



RF - TEST REPORT

- FCC Part 15.247, RSS-247 -

Type / Model Name : M2UHF-RFID

Product Description : Plug-in module

Applicant : ACD Elektronik GmbH

Address : Engelberg 2

88480 Achstetten

Manufacturer : ACD Elektronik GmbH

Address : Engelberg 2

88480 Achstetten

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

POSITIVE

Test Report No. : T46962-00-00HS

26. April 2021

Date of issue



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

FCC ID: O2FM2UHF-RFID

IC: 9137A-M2UHFRFID

Contents

1	<u>TEST STANDARDS</u>	<u>3</u>
2	<u>EQUIPMENT UNDER TEST</u>	<u>4</u>
2.1	Information provided by the Client	4
2.2	Sampling	4
2.3	Photo documentation of the EUT – Detailed photos see ATTACHMENT A	4
2.4	Equipment type	4
2.5	Short description of the equipment under test (EUT)	4
2.6	Variants of the EUT	4
2.7	Operation frequency and channel plan	5
2.8	Transmit operating modes	5
2.9	Antenna	6
2.10	Power supply system utilised	6
2.11	Peripheral devices and interface cables	6
2.12	Determination of worst-case conditions for final measurement	6
3	<u>TEST RESULT SUMMARY</u>	<u>8</u>
3.1	Final assessment	8
4	<u>TEST ENVIRONMENT</u>	<u>9</u>
4.1	Address of the test laboratory	9
4.2	Environmental conditions	9
4.3	Statement of the measurement uncertainty	9
4.1	Conformity Decision Rule	10
4.2	Measurement protocol for FCC and ISED	10
5	<u>TEST CONDITIONS AND RESULTS</u>	<u>13</u>
5.1	Conducted emissions	13
5.2	Emission bandwidth	13
5.3	Maximum peak output power	21
5.4	Spurious emissions	23
5.5	Band edge compliance	24
5.6	Radiated emissions in restricted bands	29
5.7	Equal hopping frequency use	34
5.8	Dwell time	35
5.9	Carrier frequency separation	39
5.10	Number of hopping channels	41
5.11	Psydo random hopping frequencies	43
5.12	System receiver input bandwidth	43
5.13	System receiver hopping capability	43
5.14	Antenna application	44
6	<u>USED TEST EQUIPMENT AND ACCESSORIES</u>	<u>45</u>
	<u>ATTACHMENT A</u>	<u>46</u>
A1)	Photo documentation of the EUT	46

FCC ID: O2FM2UHF-RFID

IC: 9137A-M2UHF RFID

1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15, Subpart A - General (September 2020)

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 C - Intentional Radiators (September 2020)

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

ANSI C63.10: 2013 Testing Unlicensed Wireless Devices

ETSI TR 100 028 V1.3.1: 2001-03, Electromagnetic Compatibility and Radio Spectrum Matters (ERM);
Uncertainties in the Measurement of Mobile Radio Equipment
Characteristics—Part 1 and Part 2

KDB 558074 D01 v05r02 Guidance for compliance measurements on DTS; FHSS and hybrid
system devices operating under Section 15.247 of the FCC rules,
April 2, 2019.

FCC ID: O2FM2UHF-RFID

IC: 9137A-M2UHFRFID

2 EQUIPMENT UNDER TEST

2.1 Information provided by the Client

Please note, we do not take any responsibility for information provided by the client or his representative which may have an influence on the validity of the test results.

2.2 Sampling

The customer is responsible for the choice of sample. Sample configuration, start-up and operation is carried out by the customer or according to his/her instructions.

2.3 Photo documentation of the EUT – Detailed photos see ATTACHMENT A

2.4 Equipment type

UHF-RFID reader

2.5 Short description of the equipment under test (EUT)

The EUT uses a handheld UHF RFID reader for reading active and passive tags. While charging, RFID is disabled. Charging via USB is not possible. Battery charging via external charger only.

Number of tested samples: 1 pc M2UHF-RFID
Serial number: 195000000000
Firmware version: 01.08.12.240

EUT configuration:

(The CDF filled by the applicant can be viewed at the test laboratory.)

2.6 Variants of the EUT

There are no variants.

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.

FCC ID: O2FM2UHF-RFID
IC: 9137A-M2UHFRFID

2.7 Operation frequency and channel plan

The operating frequency is 902 MHz to 928 MHz.

Channel plan:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	902.25	27	915.25
2	902.75	28	915.75
3	903.25	29	916.25
4	903.75	30	916.75
5	904.25	31	917.25
6	904.75	32	917.75
7	905.25	33	918.25
8	905.75	34	918.75
9	906.25	35	919.25
10	906.75	36	919.75
11	907.25	37	920.25
12	907.75	38	920.75
13	908.25	39	921.25
14	908.75	40	921.75
15	909.25	41	922.25
16	909.75	42	922.75
17	910.25	43	923.25
18	910.75	44	923.75
19	911.25	45	924.25
20	911.75	46	924.75
21	912.25	47	925.25
22	912.75	48	925.75
23	913.25	49	926.25
24	913.75	50	926.75
25	914.25	51	927.25
26	914.75	52	927.75

Note: The red marked frequencies are not supported by firmware. The blue marked frequencies are determined for final testing.

2.8 Transmit operating modes

Mode 1: PR-ASK
Mode 3: DSB-ASK

Note: Mode 1 and 3 are used for USA and Canada. Mode 2 and 4 are disabled.

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FCC ID: O2FM2UHF-RFID

IC: 9137A-M2UHFRFID

2.9 Antenna

The EUT uses a PCB antenna, no replacement is possible.

2.10 Power supply system utilised

Power supply voltage, V_{nom} : 3.8 VDC Li-Ion battery

2.11 Peripheral devices and interface cables

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

- USB cable, 1.5 m Model : Common
- Test notebook, DELL Model : Latitude E5410
- - Model : -

2.12 Determination of worst-case conditions for final measurement

Measurements are made in all three orthogonal axes and the settings of the EUT are changed to locate at which position and at what setting of the EUT produce the maximum of the emissions. For the further measurement the EUT is set in X position.

For the final test the following channels and test modes are selected:

Modulation type	Available channel	Tested channels	Power setting
PR-ASK	2 to 51	2, 27, 51	P23
DSB_ASK	2 to 51	2, 27, 51	P23

2.12.1 Test jig

No test jig is used.

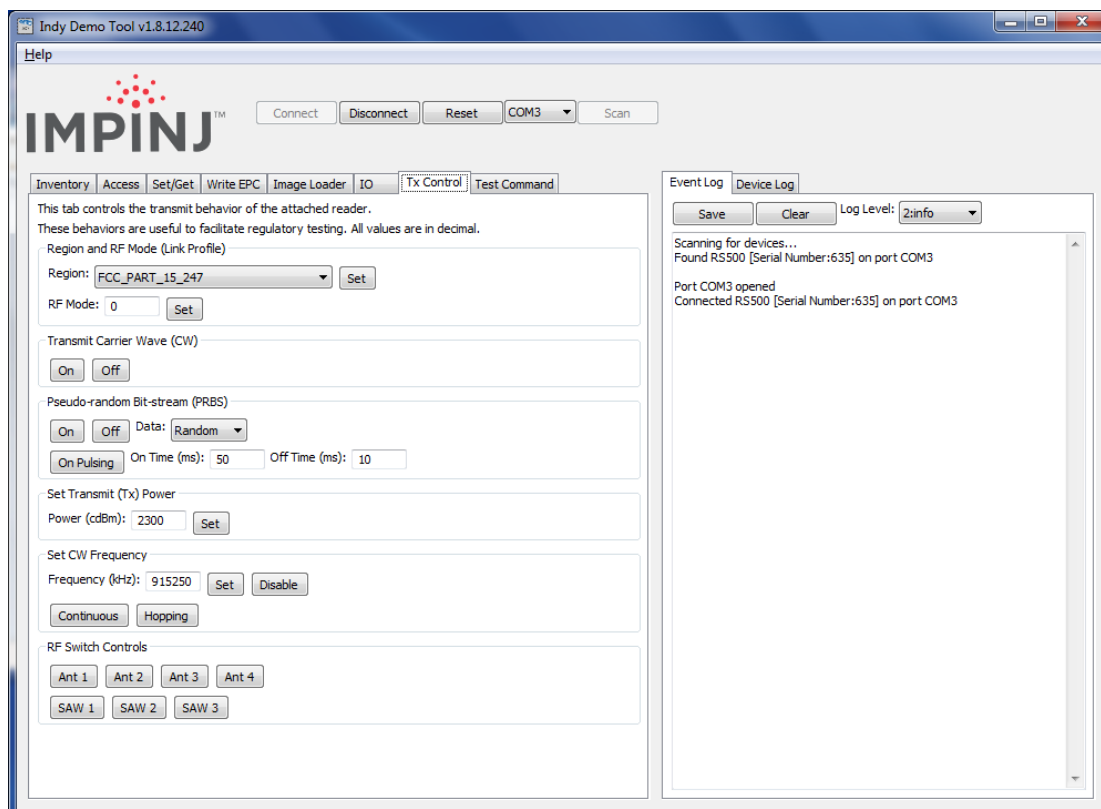
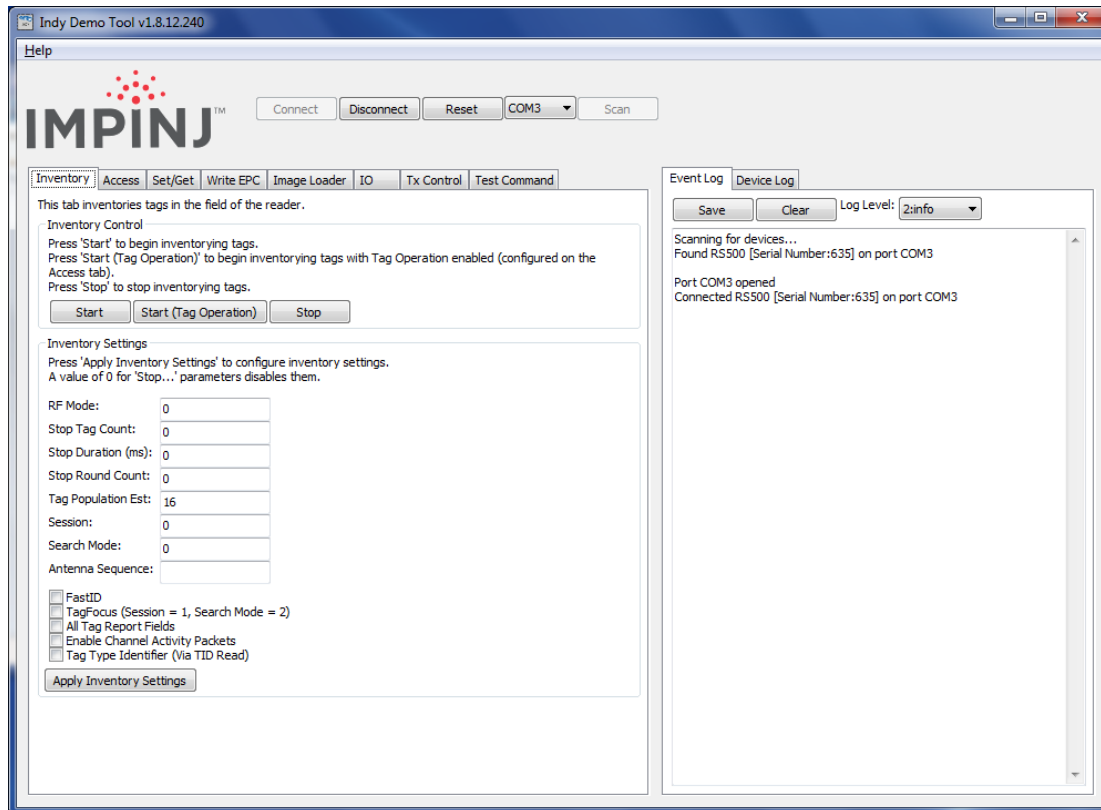
The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

FCC ID: O2FM2UHF-RFID

IC: 9137A-M2UHF RFID

2.12.2 Test software

The test software for the EUT provides free power setting, power control and the special test mode TX continuous.



FCC ID: O2FM2UHF-RFID

IC: 9137A-M2UHF RFID

3 TEST RESULT SUMMARY

Operating in the 902 MHz – 928 MHz band:

FCC Rule Part	RSS Rule Part	Description	Result
15.207(a)	RSS-Gen, 8.8	AC power line conducted emissions	not applicable
15.247(a)(1i)	RSS-247, 5.1(b)	20 dB EBW	passed
15.247(a)(1)	RSS-247, 5.1(b)	Channel separation	passed
15.247(a)(1i)	RSS-247, 5.1(c)	Dwell time	passed
15.247(b)(2)	RSS-247, 5.4(a)	Peak output power	passed
15.247(d)	RSS-247, 5.5	Unwanted emissions	not applicable
15.247(d)	RSS-Gen, 8.10	Emissions in restricted bands	passed
15.247(a)(1)	RSS-247, 5.1(a)	Hopping sequence	passed
15.247(a)(1)	RSS-247, 5.1(a)	Receiver input bandwidth	passed
15.247(a)(1i)	RSS-247, 5.4(a)	Number of hopping channels	passed
15.247(a)(1)	-	Equal hopping frequency use	passed
15.203	RSS-247, 5.4(b)	Antenna requirement	passed

The mentioned RSS Rule Parts in the above table are related to:

RSS-Gen, Issue 5, April 2018

RSS-247, Issue 2, February 2017

3.1 Final assessment

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

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

Testing commenced on : 18 January 2021

Testing concluded on : 25 January 2021

Checked by:

Tested by:

Klaus Gegenfurtner
Teamleader Radio

Hermann Smetana
Radio Team

FCC ID: O2FM2UHF-RFID

IC: 9137A-M2UHF RFID

4 TEST ENVIRONMENT

4.1 Address of the test laboratory

CSA Group Bayern GmbH
Ohmstrasse 1-4
94342 STRASSKIRCHEN
GERMANY

4.2 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

4.3 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 / 2011 + A1 / 2014 „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.

Measurement Type	Range	Confidence Level	Calculated Uncertainty
AC power line conducted emissions	0.15 MHz to 30 MHz	95%	± 3.29 dB
EBW and OBW	2400 MHz to 30000 MHz	95%	$\pm 2.5 \times 10^{-7}$
Output power ERP, radiated	1000 MHz to 7000 MHz	95%	± 2.71 dB
Field strength of the fundamental	1000 MHz to 7000 MHz	95%	± 2.71 dB
Power spectral density	2400 MHz to 3000 MHz	95%	± 0.62 dB
Spurious Emissions, conducted	9 kHz to 10000 MHz	95%	± 2.15 dB
Spurious Emissions, conducted	10000 MHz to 40000 MHz	95%	± 3.47 dB
Spurious Emissions, radiated	9 kHz to 30 MHz	95%	± 3.53 dB
Spurious Emissions, radiated	30 MHz to 1000 MHz	95%	± 4.44 dB
Spurious Emissions, radiated	1000 MHz to 30000 MHz	95%	± 2.34 dB
Spurious Emissions, radiated	30000 MHz to 40000 MHz	95%	± 5.13 dB

FCC ID: O2FM2UHF-RFID

IC: 9137A-M2UHFRFID

4.1 Conformity Decision Rule

The conformity decision rule is based on the ILAC G8 published at the time of reporting.

4.2 Measurement protocol for FCC and ISCED

4.2.1 General information

CSA Group Bayern GmbH is recognized as wireless testing laboratory under the CAB identifier:

FCC: DE 0011
ISCED: DE0009

4.2.2 General Standard information

The test methods used comply with ANSI C63.10 - "Testing Unlicensed Wireless Devices".

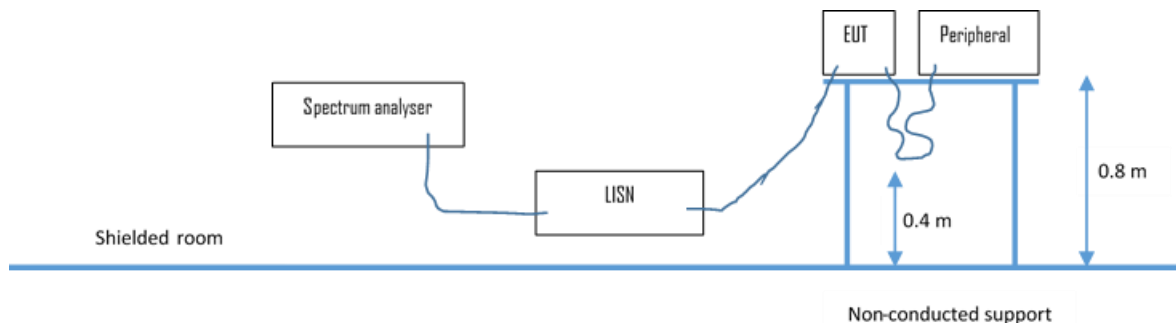
4.2.2.1 Justification

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.

