-05-009	07/05/2015	07/05/2014		
	Sucoflex N-2000-SMA	02-02/50-05-075				
	SF104/11N/11N/1500MM	02-02/50-13-015				