EMCC DR. RAŠEK

TEST REPORT # EMCC-980398GA, 2016-05-03

EQUIPMENT UNDER TEST:

Trade Name:	RFID Pen Style Read/Write Unit
Type Designation(s):	ilD PENsolid UHFcc
Serial Number:	Sample #1: 103015 Sample #2: 103014
Equipment Class:	Low Power Transceiver
Manufacturer:	Micro-Sensys GmbH
Address:	In der Hochstedter Ecke 2 99098 Erfurt Germany
Phone:	+49 361 59874-0
Fax:	+49 361 59874-17

RELEVANT STANDARD(S): 47 CFR 15C, RSS-247 Issue 1 (2015-05)

MEASUREMENT PROCEDURE:

☒ ANSI C63.4-2014
☒ Other: ANSI C63.10-2013
☒ D00-705 Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems
☒ RSS-Gen Issue 4 (2014-11)
☒ RSS-102 Issue 5 (2015-03)

TEST REPORT PREPARED BY:

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HEAD OF COMMERCIAL EMC AND RADIO DEPT.:

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1 GENERAL INFORMATION

1.1 Purpose

The purpose of this report is to show compliance with the 47 CFR 15.247 and Industry Canada RSS-247 requirements for the certification of licence-exempt intentional radiator.

1.2 Limits and Reservations

The test results in this report apply only to the particular equipment under test (EUT) as declared in this report. This test report shall not be reproduced except in full without the written permission of EMCCons DR. RAŠEK GmbH & Co. KG.

1.3 Test Location

Test Laboratory:	EMCCons DR. RAŠEK GmbH & Co. KG
Accreditation No.:	D-PL-12067-01-00
Address of Labs I, II, III and Head Office:	EMCCons DR. RAŠEK GmbH & Co. KG Boelwiese 8 91320 Ebermannstadt GERMANY
Address of Labs IV and V:	EMCCons DR. RAŠEK GmbH & Co. KG Stoernhofer Berg 15 91364 Unterleinleiter GERMANY
Test Laboratory:	EMCCons DR. RAŠEK GmbH & Co. KG, Test Laboratory IV located at Stoernhofer Berg 15, 91364 Unterleinleiter, Germany
Test Site Registrations:	IC: Site# 3464C-1, January 21, 2015 FCC: Registration Number 878769, December 24, 2013,.
Phone:	+49 9194 7262-0
Fax:	+49 9194 7262-199
E-Mail:	emc.cons@emcc.de
Web:	www.emcc.de

1.4 Manufacturer

Company Name:	Micro-Sensys GmbH
Street:	In der Hochstedter Ecke 2
City:	99098 Erfurt
Country:	Germany
Name for contact purposes:	Mr Peter Peitsch
Phone:	+49 361 59874-16
Fax:	+49 361 59874-17
E-Mail:	ppeitsch@microsensys.de

1.5 Dates and Test Location

Date of receipt of EUT: 2016-02-16
Test Date: see table below
Test Location: Lab IV

1.6 Ordering Information

Purchase Order and Date: D-055-16, 2016-02-01
Vendor Number: -

1.7 Climatic Conditions

Date	Temperature [°C]	Relative Humidity [%]	Air Pressure [hPa]	Lab	Customer attended tests
2016-02-09	24	31	955	IV	yes
2013-02-10	24	29	955	IV	no
2013-02-11	23	30	965	IV	no
2013-02-12	24	28	961	IV	no
2016-02-15	23	31	968	IV	no
2016-02-16	23	27	991	IV	no
2016-03-02	23	29	961	IV	no
2016-04-20	23	27	987	IV	no