4.2.3 Details of test procedures

4.2.3.1 Conducted emission

Test setup according ANSI C63.10



The final level, expressed in dBμV, is arrived at by taking the reading directly from the Spectrum analyser. This level is compared to the limit.

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

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

$$\mu\text{V} = \text{Inverse log}(\text{dB}\mu\text{V}/20)$$

Conducted emissions on the 50 Hz and/or 60 Hz power interface of the EUT are measured in the frequency range of 150 kHz to 30 MHz. 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. The receiver is protected by means of an impedance matched pulse limiter connected directly to the RF input. 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 emission is re-measured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

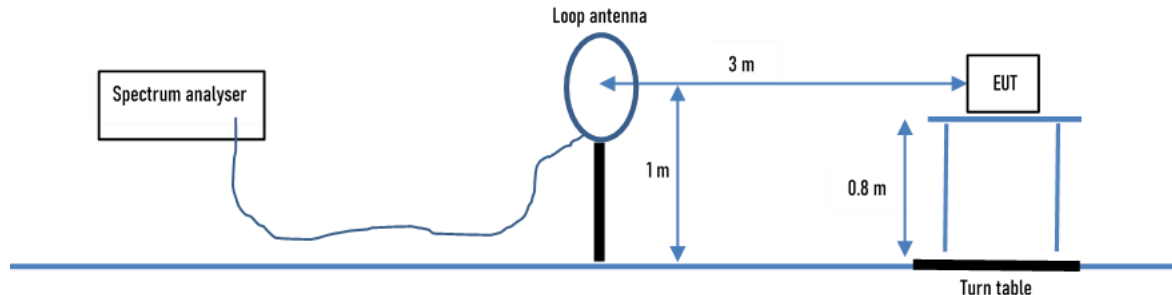
FCC ID: O2FM2UHF-RFID

IC: 9137A-M2UHF RFID

4.2.3.2 Radiated emission

4.2.3.2.1 OATS1 test site (9 kHz - 30 MHz):

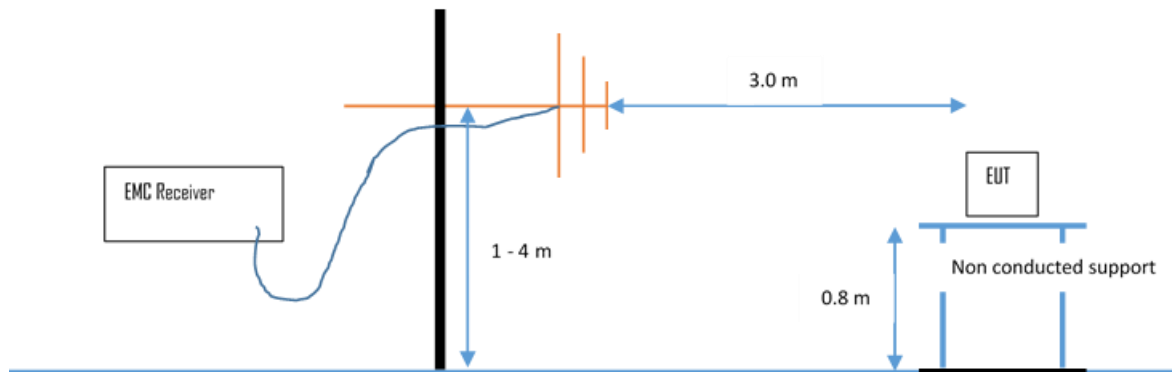
Test setup according ANSI C63.10



Emissions from the EUT are measured in the frequency range of 9 MHz to 30 MHz using a tuned receiver and a calibrated loop antenna. Table top equipment is placed on a 1.0 X 1.5 m non-conducting table 80 centimetres above the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screened room located outside the test area. The antenna is positioned 3, 10 or 30 metres horizontally from the EUT and is repeated vertically. To locate maximum emissions from the test sample the antenna is varied along the site axis and the EUT is rotated 360 degrees.

4.2.3.2.2 OATS1 test site (30 MHz - 1 GHz):

Test setup according ANSI C63.10.



Spurious emissions from the EUT are measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarised antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection. Table top equipment is placed on a 1.0 X 1.5 m non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screened room located outside the test area. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 metres and the EUT is rotated 360 degrees. The final level in dBµV/m is calculated by taking the reading from the EMI receiver (Level dBµV) and adding the correction factors and cable loss factor (dB). The FCC limit is subtracted from this result in order to provide the limit margin listed in the measurement protocol.

The resolution bandwidth setting:

30 MHz – 1000 MHz: RBW: 120 kHz

Example:

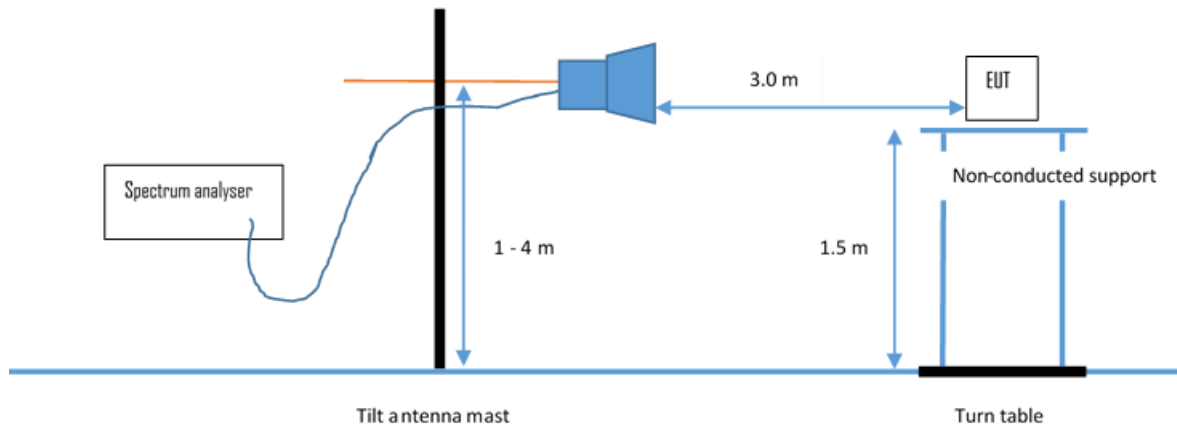
Frequency (MHz)	Level (dBµV)	+	Factor (dB)	=	Level (dBµV/m)	-	Limit (dBµV/m)	=	Delta (dB)
719.0	75.0	+	32.6	=	107.6	-	110.0	=	-2.4

FCC ID: O2FM2UHF-RFID

IC: 9137A-M2UHF RFID

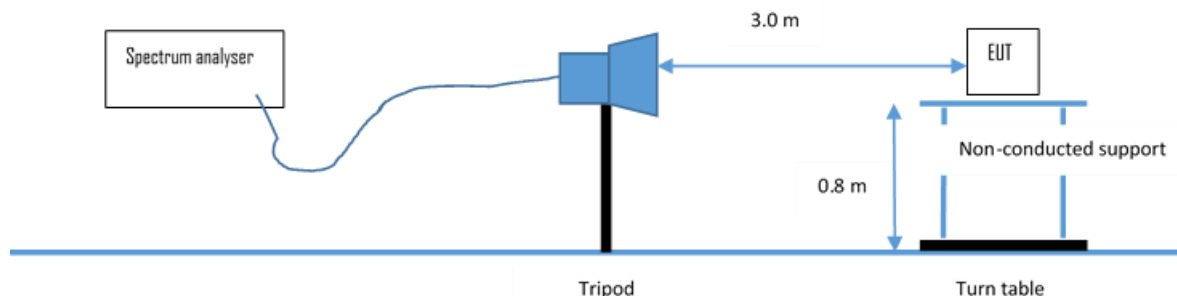
4.2.3.2.3 Anechoic chamber 1 (1000 MHz – 18000 MHz)

Test setup according ANSI C63.10.



Radiated emissions from the EUT are measured in the frequency range 1 GHz up to 18 GHz as specified in 47 CFR Part 15, Subpart A, Section 15.33, using a spectrum analyser and appropriate linearly polarized antennas. Table top equipment is placed on a non-conducting table, 1.5 metre above the ground plane. The turntable is fully covered with the appropriate absorber (Type VHP-12). Any controlling device is positioned such that it does not significantly influence the measurement results. Interconnecting cables that hang closer than 40 cm to the ground plane are folded back and forth in the center, forming a bundle 30 cm to 40 cm long. Measurements are made in three orientations of the EUT and the horizontal and vertical polarization planes of measurement antenna in a fully anechoic room. The measurement antenna is adjusted and the EUT orientated to permit the measurement of the maximum emission from the EUT. The conditions determined as worst-case will then be used for the final measurements.

4.2.3.2.4 Anechoic chamber 1 (18 GHz – 40 GHz)



Emissions from the EUT are measured in the frequency range 18 GHz up to 40 GHz as specified in 47 CFR Part 15, Subpart A, Section 15.33, using a spectrum analyser and appropriate linearly polarized antennas. Table top equipment is placed on a non-conducting table, 0.8 metre above the ground plane. The turntable is fully covered with the appropriate absorber (Type VHP-12). Any controlling device is positioned such that it does not significantly influence the measurement results. Interconnecting cables that hang closer than 40 cm to the ground plane are folded back and forth in the center, forming a bundle 30 cm to 40 cm long. Measurements are made in three orientations of the EUT and the horizontal and vertical polarization planes of measurement antenna in a fully anechoic room. The measurement antenna is adjusted and the EUT orientated to permit the measurement of the maximum emission from the EUT. The conditions determined as worst-case will then be used for the final measurements. Where appropriate, the test distance may be reduced in order to detect emissions under better uncertainty. The limits are adopted.

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.

FCC ID: O2FM2UHF-RFID

IC: 9137A-M2UHF RFID

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: NONE

Remarks: Not applicable, the EUT is battery driven.

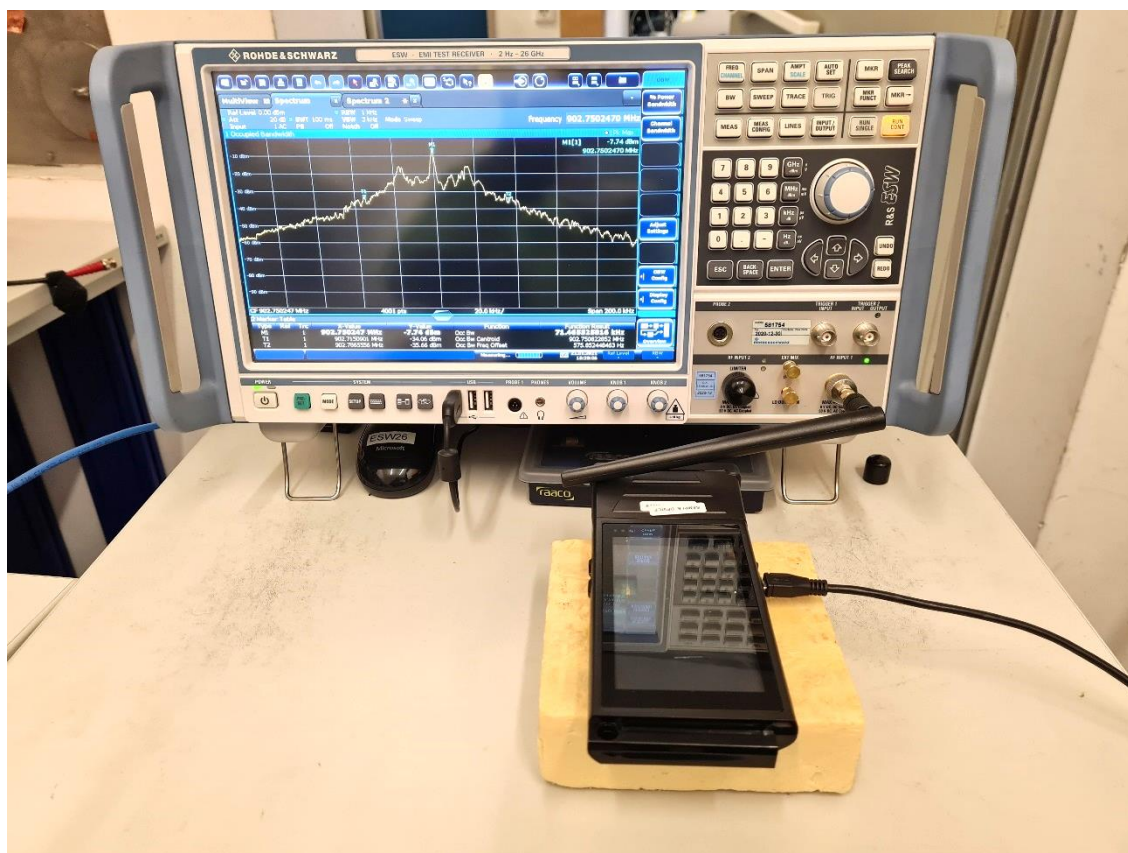
5.2 Emission bandwidth

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

5.2.1 Description of the test location

Test location: Shielded Room S6

5.2.2 Photo documentation of the test set-up



FCC ID: O2FM2UHF-RFID

IC: 9137A-M2UHF RFID

5.2.1 Applicable standard

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

For frequency hopping systems operating in the 902-928 MHz band: The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

5.2.2 Description of Measurement

The bandwidth is measured at an amplitude level reduced from the seeence level by a specified ratio of -20 dB. The seeence level is the level of the highest signal amplitude 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.

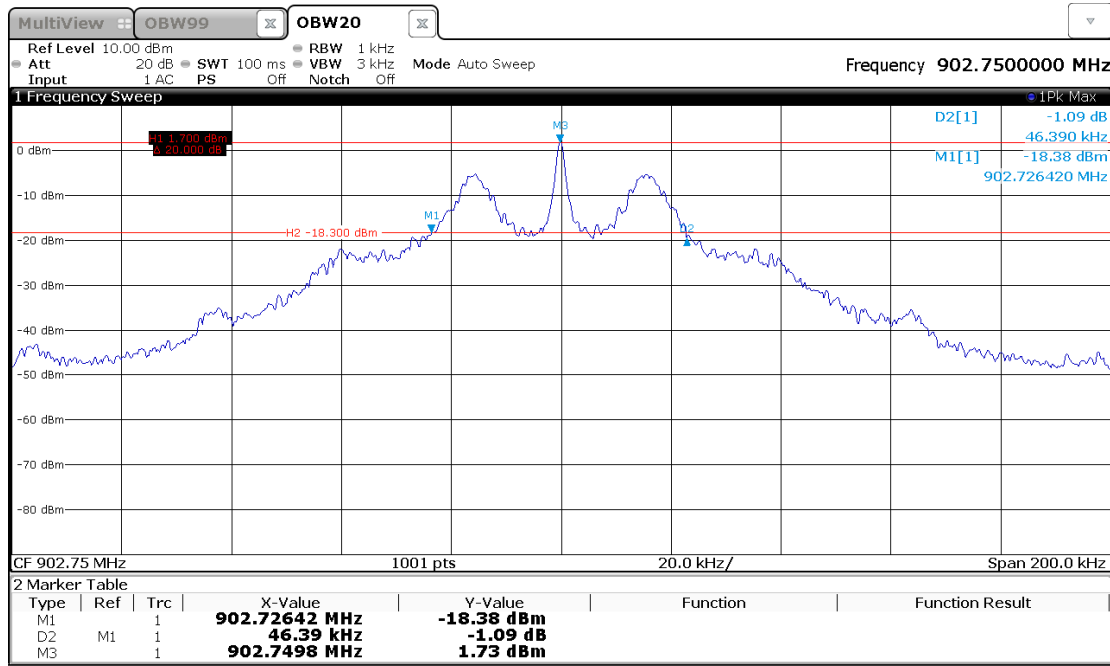
Analyser settings:

RBW: 1 kHz, VBW: 3 kHz, Sweep time: auto, Detector: Peak, Trace mode: Max hold

5.2.3 Test result

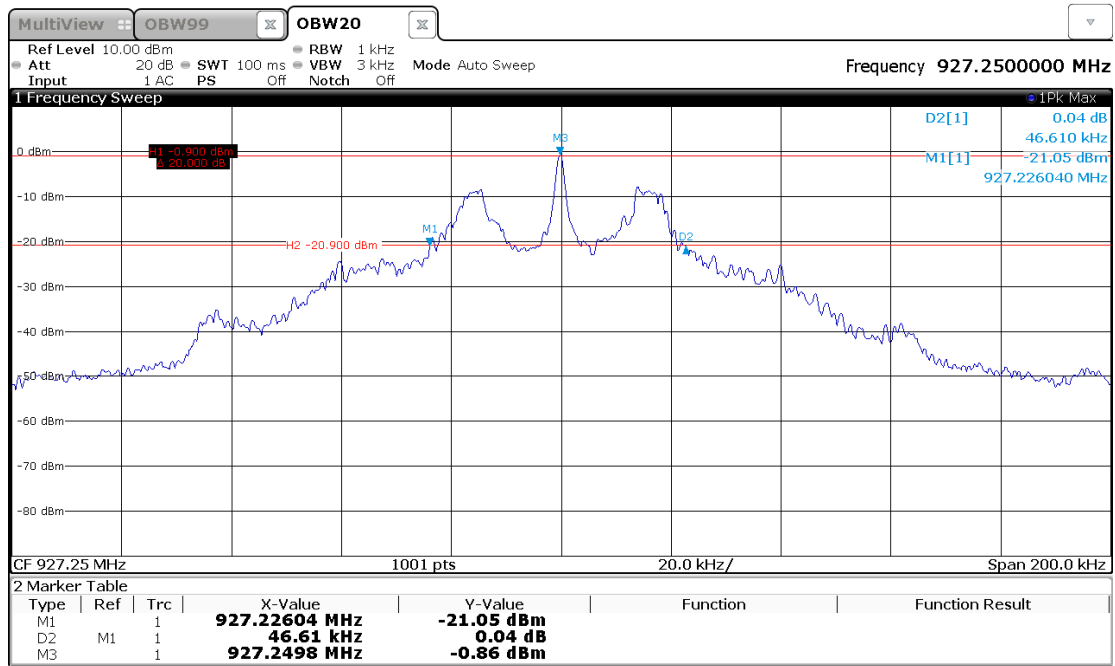
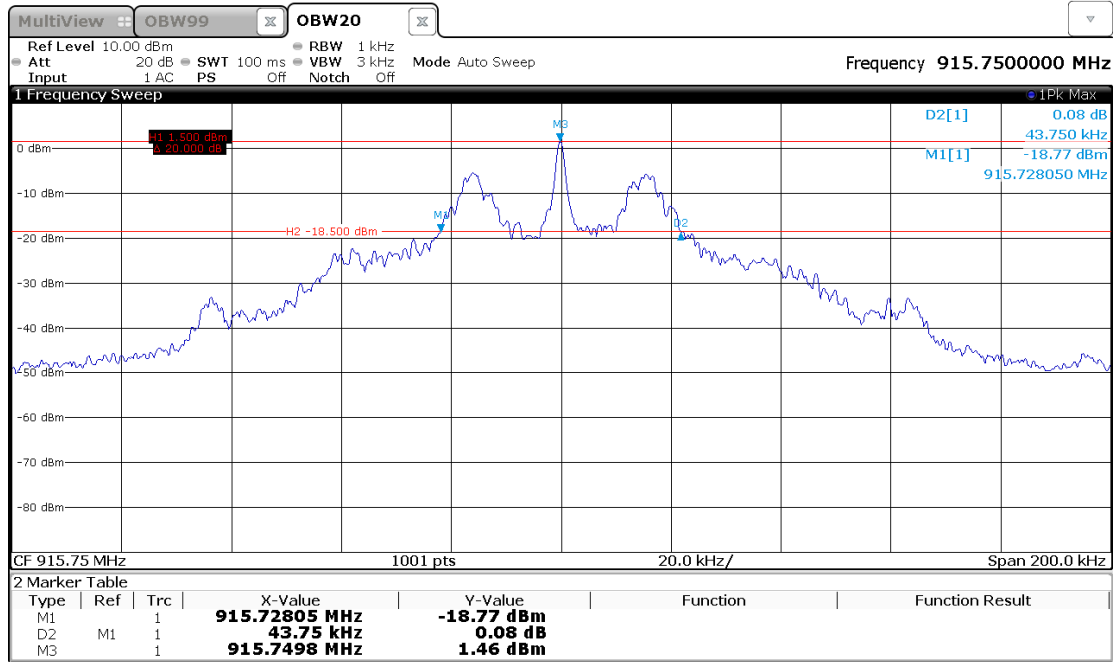
EBW 20 dB

Mode 1:



FCC ID: O2FM2UHF-RFID

IC: 9137A-M2UHF RFID

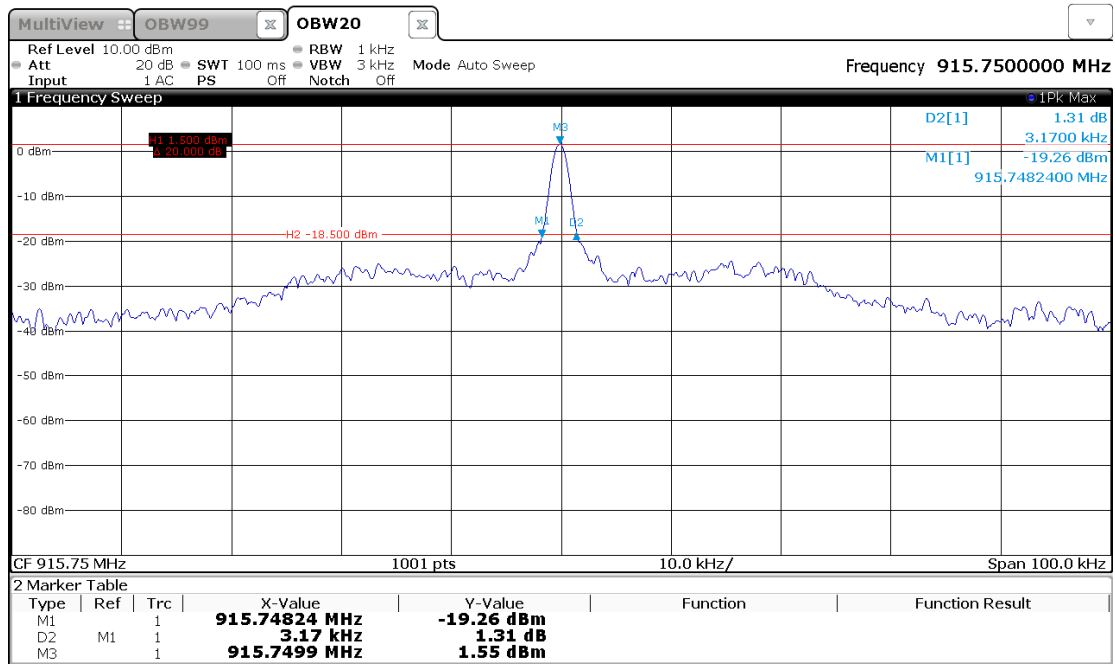
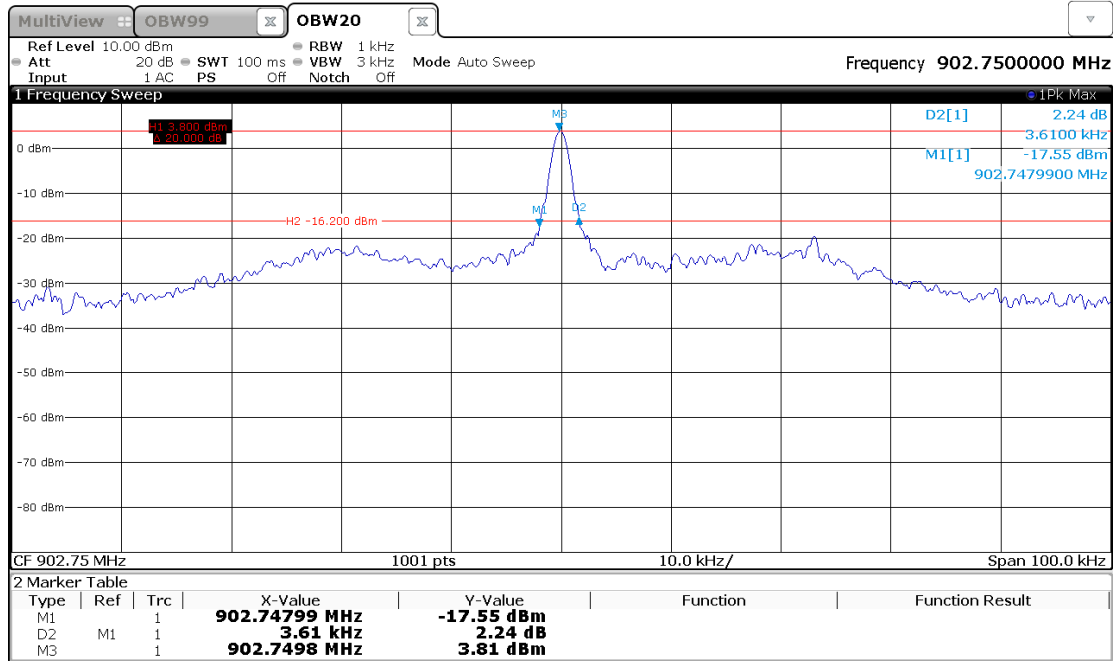


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Mode 3

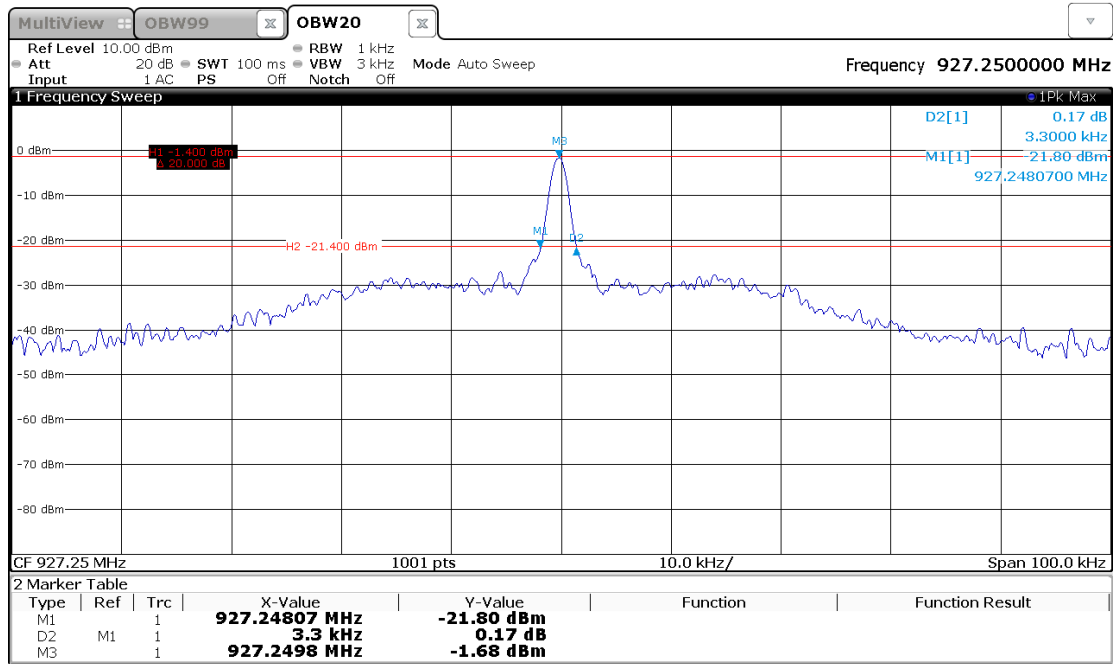
FCC ID: O2FM2UHF-RFID

IC: 9137A-M2UHF RFID



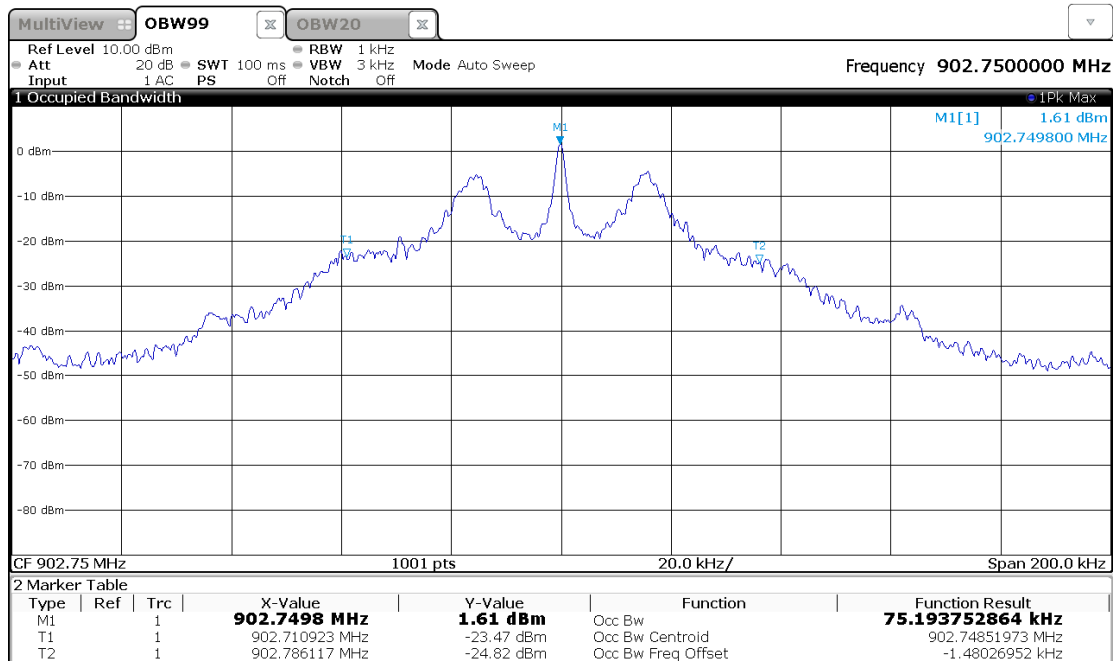
FCC ID: O2FM2UHF-RFID

IC: 9137A-M2UHF RFID



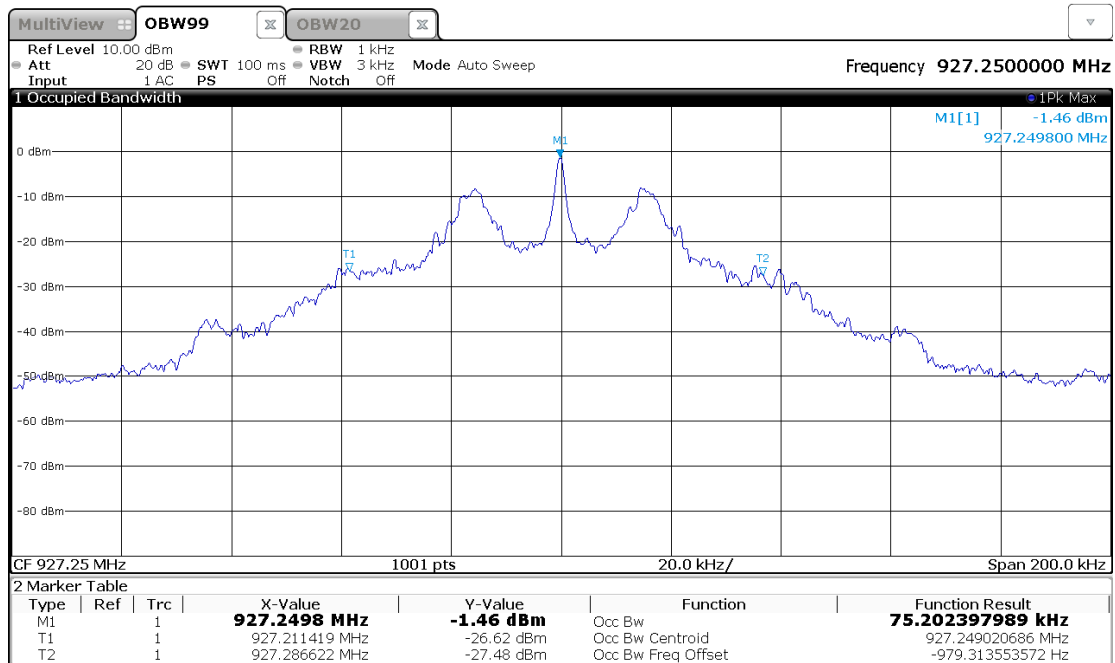
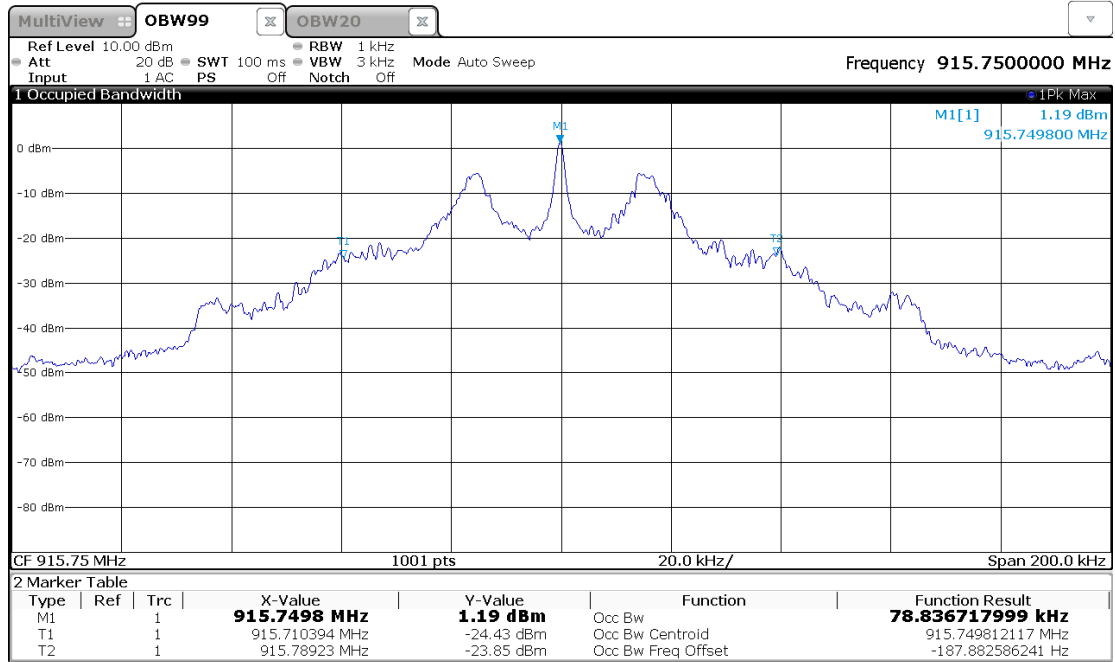
Note: The EBW 20 dB is smaller then 500 kHz.