The tests were attended by Mr Peitsch and Mr Gablovsky on 2016-02-09

2 PRODUCT DESCRIPTION

2.1 Equipment Under Test (EUT)

Trade Name:	RFID Pen Style Read/Write Unit
Type Designation(s):	ilD PENsolid UHFcc
Serial Number(s):	Sample #1: 103015 Sample #2: 103014
FCC ID:	ZLCPENSOLIDUFX
Industry Canada Certification Number:	21228-PENSOLIDUFX
Application:	Low Power Transceiver
Transmit Frequency:	902.7 – 927.2 MHz
Modulation:	Load Modulation
Emission Designator:	96K4A1D
Antenna gain	< 0 dBi (acc. to customer)
Power Supply:	Internal 3.7V Lithium-Ionen accumulator Operation range: 3.6 V – 4.2 V (acc. to customer)
Ports:	Micro USB connector
Antennas:	Internal
Operation Temperatur:	-20 °C to +60 °C
HVIN (Hardware Version Identification Number)	B8 XX
FVIN (Firmware Version Identification Number)	F3 XX
Variants:	None
Remarks:	None

2.2 Intended Use

The EUT is a RFID transceiver board for reading RFID tags.

2.3 EUT Peripherals/Simulators

The EUT was tested standalone. For charging and configuration changes the following peripherals were provided by the customer.

- Laptop with software
- USB power supply with USB cable

Photograph 2.3-1: Laptop with test software

Photograph 2.3-2: Software "Interface config tool"

Photograph 2.3-3: USB cable and USB power supply

Intentionally left blank

2.4 Mode of operation during testing and test set-up

The equipment under test (EUT) was operated during the tests under the following conditions:

Mode: Normal Operation
The default EUT software was loaded with the provided laptop and test software. The timeout was increased with the configuration software provided with the Laptop to ensure it does not switch off during the test.

The internal battery was charged to the “status perfect” according to the configuration software provided by the customer.

This mode was used for the band-edge, number of hopping frequencies and carrier frequency separation measurement.

Mode: TxRx on 902, 915 or 927MHz:
A test software was loaded on the EUT which did transmit with the normal dwell time and repetition rate, but on a single frequency. There was a test software for 902, 915 and 927 MHz available. The timeout was increased with the configuration software provided with the Laptop to ensure it does not switch off during the test.

The internal battery was charged to the “status perfect” according to the configuration software provided by the customer.

This mode was used for the bandwidth and dwell time measurement.

Mode CW: on 902, 915 or 927MHz
A test software was loaded on the EUT which provided a continues wave signal on a single frequency. There was a test software for 902 ,915 and 927 MHz available. The timeout was increased with the configuration software provided with the Laptop to ensure it does not switch off during the test.

The internal battery was charged to the “status perfect” according to the configuration software provided by the customer.

This mode was used for peak power and spurious radiated emissions measurement.

Mode: Connected
The EUT was connected via USB cable to the Laptop provided by the customer. The software “Interface config tool” provided by the customer was used to connect to the EUT.

This mode was used for the conducted emission measurement.

2.5 Modifications required for compliance

For the band-edge measurement with EUT sample #1 was done with a new firmware. This new firmware provided by the customer was version number 3.00.05.

2.6 Description of Pseudorandom Frequency Hopping Sequence

The following description was provided by the customer:
“

The hopping sequence is generated by the microcontroller of the devices. For this purpose the firmware of the microcontroller generates by means of an implemented pseudorandom number generator a series of random numbers from 0 to 49 (example for a generated series:
30,40,8,21,48,9,28,13,49,35,5,38,11,34,27,17,41,1,10,36,6,29,26,37,2,24,14,33,20,31,44,47,46,0,2,15,3,19,22,4,45,23,7,18,39,16,43,25,42,32).
The implemented algorithm also uses the serial number of the devices so that the series of different devices varies. To every of these numbers a frequency channel in the range of 902.7MHz – 927.2MHz is assigned whereby the channel distance is always 0.5MHz. The hopping from one channel to next is made according to the series of these random numbers. If the last number of the series is reached then the next number is the starting number of the same series. This procedure guarantees an equal hopping frequency use. The hopping will be done after a time period of 400ms or if a transponder communication was failed.
“