OBW99:
Mode 1



FCC ID: O2FM2UHF-RFID

IC: 9137A-M2UHF RFID

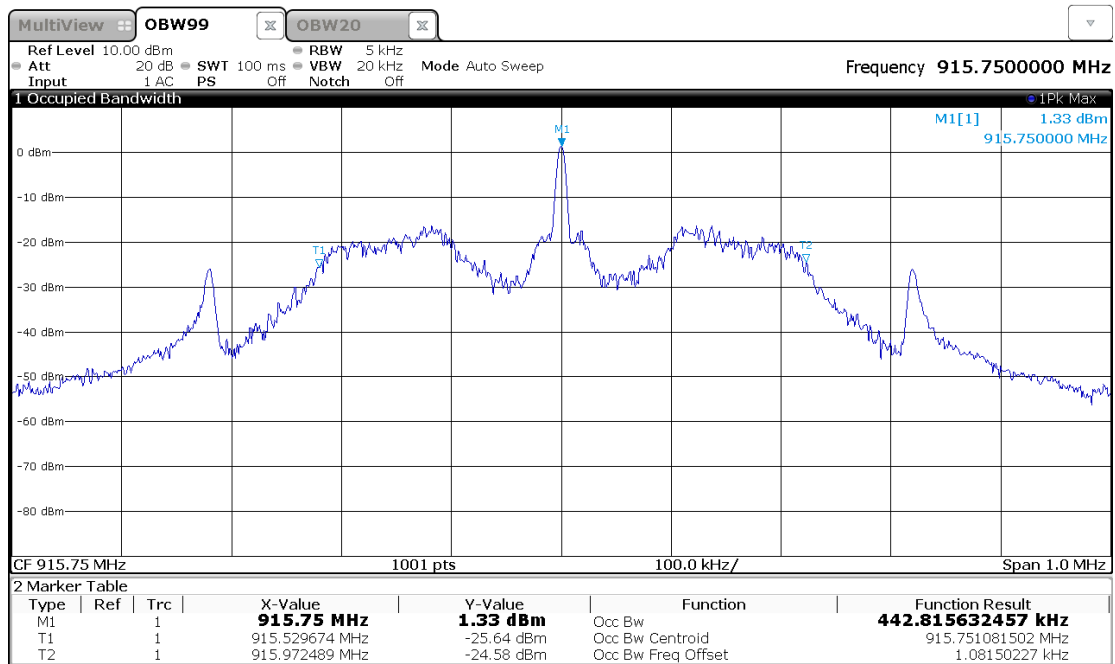
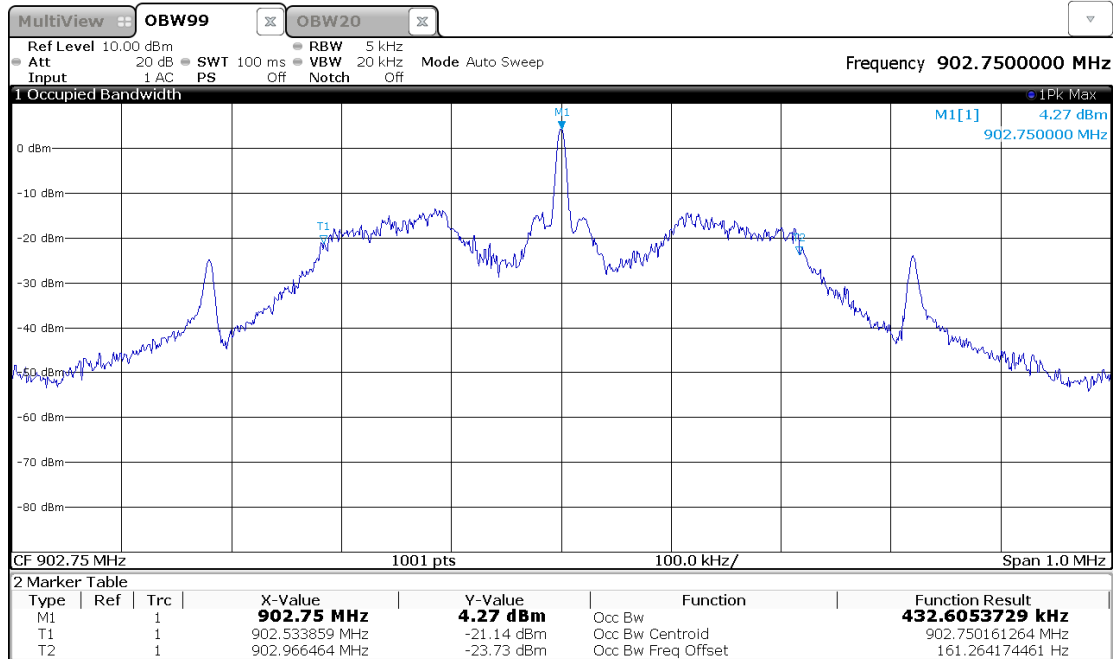


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Mode 3

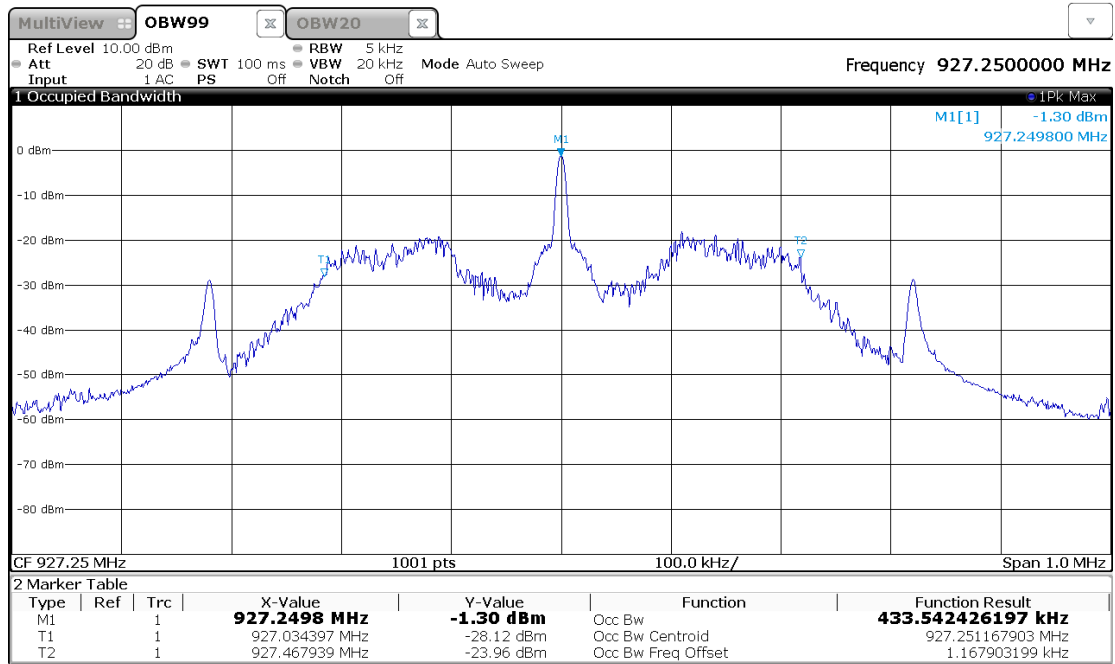
FCC ID: O2FM2UHF-RFID

IC: 9137A-M2UHF RFID



FCC ID: O2FM2UHF-RFID

IC: 9137A-M2UHF RFID



Limit according to FCC Part15C, Section 15.247(a)(1)(i).

For frequency hopping systems operating in the 902-928 MHz band:
The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

The requirements are **FULFILLED**.

Remarks:

FCC ID: O2FM2UHF-RFID

IC: 9137A-M2UHFRFID

5.3 Maximum peak output power

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

5.3.1 Description of the test location

Test location: OATS 1
Test distance: 3 m

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: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels.

5.3.4 Description of Measurement

The measurement is performed radiated with a measurement receiver, because of the PCB antenna, no temporary antenna connector is available. While measuring the hopping is stopped, the carrier is measured in continuous transmit mode 1 and 3 using the assigned frequency according to ANSI C63.10, item 7.8.5.

Receiver settings:
RBW: 120 kHz, Detector: Max peak, Measurement time: 1 s

FCC ID: O2FM2UHF-RFID
IC: 9137A-M2UHF RFID
5.3.5 Test result

The output power is measured in terms of fieldstrength.

Frequency (MHz)	Reading Vert. (dBμV)	Reading Hor. (dBμV)	Correct. Vert. (dB)	Correct. Hor. (dB)	Level Vert. (dBμV/m)	Level Hor. (dBμV/m)	Limit (dBμV/m)	Dlimit (dB)
Mode1								
902.75	84.5	89.4	29.9	30.3	114.4	119.7	131.2	-11.5
915.25	80.7	88.2	30.0	30.4	110.7	118.6	131.2	-12.6
927.25	80.6	87.0	30.1	30.5	110.7	117.5	131.2	-13.7
Mode3								
902.75	84.5	89.5	29.9	30.3	114.4	119.8	131.2	-11.4
915.25	80.6	88.3	30.0	30.4	110.6	118.7	131.2	-12.5
927.25	80.6	86.7	30.1	30.5	110.7	117.2	131.2	-14.0

For calculation to dBm to following formula is used:

$$\text{EIRP} = \text{FS} - 95.2 = 119.7 \text{ dBμV/m} - 95.2 = 24.5 \text{ dBm};$$

Mode 1:

Channel	f (MHz)	EIRP (dBm)	Gain (dBi)	A (dBm)	Limit (dBm)	Delta (dB)
2	902.75	24.5	0.0	24.5	30.0	-5.5
27	915.25	23.4	0.0	23.4	30.0	-6.6
51	927.25	22.0	0.0	22.0	30.0	-8.0

Mode 3:

Channel	f (MHz)	EIRP (dBm)	Gain (dBi)	A (dBm)	Limit (dBm)	Delta (dB)
2	902.75	24.6	0.0	24.6	30.0	-5.4
27	915.25	23.5	0.0	23.5	30.0	-6.5
51	927.25	22.0	0.0	22.0	30.0	-8.0

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

Frequency (MHz)	Channel separation kHz	Hop Channels	Peak power limit (dBm)	(Watt)
902 - 928	500	≥ 50	30	1

The requirements are **FULFILLED**.

Remarks:

FCC ID: O2FM2UHF-RFID**IC: 9137A-M2UHFRFID****5.4 Spurious emissions**

For test instruments and accessories used see section 6 Part **SER1, SER2 and SER3**.

5.4.1 Description of the test location

Test location: NONE

5.4.2 Applicable standard

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

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the 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 a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

5.4.3 Description of Measurement

A spectrum analyser is connected to the output of the transmitter via a suitable attenuator while EUT is operating in transmit mode using the assigned frequency according to ANSI C63.10, item 7.8.8.

Spectrum analyser settings:

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

Remarks: Not applicable, the EUT hold the general limits, see 5.6

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.

FCC ID: O2FM2UHF-RFID

IC: 9137A-M2UHF RFID

5.5 Band edge compliance

For test instruments and accessories used see section 6 Part SEC2-3.

5.5.1 Description of the test location

Test location: Shielded Room S6

5.5.2 Applicable standard

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

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).

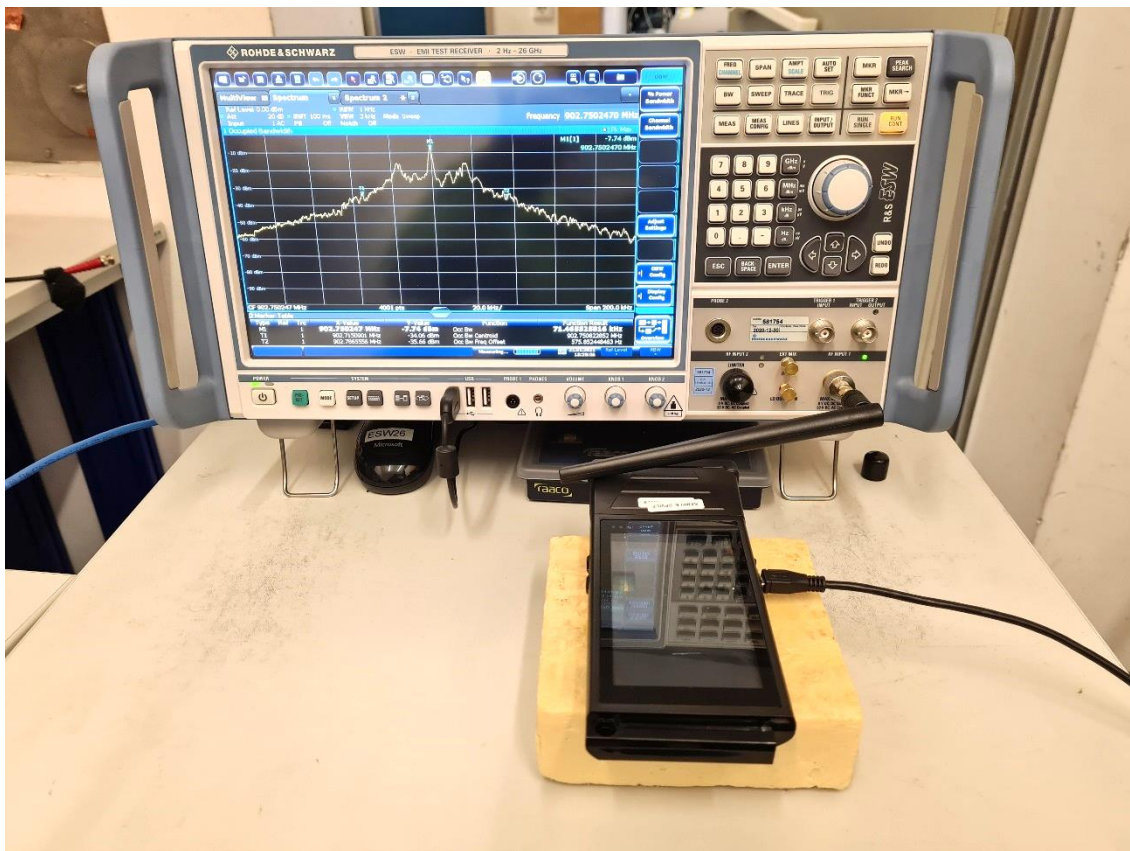
5.5.3 Description of Measurement

A spectrum analyser is connected to the output of the transmitter via a suitable attenuator while EUT was operating in transmit mode at the assigned frequency according to ANSI C63.10, item 7.8.6 and 6.10.

Spectrum analyser settings:

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

5.5.4 Photo documentation of the test set-up

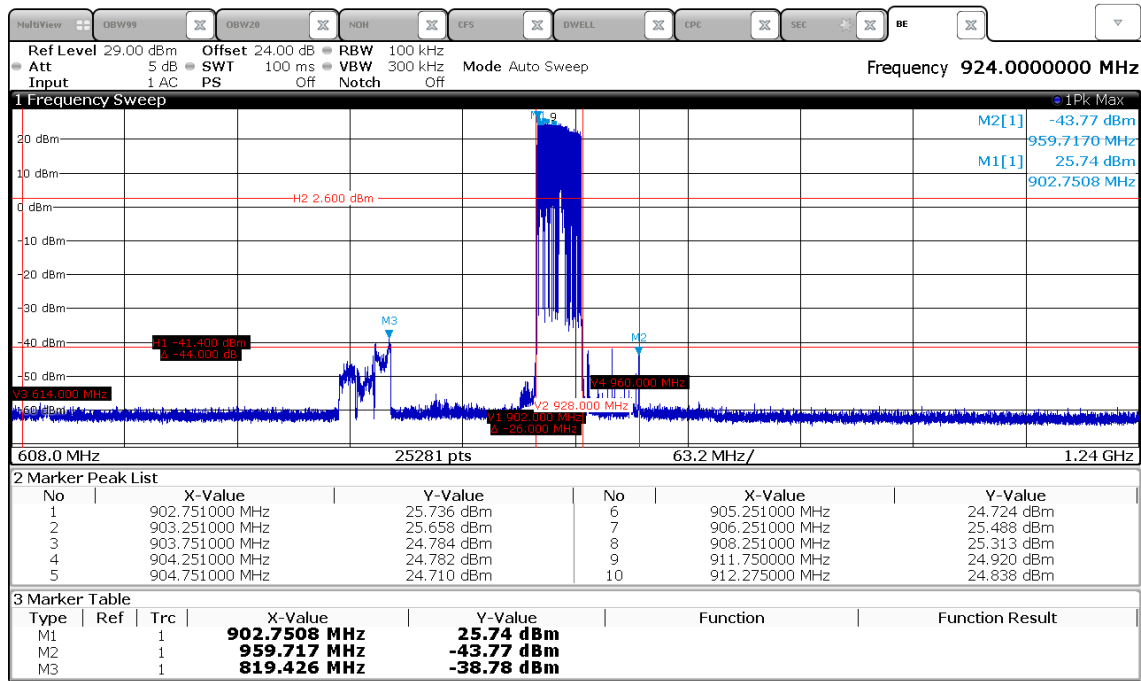


FCC ID: O2FM2UHF-RFID

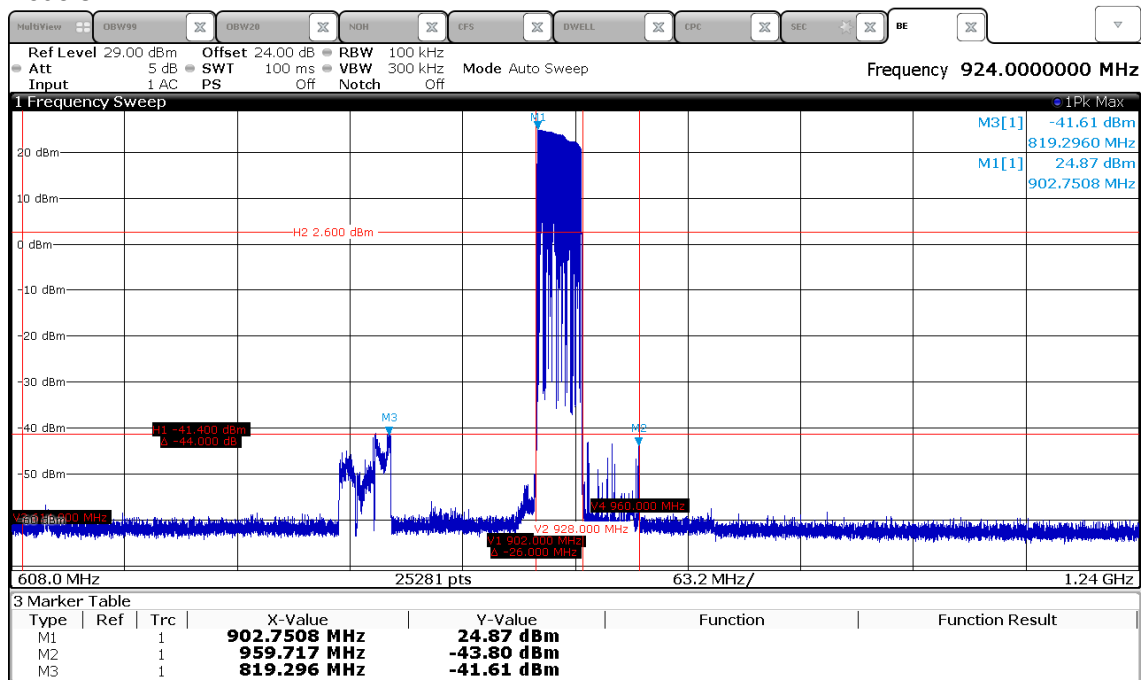
IC: 9137A-M2UHF RFID

5.5.5 Test result

Hopping, mode 1



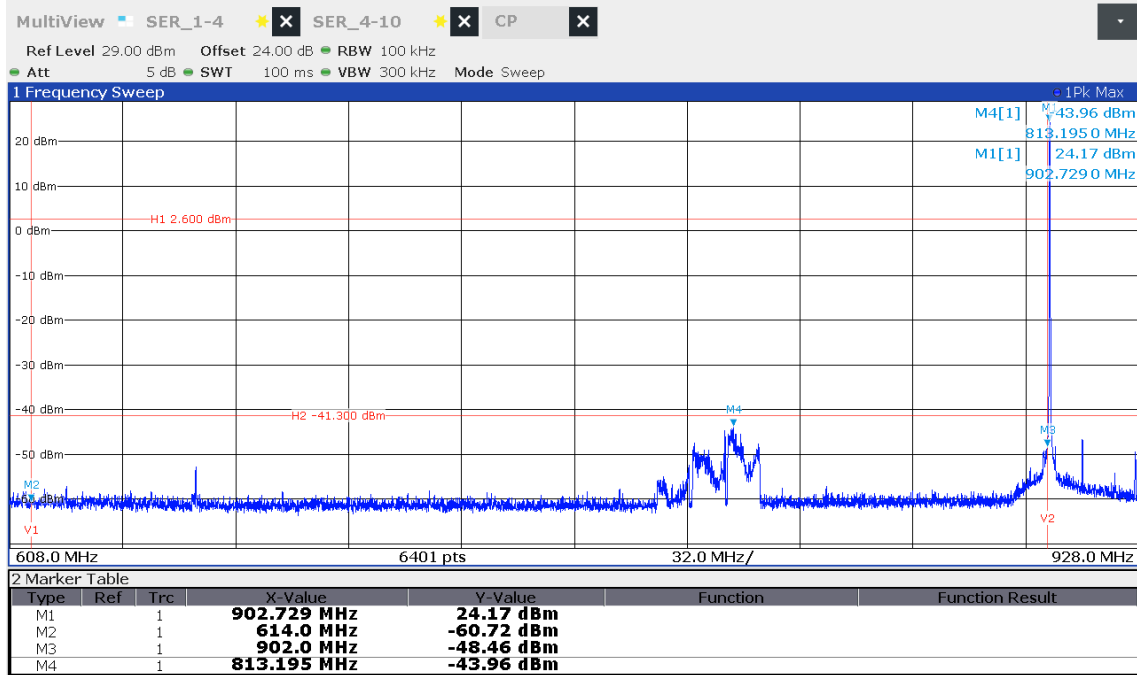
Hopping, mode 3



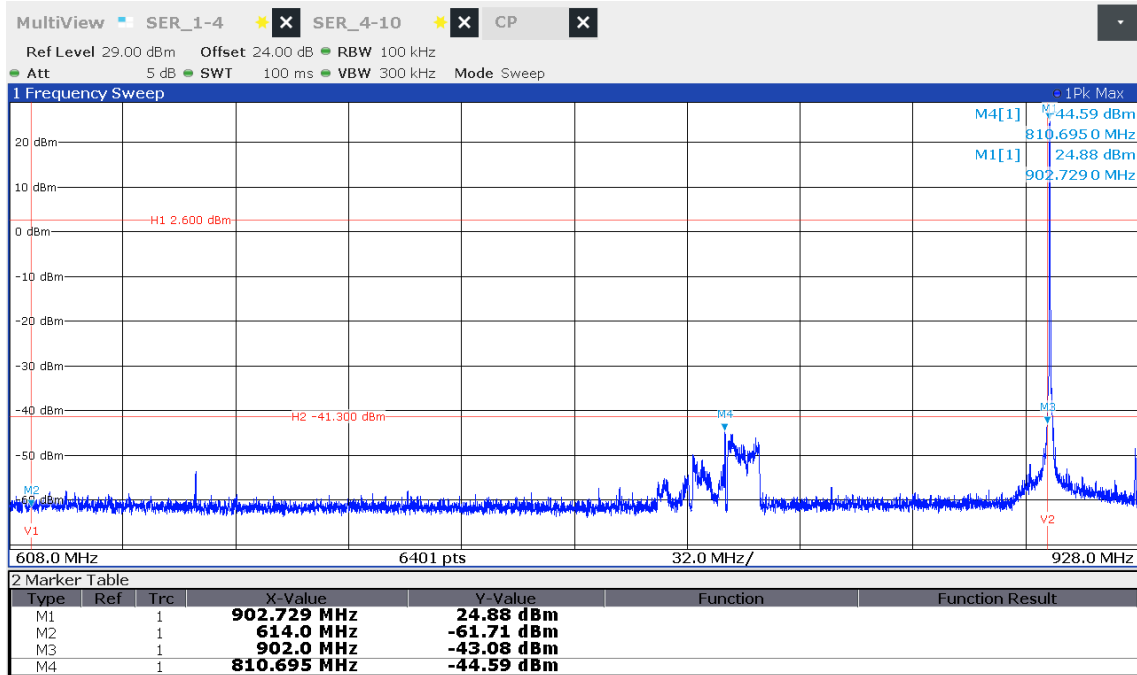
FCC ID: O2FM2UHF-RFID

IC: 9137A-M2UHF RFID

CH2, mode 1:



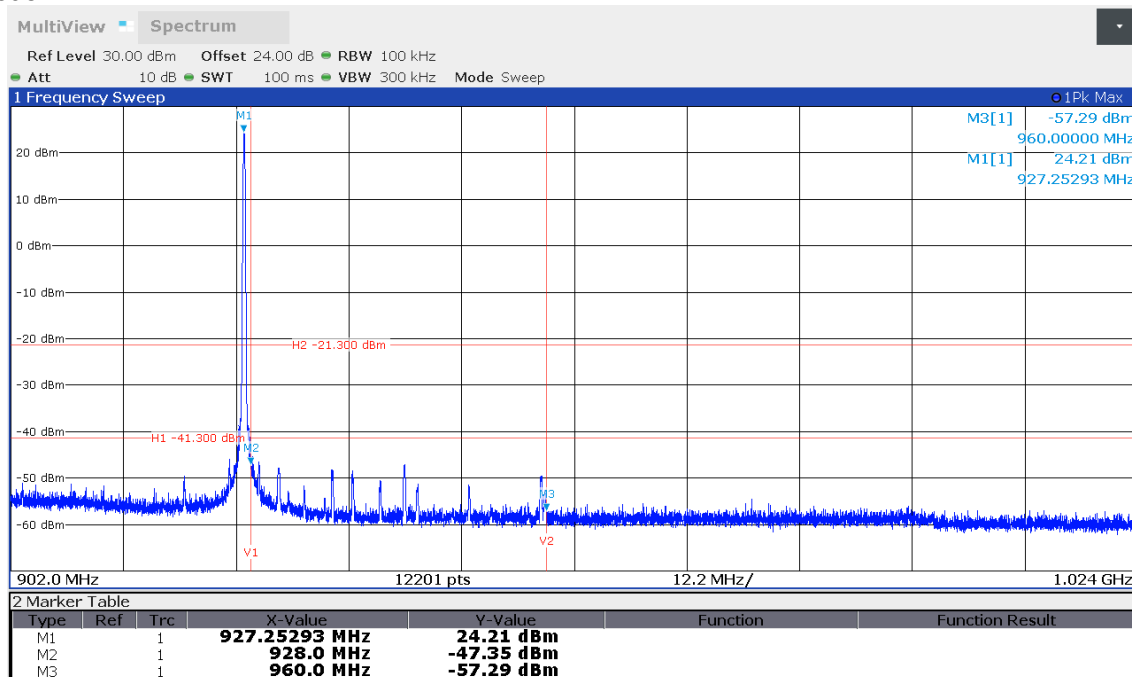
CH2, mode 3:



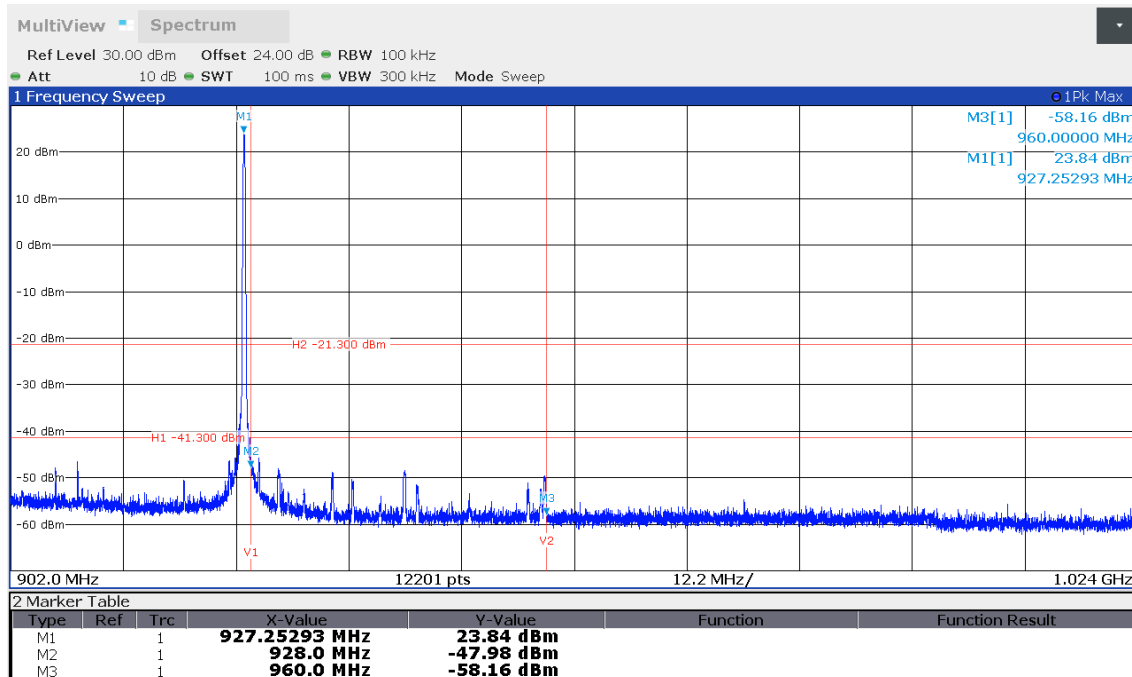
FCC ID: O2FM2UHF-RFID

IC: 9137A-M2UHFRFID

CH51, mode 1:



CH51, mode 3:



FCC ID: O2FM2UHF-RFID**IC: 9137A-M2UHFRFID**

Peak-Limit according to FCC Part 15C, Section 15.247(d):

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).

The requirements are **FULFILLED**.

Remarks:

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.

FCC ID: O2FM2UHF-RFID

IC: 9137A-M2UHFRFID

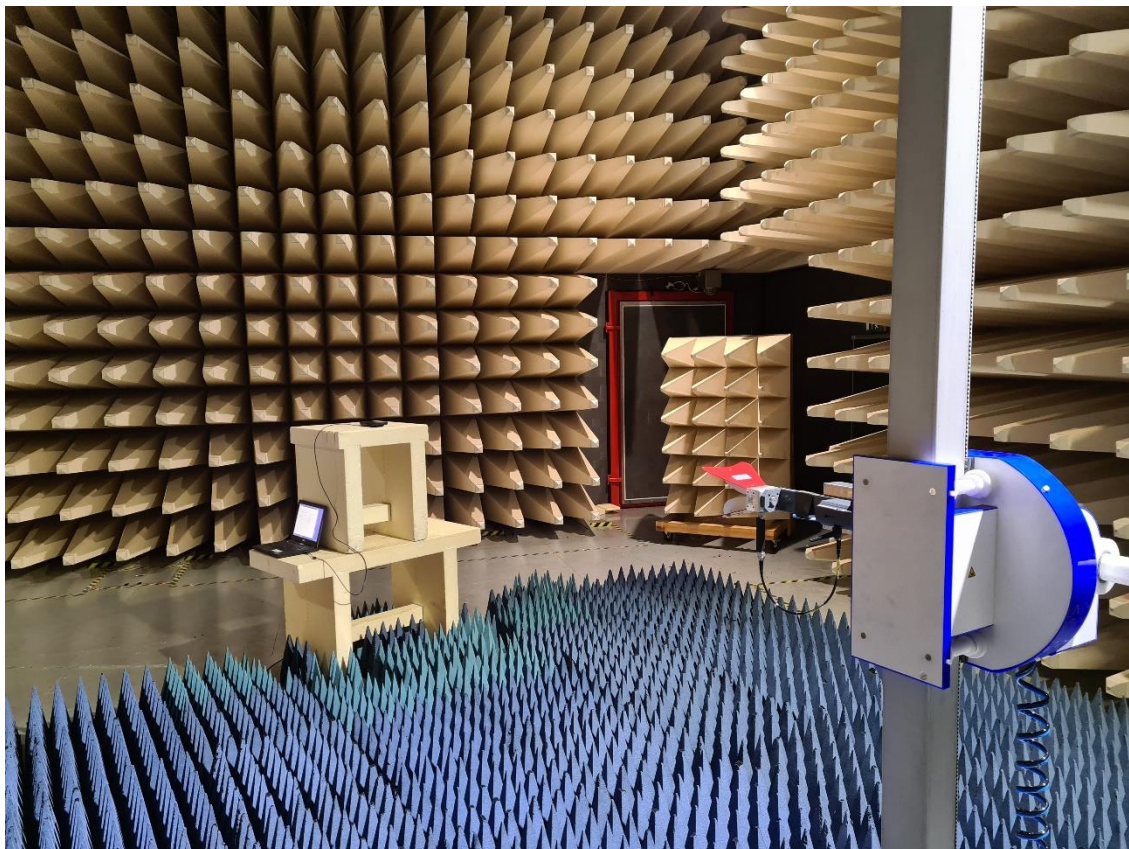
5.6 Radiated emissions in restricted bands

For test instruments and accessories used see section 6 Part **SER3**.