3 TEST RESULTS SUMMARY

Summary of test results for the following EUT:

Manufacturer: Micro-Sensys GmbH
Device: RFID Pen Style Read/Write Unit
Type(s): ilD PENsolid UHFcc
Serial No(s): Sample #1: 103015, Sample #2 103014

Requirement	47 CFR Section	RSS, Section	Report Section	Test Result
Antenna Requirement	15.203	RSS-Gen Issue 4 (2014-11), 8.3	4	Pass
AC Line Conducted Emissions	15.207	RSS-Gen Issue 4 (2014-11), 8.8	5	Pass Sample #1
Carrier Frequency Separation	15.247 (a 1)	RSS-247 Issue 1 (2015-05), 5.1	6	Pass Sample #1
Number of Hopping Frequencies	15.247 (a 1)	RSS-247 Issue 1 (2015-05), 5.1	7	Pass Sample #1
Time of Occupancy	15.247 (a 1)	RSS-247 Issue 1 (2015-05), 5.1	8	Pass Sample #1
20 dB Bandwidth	15.247(a 1)	RSS-247 Issue 1 (2015-05), 5.1	9	Pass Sample #2
Maximum Peak Power Conducted	15.247	RSS-247 Issue 1 (2015-05), 5.4	10	Pass Sample #1
Radiated Emissions	15.247 15.209, 15.205(a)	RSS-247 Issue 1 (2015-05), 5.5 RSS-Gen Issue 4 (2014-11), 8.9	11	Pass Sample #1
Band-edge Emissions	15.247	RSS-247 Issue 1 (2015-05), 5.5 RSS-Gen Issue 4 (2014-11), 8.9	12	Pass Sample #1
Radiofrequency radiated exposure Evaluation	1.1307	RSS-102 Issue 5 (2015-03)	13	Pass Sample #1

N.A. – not applicable; N.T. – Not tested

The client has made the determination that EUT Condition, Characterization, and Mode of Operation are representative of production units and meet the requirements of the specifications referenced herein. Consistent with Industry practice, measurement and test equipment not directly involved in obtaining measurement results but having an impact on measurements (such as cable loss, antenna factors, etc.) are factored into the "Correction Factor" documented in certain test results. Instrumentation employed for testing meets tolerances consistent with known Industry Standards and Regulations.
The measurements contained in this report were made in accordance with the procedures described in ANSI C63.10-2013 and RSS-Gen Issue 4.
All requirements were found to be within the limits outlined in this report.
The test results in this report apply only to the particular equipment under test (EUT) as declared in this report.

Test Personal: Ludwig Kraft
Issuance Date: 2016-05-03

4 ANTENNA REQUIREMENT

Test Requirement: FCC 47 CFR 15.203, RSS-Gen Issue 4 (2014-11), 8.3

4.1 Regulation

FCC 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 Part 15C. The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221.
Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

IC RSS-Gen: 8.3 Transmitter Antenna for Licence-Exempt Radio Apparatus
The applicant for equipment certification, as per RSP-100, must provide a list of all antenna types that may be used with the licence-exempt transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna.

Licence-exempt transmitters that have received equipment certification may operate with different types of antennas. However, it is not permissible to exceed the maximum equivalent isotropically radiated power (e.i.r.p.) limits specified in the applicable standard (RSS) for the licence-exempt apparatus.

Testing shall be performed using the highest gain antenna of each combination of licence-exempt transmitter and antenna type, with the transmitter output power set at the maximum level. When a measurement at the antenna connector is used to determine RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna manufacturer.

User manuals for transmitters equipped with detachable antennas shall also contain the following notice in a conspicuous location:

This radio transmitter (identify the device by certification number or model number if Category II) has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types approved for use with the transmitter, indicating the maximum permissible antenna gain (in dBi).

4.2 Result

EUT is equipped with an internal antenna.