5.6.1 Description of the test location

Test location: Anechoic chamber 1
Test distance: 3 m

5.6.2 Photo documentation of the test set-up



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.

FCC ID: O2FM2UHF-RFID
IC: 9137A-M2UHF RFID
5.6.3 Applicable standard

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

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).

5.6.4 Description of Measurement

The restricted bands are measured radiated. The span of the spectrum analyser was set wide enough to capture the restricted band and measure 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.

Spectrum analyser settings:

RBW: 1 MHz,	VBW: 3 MHz,	Sweep: 100 ms,	Detector function: Peak
RBW: 1 MHz,	VBW: 3 MHz,	Sweep: 100 ms,	Detector function: RMS

5.6.5 Test result

Note: Mode 1 and mode 3 is so similar, that mode 1 is measured only.

f < 1000 MHz

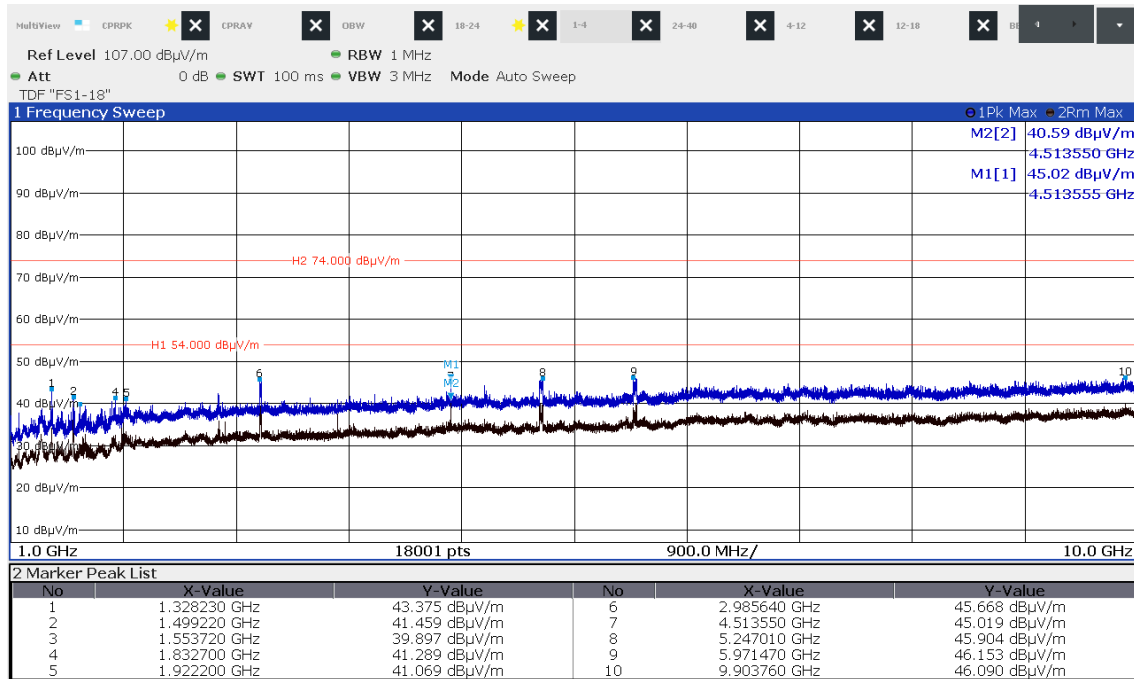
Frequency (MHz)	Reading Vert. (dBµV)	Reading Hor. (dBµV)	Correct. Vert. (dB)	Correct. Hor. (dB)	Level Vert. (dBµV/m)	Level Hor. (dBµV/m)	Limit (dBµV/m)	Dlimit (dB)
39.98	11.5	1.6	14.0	15.0	25.5	16.6	40.0	-14.5
72.90	13.7	6.3	12.3	12.8	26.0	19.1	40.0	-14.0
199.69	21.8	7.7	13.9	13.3	35.7	21.0	43.5	-7.8
266.00	12.8	8.2	16.2	16.3	29.0	24.5	46.0	-17.0
551.00	4.9	1.3	24.0	24.3	28.9	25.6	46.0	-17.1

FCC ID: O2FM2UHF-RFID

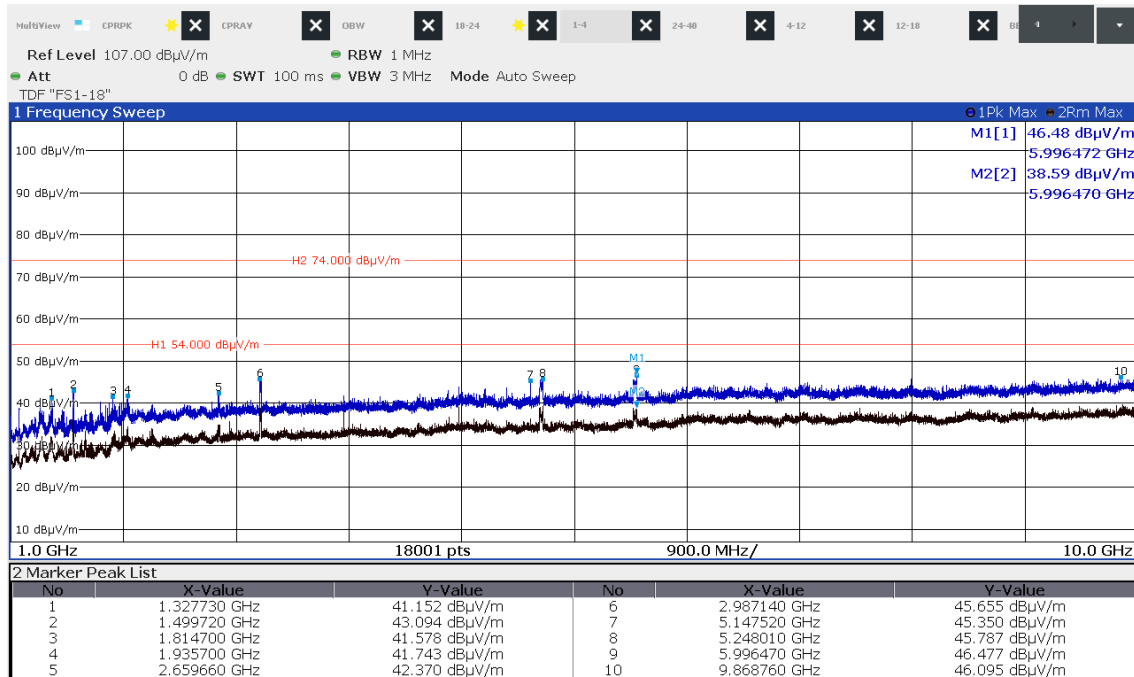
IC: 9137A-M2UHF RFID

f > 1000 MHz

Ch2, mode1



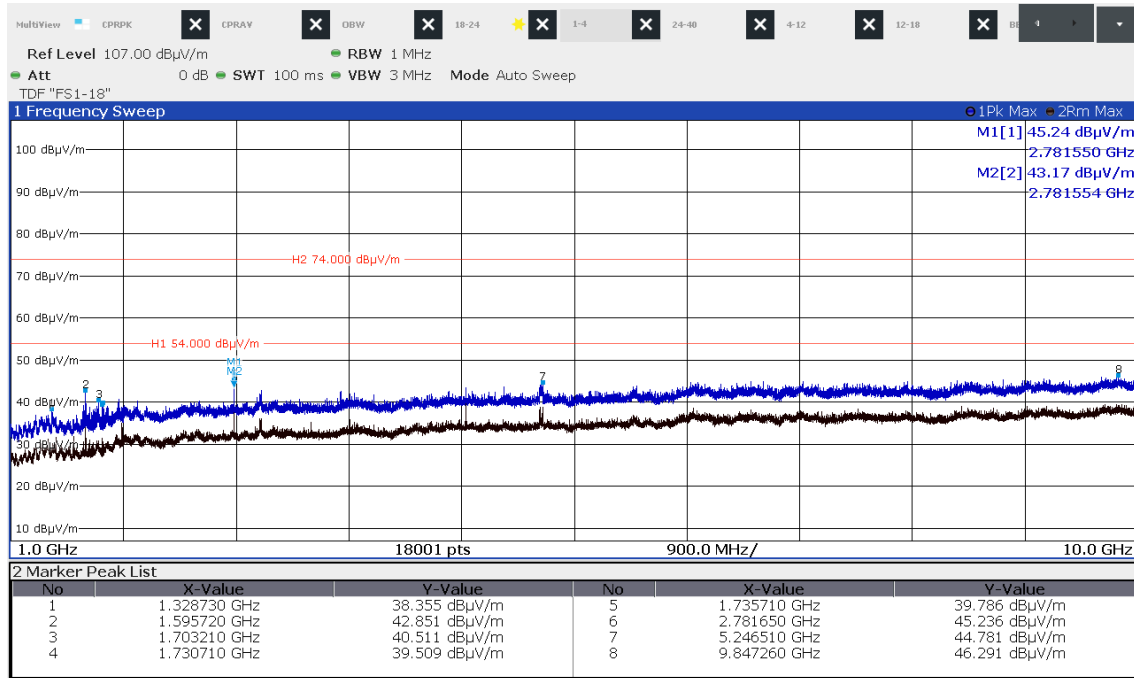
CH27



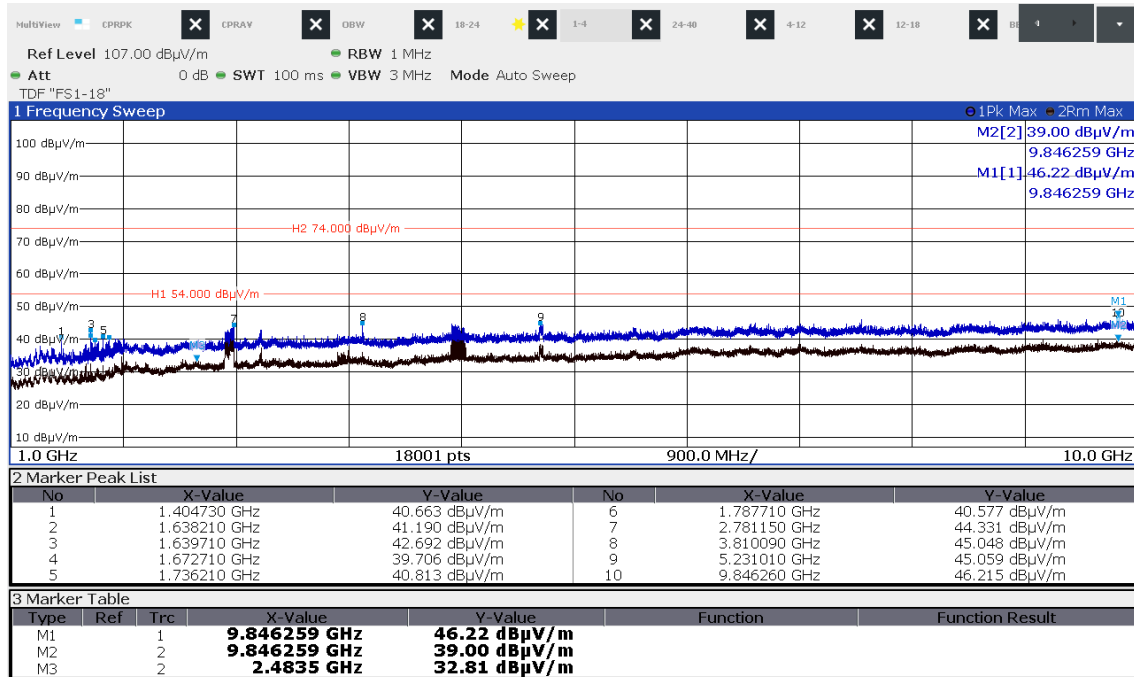
CH51

FCC ID: O2FM2UHF-RFID

IC: 9137A-M2UHF RFID



Hopping, mode 1



Peak-Limit according to FCC Part 15C, Section 15.205(a):

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).

Frequency	Limits acc. 15.209		Measurement distance
(MHz)	PK dB(μV/m)	AV dB(μV/m)	(m)
210 - 960	66	46	3

FCC ID: O2FM2UHF-RFID
IC: 9137A-M2UHF RFID
Restricted bands of operation:

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209:

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

RSS-Gen, Table 6 – Restricted Frequency Bands

MHz	MHz	MHz	GHz
0.090 - 0.110	12.57675 - 12.57725	399.9 - 410	7.250 - 7.750
0.495 - 0.505	13.36 - 13.41	608 - 614	8.025 – 8.500
2.1735 - 2.1905	16.42 - 16.423	960 - 1427	9.0 - 9.2
3.020 - 3.026	16.69475 - 16.69525	1435 - 1626.5	9.3 - 9.5
4.125 - 4.128	16.80425 - 16.80475	1645.5 - 1646.5	10.6 - 12.7
4.17725 - 4.17775	25.5 - 25.67	1660 - 1710	13.25 - 13.4
4.20725 - 4.20775	37.5 - 38.25	1718.8 - 1722.2	14.47 - 14.5
5.677 - 5.683	73 - 74.6	2200 - 2300	15.35 - 16.2
6.215 - 6.218	74.8 - 75.2	2310 - 2390	17.7 - 21.4
6.26775 - 6.26825	108 – 138	2483.5 - 2500	22.01 - 23.12
6.31175 - 6.31225	149.9 - 150.05	2655 - 2900	23.6 - 24.0
8.291 - 8.294	156.52475 - 156.52525	3260 – 3267	31.2 - 31.8
8.362 - 8.366	156.7 - 156.9	3332 - 3339	36.43 - 36.5
8.37625 - 8.38675	162.0125 - 167.17	3345.8 - 3358	Above 38.6
8.41425 - 8.41475	167.72 - 173.2	3500 - 4400	
12.29 - 12.293	240 – 285	4500 - 5150	
12.51975 - 12.52025	322 - 335.4	5350 - 5460	

The requirements are **FULFILLED**.

Remarks: Only the worst-case plots are listed.

FCC ID: O2FM2UHF-RFID**IC: 9137A-M2UHFRFID****5.7 Equal hopping frequency use**

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

Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

The manufacturer declares following:

All communications between the reader and tags conform to the EPC Global Gen2 standard. At the start of a communication session the reader transmits CW for a minimum of 1.5ms to power all of the tags in the field. The reader then transmits a 'query' data command to direct tags in its range to identify themselves. Upon completion of the command, the reader again transmits CW to keep the tags powered and allow one of the tags to respond through backscatter modulation of the carrier which the tag receives from the reader. Once a particular tag has been singulated and its EPC code ('ID') received, that tag leaves the round, the reader issues another query command and the process repeats. This process continues until the transmitter ramps its RF power down as close as possible to the end of each 200ms transmission interval. A new communication round is initiated after the LO completes the hop when transmission is resumed.

Remarks:

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.

FCC ID: O2FM2UHF-RFID

IC: 9137A-M2UHF RFID

5.8 Dwell time

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

5.8.1 Description of the test location

Test location: Shielded Room S6

5.8.2 Photo documentation of the test set-up



5.8.3 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 and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period;

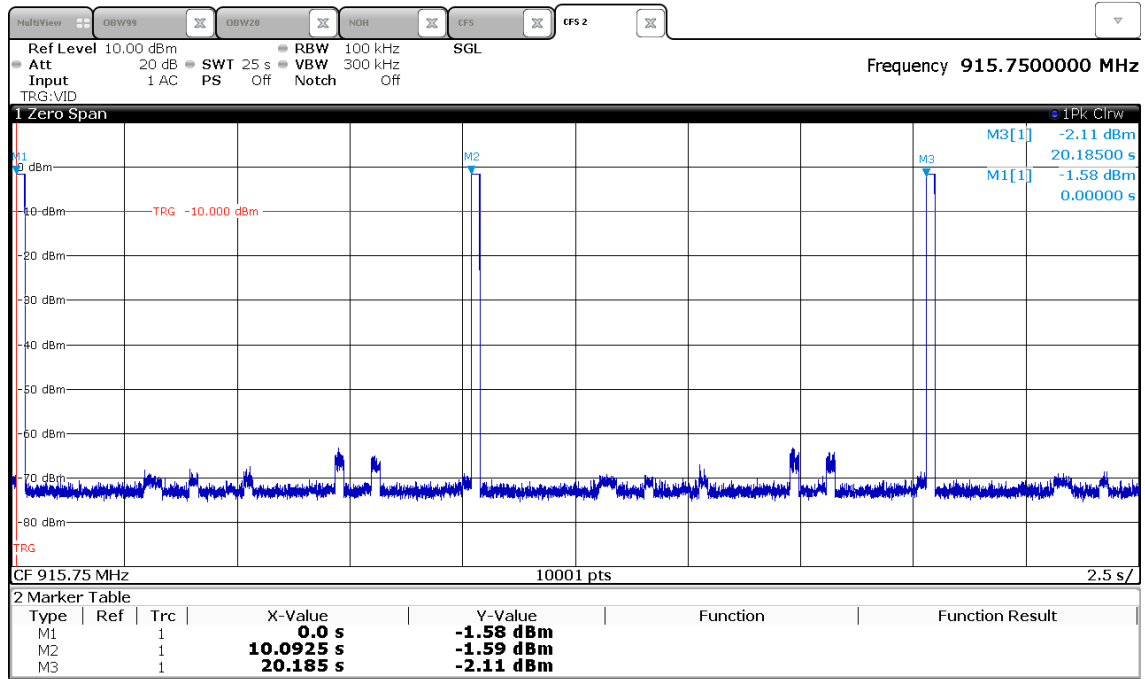
The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

FCC ID: O2FM2UHF-RFID

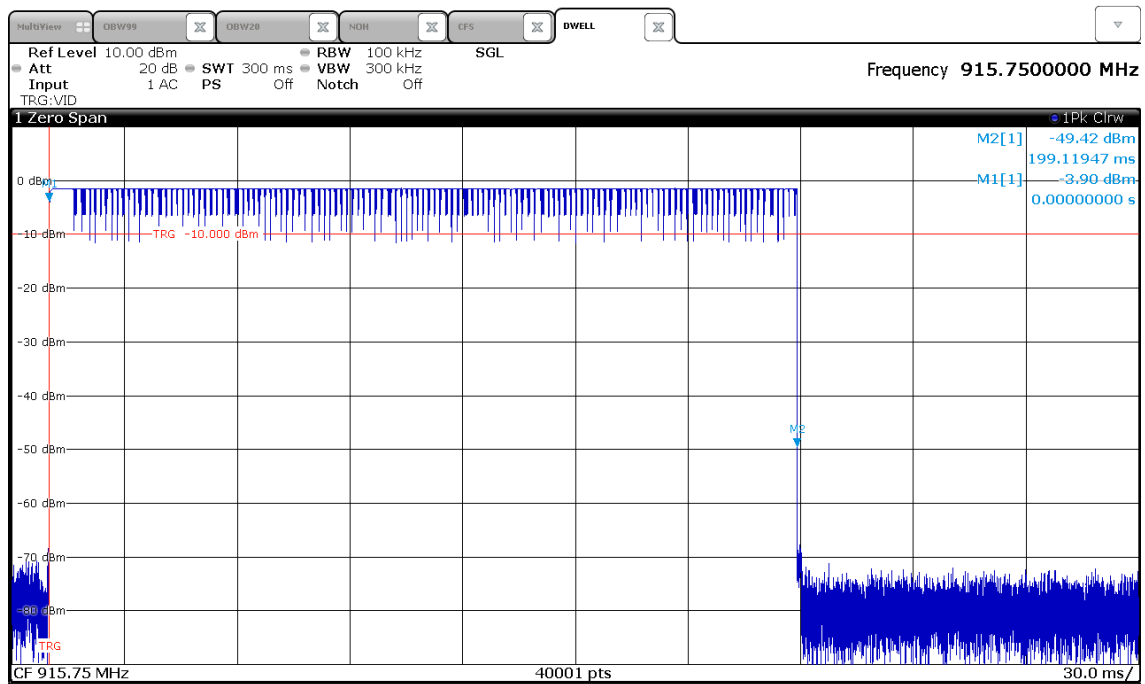
IC: 9137A-M2UHF RFID

5.8.4 Test result

Mode 1:



The dwell time is measured at ch27 in a 20 s period.

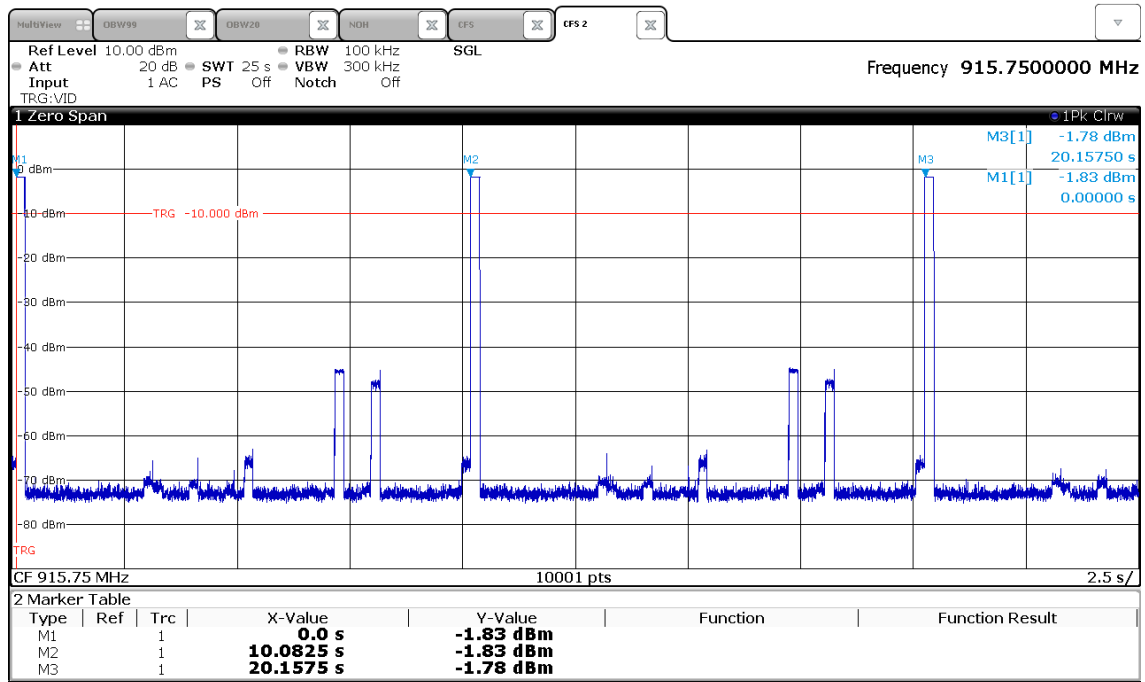


Mode 1 Dwell time = 2 * 199.1 = 398.2 ms

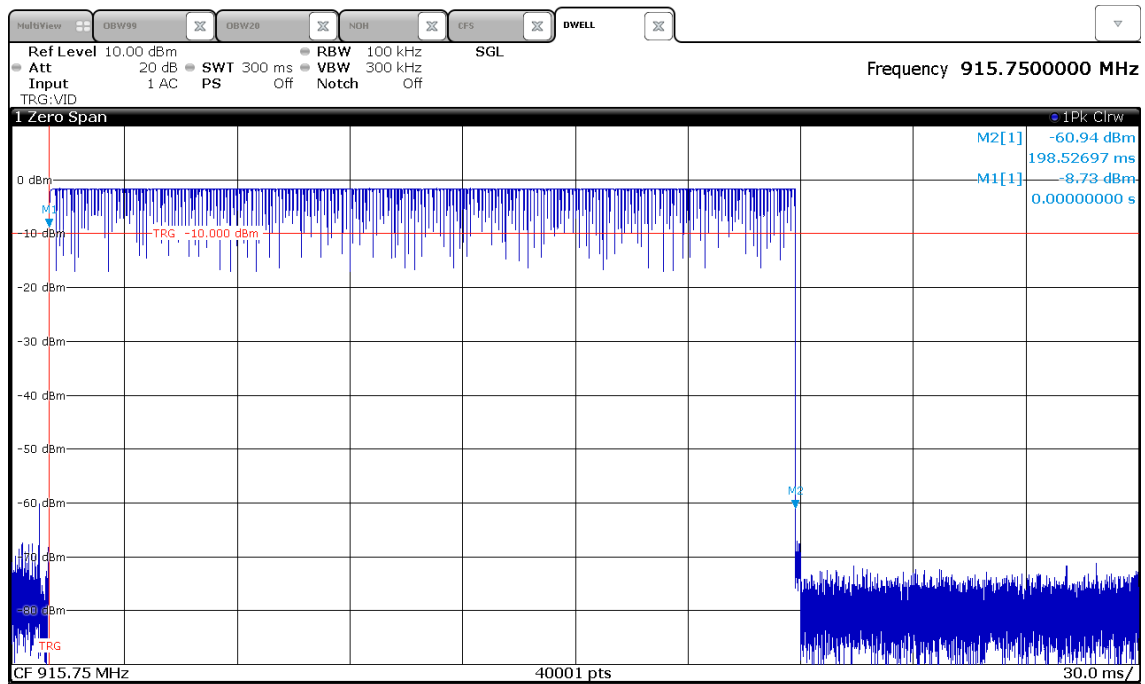
FCC ID: O2FM2UHF-RFID

IC: 9137A-M2UHF RFID

Mode 3



The dwell time is measured at ch27 in a 20 s period.



Mode 3 Dwell time = 2 * 198.5 = 397.0 ms

FCC ID: O2FM2UHF-RFID**IC: 9137A-M2UHFRFID**

Limit 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 and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period;

The requirements are **FULFILLED**.

Remarks:

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.

FCC ID: O2FM2UHF-RFID

IC: 9137A-M2UHF RFID

5.9 Carrier frequency separation

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

5.9.1 Description of the test location

Test location: Shielded Room S6

5.9.2 Photo documentation of the test set-up



5.9.3 Applicable standard

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

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

5.9.4 Description of Measurement

The measurement is performed using a spectrum analyser in single sweep mode. A part of the operating frequency is used for better resolution. In normal application mode all the channels of the part of operating frequency are displayed and the separation is measured. The 20 dB OBW has to be measured before to compare whether the OBW requirement is fulfilled.

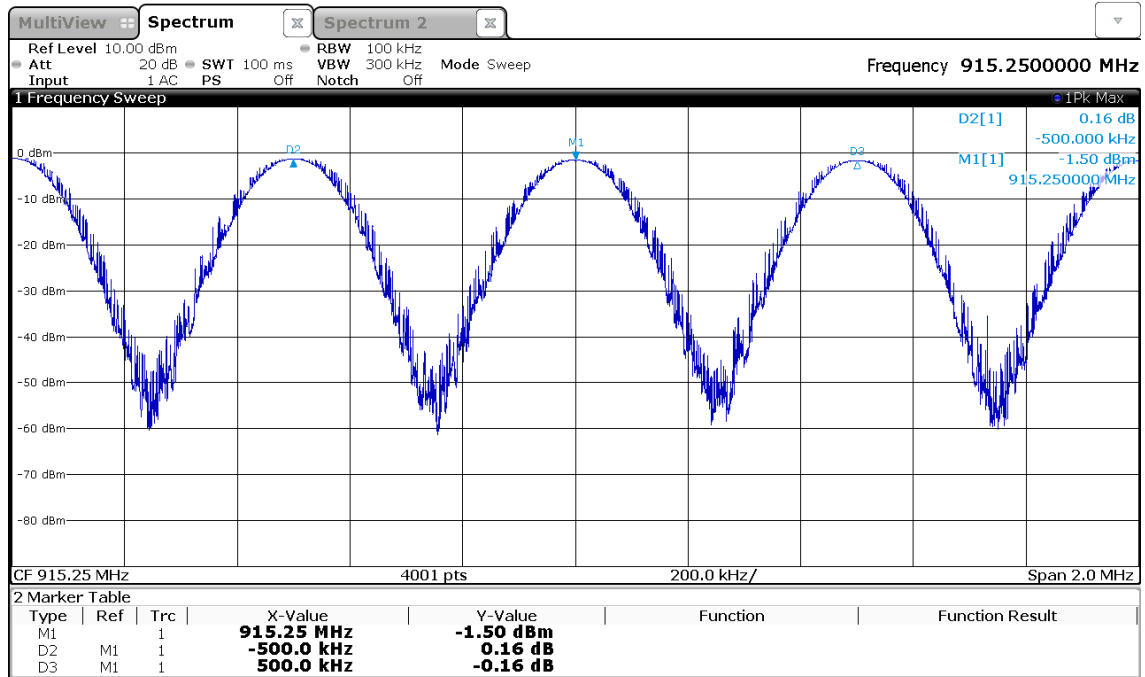
The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

FCC ID: O2FM2UHF-RFID

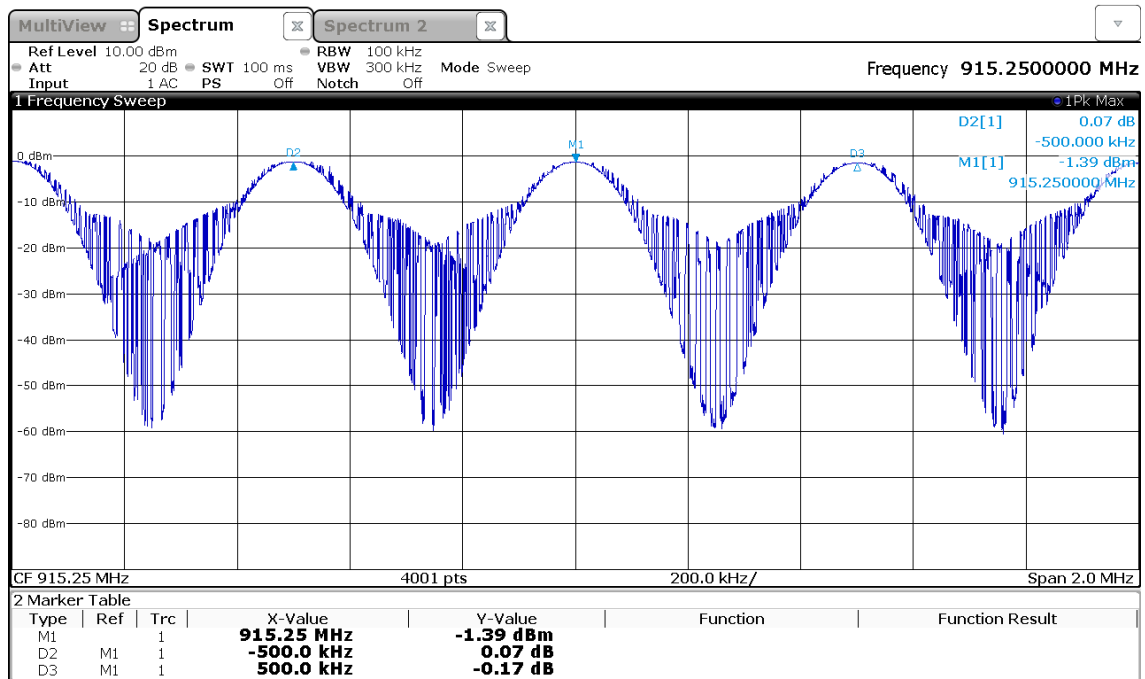
IC: 9137A-M2UHF RFID

5.9.5 Test result

Mode 1



Mode 3



FCC ID: O2FM2UHF-RFID

IC: 9137A-M2UHF RFID

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

Frequency (MHz)	Hopping channels	Limit channel separation
902 - 928	≥ 50	> 25 kHz or 20 dB bandwidth, whichever is greater

The requirements are **FULFILLED**.

Remarks: For detailed test results please see the following test protocols.