Manufacturer:	Micro-Sensys GmbH
Device:	RFID Pen Style Read/Write Unit
Type(s):	ilD PENsolid UHFcc
Serial No(s):	Sample #1 103015, Sample #2 103014

The EUT meets the requirements of this section.

5 POWER LINE CONDUCTED EMISSIONS TEST

Test Requirement: FCC 47 CFR, §15.207, IC RSS-Gen, 8.8
Test Procedure: ANSI C63.10-2013, IC RSS-Gen

5.1 Regulation

FCC 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, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

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
0.5-30	60	50

*Decreases with the logarithm of the frequency.

(b) The limit shown in paragraph (a) of this section shall not apply to carrier current systems operating as intentional radiators on frequencies below 30 MHz.

In lieu thereof, these carrier current systems shall be subject to the following standards:

(1) For carrier current system containing their fundamental emission within the frequency band 535–1705 kHz and intended to be received using a standard AM broadcast receiver: no limit on conducted emissions.

(2) For all other carrier current systems: 1000 μV within the frequency band 535–1705 kHz, as measured using a 50 μH/50 ohms LISN.

(3) Carrier current systems operating below 30 MHz are also subject to the radiated emission limits in § 15.205, § 15.209, § 15.221, § 15.223, or § 15.227, as appropriate.

(c) Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. Devices that include, or make provisions for, the use of battery chargers which permit operating while charging, AC adapters or battery eliminators or that connect to the AC power lines indirectly, obtaining their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.

IC RSS-Gen: 8.8 AC Power Line Conducted Emissions Limits for Licence-Exempt Radio Apparatus
A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz-30 MHz, shall not exceed the limits in Table 3.
Unless the requirements applicable to a given device state otherwise, for any radio apparatus equipped to operate from the public utility AC power supply either directly or indirectly (such as with a battery charger), the radio frequency voltage of emissions conducted back onto the AC power lines in the

frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in Table 3 below. The more stringent limit applies at the frequency range boundaries.
The conducted emissions shall be measured in accordance with the reference publication mentioned in Section 3.

Table 3 – AC Power Line Conducted Emissions Limits

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
0.5-30	60	50

*Decreases with the logarithm of the frequency.
**A linear average detector is required.

→ The IC limits are equal to the FCC limits.

5.2 Test Equipment

Type	**Manufacturer/ Model No.**	**EMCC Ident No.**	**Last Calibration**	**Next Calibration**
EMI Test Receiver	Rohde & Schwarz / ESU8	3846	2015-07	2016-07
V-LISN 50 Ω//(50 uH + 5 Ω)	Rohde & Schwarz / ESH2-Z5	1901	2015-09	2017-09
Protector Limiter	Rohde & Schwarz / ESH3-Z2	1519	2015-09	2017-09
AC Power Source	AEG	0001	n.a	n.a
Multimeter	Agilent / U1241A	2720	2015-01	2017-01

5.3 Test Procedures

The EUT was placed on a wooden table of nominal size 1 m by 1.5 m, raised 80 cm above the reference groundplane. The vertical conducting wall of the screened room was located 40 cm to the rear of the EUT.
The EUT was placed on a wooden table connected to the laptop provided by the customer via USB cable. The laptop was connected to LISN via the power supply. The distance between the power supply laptop and EUT was 10 cm. The connection cables from the EUT to the laptop and from the laptop to the power supply were bundled not exceeding 40 cm in length.
LISN housing, measuring instrument case, reference ground plane and the vertical conducting wall of the screened room was bonded together.

5.4 Test Result

Freq [MHz]	Line	Detector	Result [dBµV]	Limit [dBµV]	Margin
16.095	L	AV	30.5	50.0	19.5
20.595	L	AV	29.7	50.0	20.3
0.200	L	AV	32.7	53.6	20.9
20.000	L	AV	29.0	50.0	21.0
0.210	L	QP	42.0	63.2	21.2
0.150	L	QP	44.2	66.0	21.8
16.095	N	AV	30.4	50.0	19.6
21.065	N	AV	29.7	50.0	20.3
0.205	N	AV	32.6	53.4	20.8
20.120	N	AV	29.0	50.0	21.0
0.200	N	QP	42.0	63.6	21.6
14.440	N	AV	28.0	50.0	22.0

The table above contains worst-case emissions, only. For further details refer to the test plots.

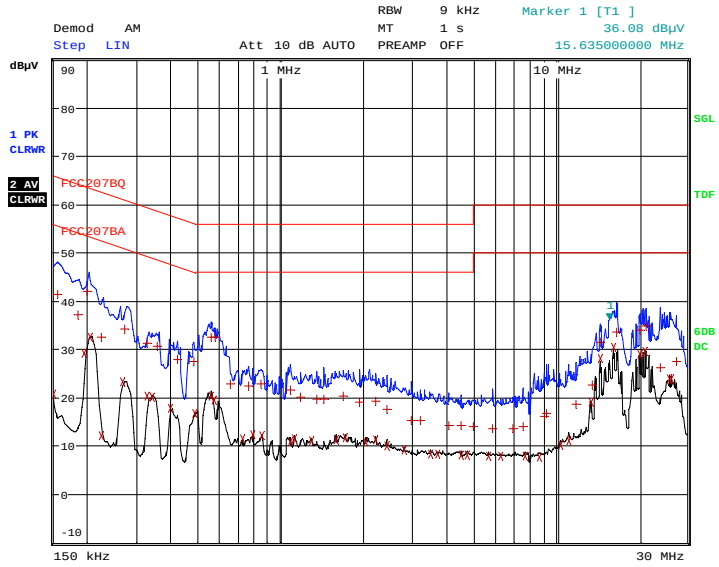
Manufacturer:	Micro-Sensys GmbH
Device:	RFID Pen Style Read/Write Unit
Type(s):	ilD PENsolid UHFcc
Serial No(s):	Sample #1 103015
Test date:	2016-03-12

The EUT meets the requirements of this section.

5.5 Measurement Plots

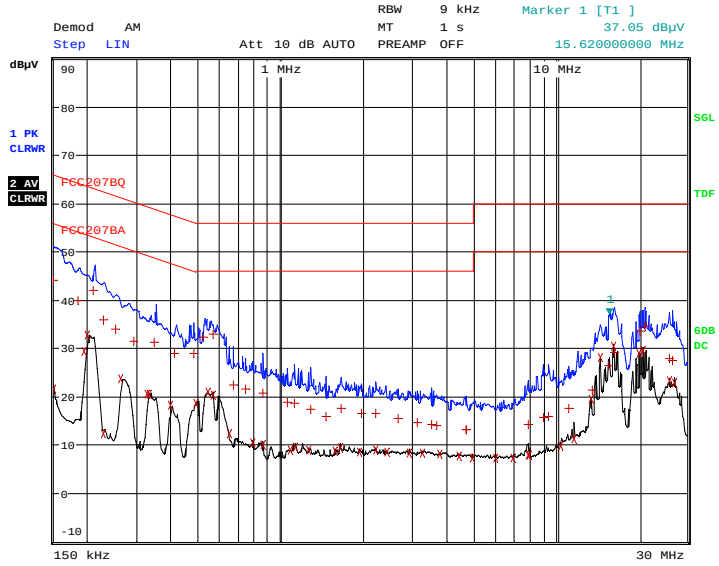
Refer to the following pages.