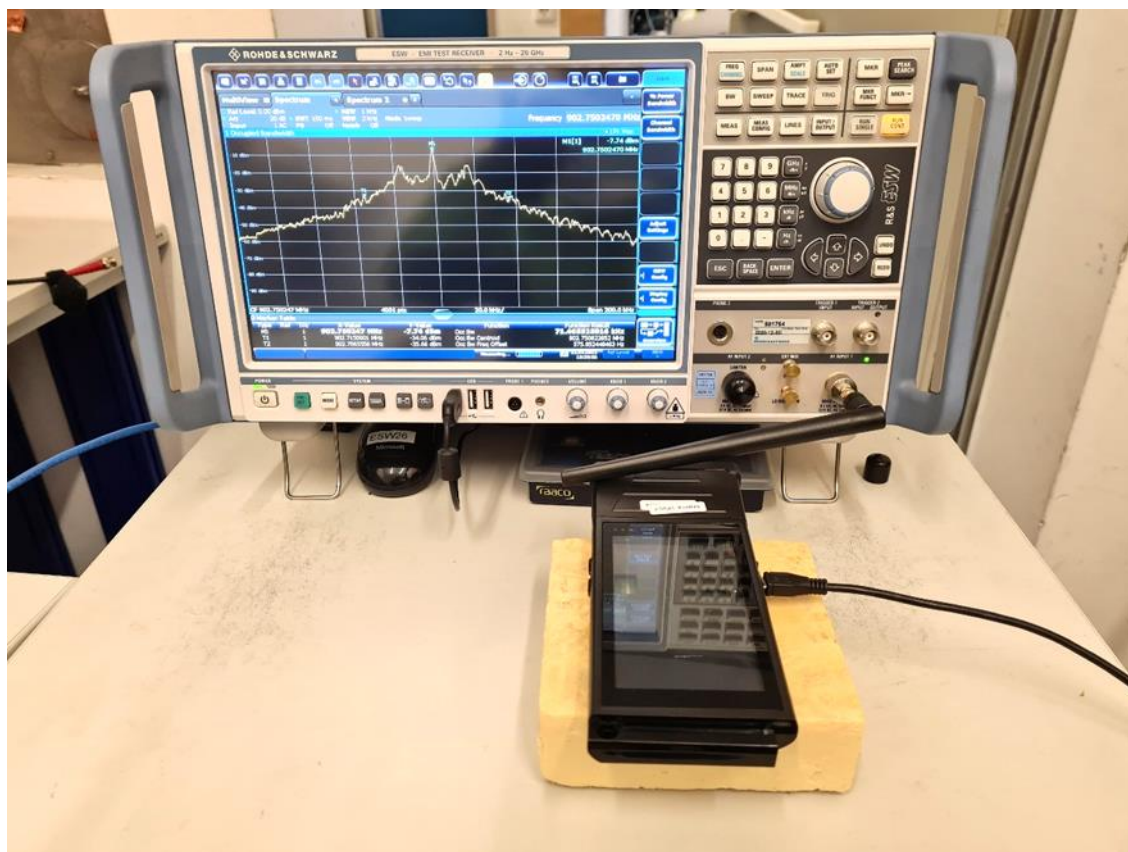
5.10 Number of hopping channels

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

5.10.1 Description of the test location

Test location: Shielded Room S6

5.10.2 Photo documentation of the test set-up



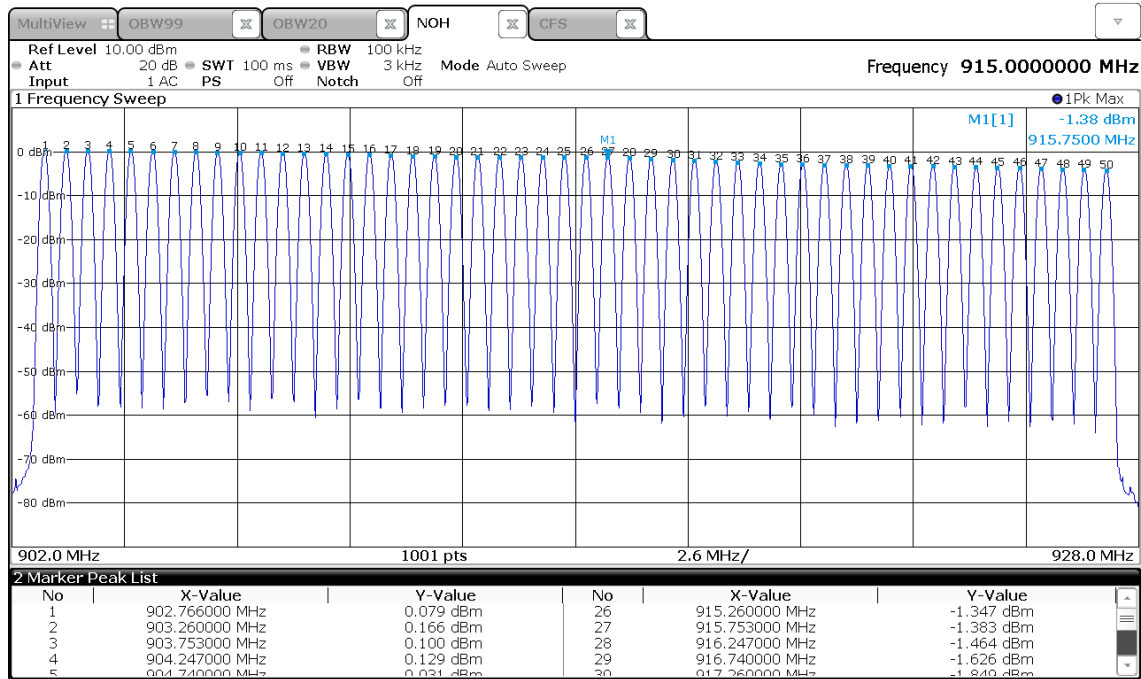
FCC ID: O2FM2UHF-RFID
IC: 9137A-M2UHF RFID

5.10.3 Applicable standard

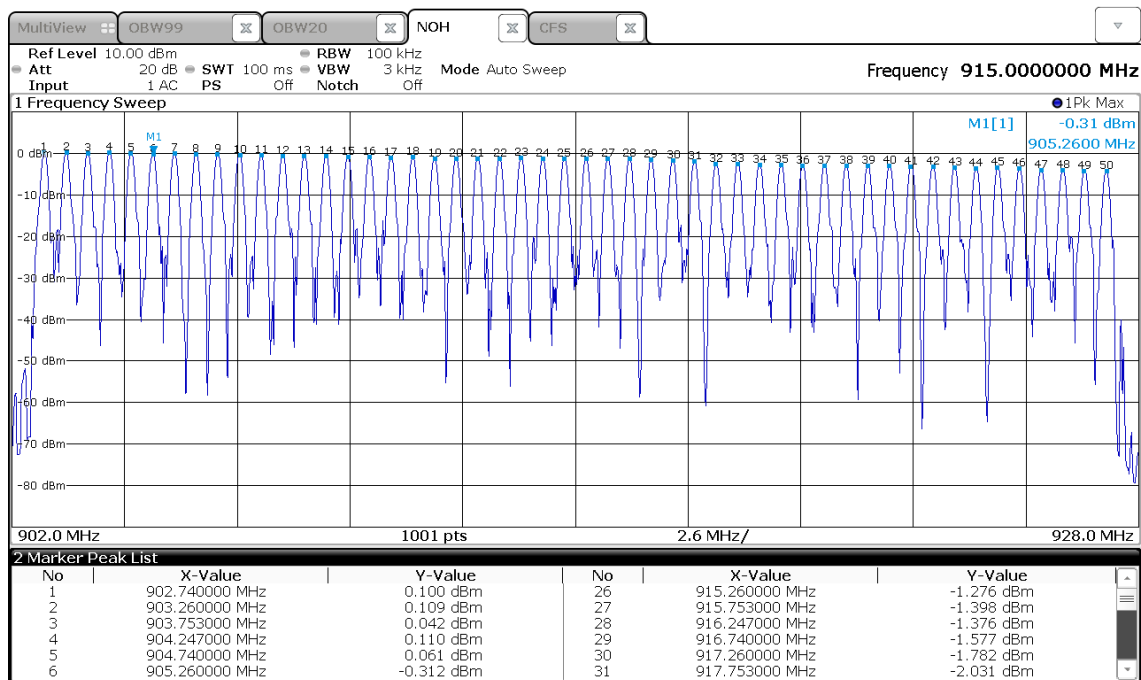
According to FCC Part 15, Section 15.247(a)(1)(i):
The system shall use at least 50 hopping frequencies.

5.10.4 Test result

Mode 1



Mode 3


Hopping channel frequency range
902 - 928
Number of all available hopping channels
50

FCC ID: O2FM2UHF-RFID
IC: 9137A-M2UHFRFID

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

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

The requirements are **FULFILLED**.

Remarks:

5.11 Psudo random hopping frequencies

The manufacturer declares following:

Frequency hopping in the FCC/IC region is maintained in a look-up table permanently stored in the microcontroller memory. The LO hopping sequence follows a pseudo-random pattern originally generated by a feedback shift register and cannot be altered by the end user. The LO dwells on each of the 50 hopping channels between 902.75 MHz and 927.25 MHz for 200 ms respectively. A firmware timer guarantees that the transmitter is turned off immediately before each 200 ms time period has elapsed. The use of a common local oscillator for the receiver and transmitter of the SiP ensures that they are always tuned to the same RF channel.

5.12 System receiver input bandwidth

The manufacturer declares following:

In a passive RFID system, the tag sends data to the reader by means of Backscatter Modulation. The passive RFID tag modulates its antenna impedance between a reflective and absorptive state, thus reflecting some of the RF signal which the reader has transmitted to it. The composite RF signal reflected back to the reader then appears as modulation sidebands centered at the reader's RF carrier.

5.13 System receiver hopping capability

The R2000 receiver, as described in the LO section, is always tuned to the RF channel on which it is presently transmitting. The R2000 performs a direct conversion of its RF input which centers it at DC. After downconversion, analog bandpass filters separate the desired data sidebands from the DC component (down converted carrier). The filters also reduce any down converted adjacent channel that may have been received from an interfering reader. Each of the I and Q baseband signals is digitized, undergoes further digital filtering and the composite signal is demodulated.

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.

FCC ID: O2FM2UHF-RFID

IC: 9137A-M2UHFRFID

5.14 Antenna application

5.14.1 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.

The EUT has an integrated PCB antenna; that prevents manipulation by a user. No external power amplifier can be connected. The requirements of part 15.203 and 15.204 are met.

5.14.2 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.

Remarks: No defacto limit results.

FCC ID: 02FM2UHF-RFID

IC: 9137A-M2UHFRFID

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.
CPR 2	ESVS 30	02-02/03-05-006	15/07/2021	15/07/2020		
	VULB 9168	02-02/24-05-005	18/12/2021	18/12/2020		
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
MB	ESW26	02-02/03-17-002	30/12/2021	30/12/2020		
SEC 2-3	ESW26	02-02/03-17-002	30/12/2021	30/12/2020		
SER 2	ESVS 30	02-02/03-05-006	15/07/2021	15/07/2020		
	VULB 9168	02-02/24-05-005	18/12/2021	18/12/2020		
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
SER 3	AMF-6D-01002000-22-10P	02-02/17-15-004				
	3117	02-02/24-05-009	18/06/2021	18/06/2020		
	18N-20	02-02/50-17-003				
	BAM 4.5-P	02-02/50-17-024				
	NCD	02-02/50-17-025				
	KK-SF106-2X11N-6,5M	02-02/50-18-016				
	WHJ10-900-1000-8000-40EF	02-02/50-20-018				

FCC ID: O2FM2UHF-RFID

IC: 9137A-M2UHF-RFID

ATTACHMENT A

A1) Photo documentation of the EUT

External view:



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.

FCC ID: O2FM2UHF-RFID

IC: 9137A-M2UHFRFID

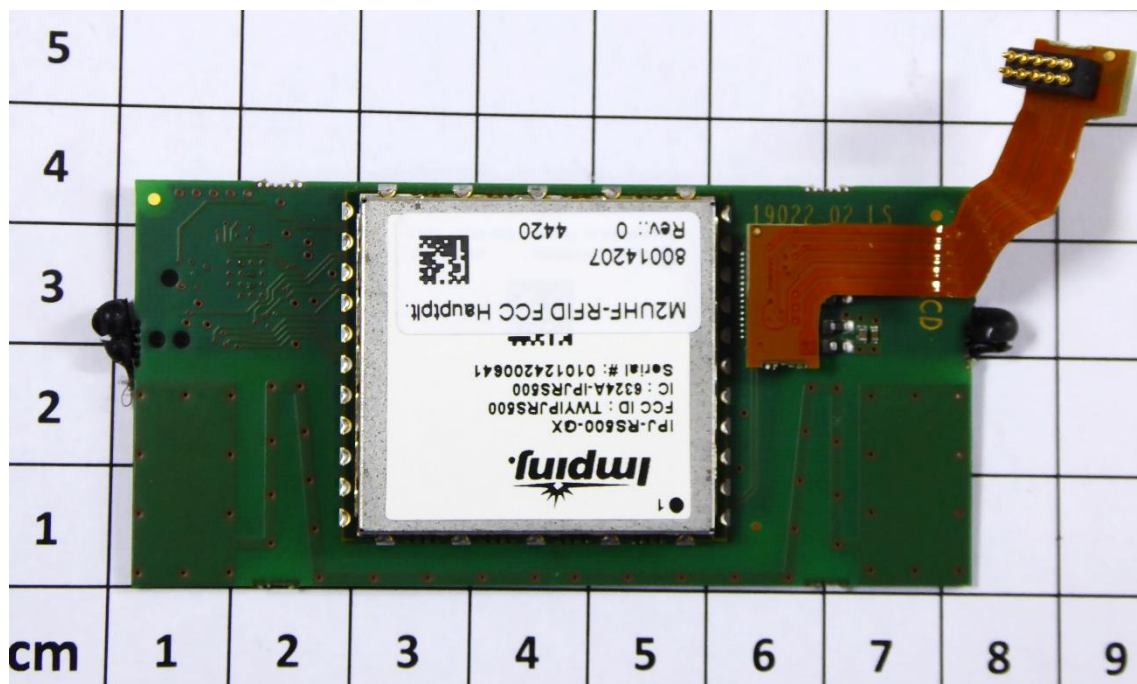
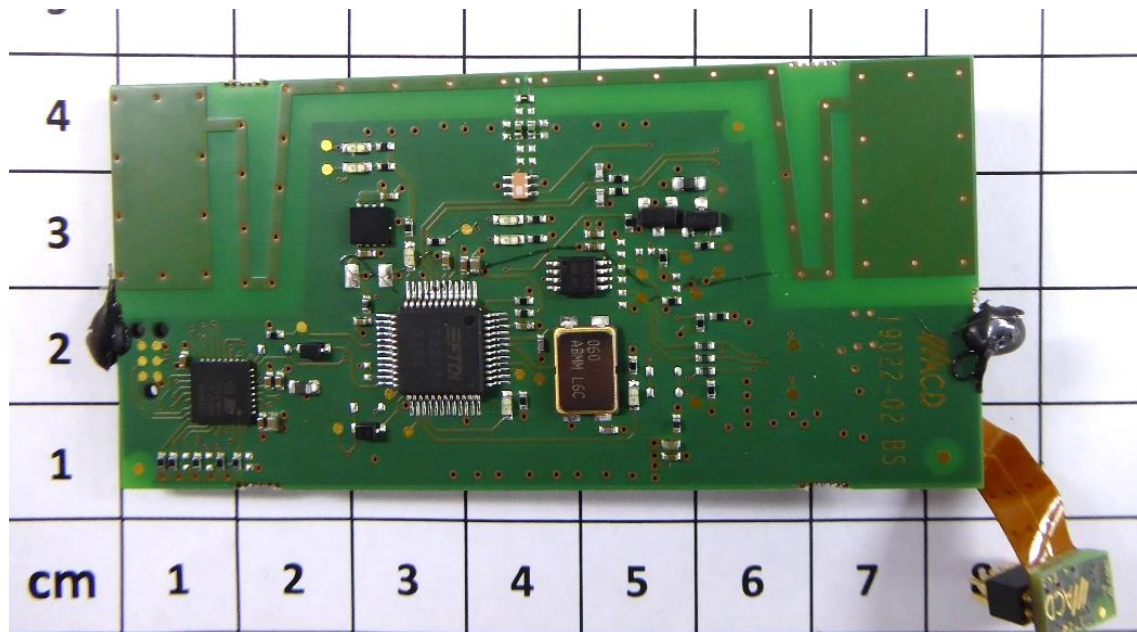


The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

FCC ID: O2FM2UHF-RFID

IC: 9137A-M2UHF RFID

Internal view:



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.

FCC ID: O2FM2UHF-RFID

IC: 9137A-M2UHF RFID

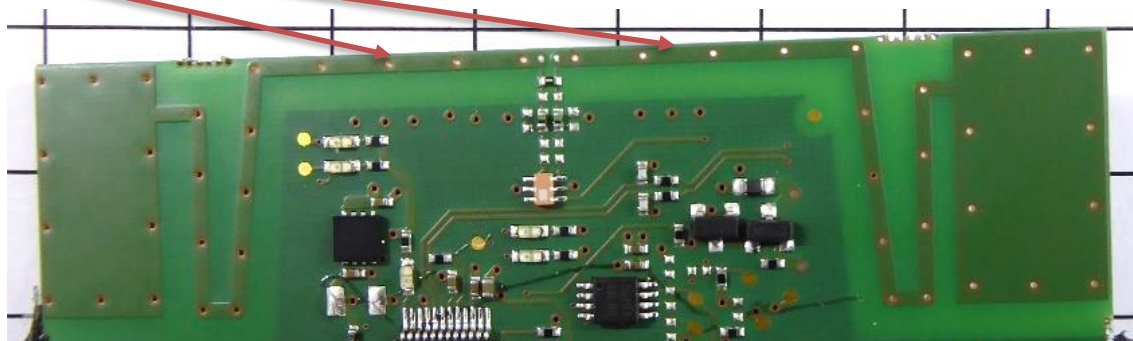


The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

FCC ID: O2FM2UHF-RFID

IC: 9137A-M2UHFRFID

PCB antenna



EUT with host



Host battery



- End of attachment_A -