Test Sample #1 on line N:



Manufacturer: Micro Sensys, EUT 103015, Power 115Vac / 60 Hz
, Line: N, Mode: Connected
Date: 12.FEB.2016 12:05:59

Test Sample #1 on line L:



Manufacturer: Micro Sensys, EUT 103015, Power 115Vac / 60 Hz
, Line: L, Mode: Connected
Date: 12.FEB.2016 11:58:10

6 NUMBER OF HOPPING FREQUENCIES

Test Requirement: FCC 47 CFR, 15.247, IC RSS-247 Issue 1 (2015-05),5.1(1)
Test Procedure: ANSI C63.10-2013, DA 00-705

6.1 Regulation

FCC 15.247

…
(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; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

IC RSS-247 5.1

…
(3) For FHSs in the band 902-928 MHz: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 20-second period. If the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 10-second period. The maximum 20 dB bandwidth of the hopping channel shall be 500 kHz.

6.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
Log Per. Antenna	Schwarzbeck VUSLP 9111B	3203	2015-05	2017-05
EMI Test Receiver	Rohde & Schwarz ESU8	3846	2015-08	2016-08

6.3 Test Procedures

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = the frequency band of operation
RBW ≥ 1% of the span
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

Allow the trace to stabilize. It may prove necessary to break the span up to sections, in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

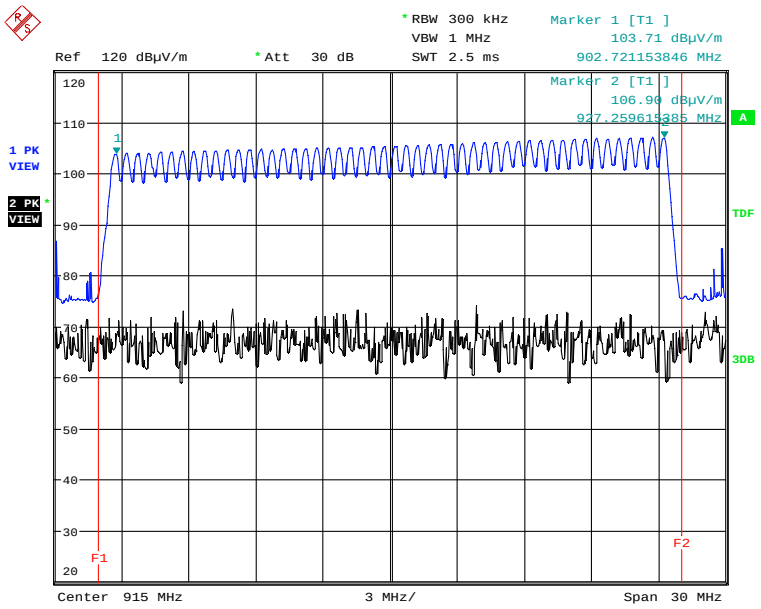
6.4 Test Result

EUT, mode	Number of hopping frequencies	Limit
Sample #1, normal operation	**50**	50

Manufacturer: Micro-Sensys GmbH
Device: RFID Pen Style Read/Write Unit
Type(s): ilD PENsolid UHFcc
Serial No(s): Sample #1 103015
Test date: 2016-02-11

The EUT meets the requirements of this section.

6.5 Measurement Plot



EUT: 103015; Mode: Normal TransmitReceive Pol. Hor
Date: 11.FEB.2016 10:29:22

7 20dB BANDWIDTH

Test Requirement: FCC 47 CFR, 15.247, IC RSS-247 Issue 1 (2015-05),5.1(1)
Test Procedure: ANSI C63.10-2013, DA 00-705

7.1 Regulation

FCC 15.247

…
(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; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

IC RSS-247 5.1

…
(3) For FHSs in the band 902-928 MHz: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 20-second period. If the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 10-second period. The maximum 20 dB bandwidth of the hopping channel shall be 500 kHz.

7.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
Log Per. Antenna	Schwarzbeck VUSLP 9111B	3203	2015-05	2017-05
EMI Test Receiver	Rohde & Schwarz ESU8	3846	2015-08	2016-08

7.3 Test Procedures

Use the following spectrum analyzer settings:

Span = approximately 2 to 3 times the 20 dB bandwidth, centred on a hopping channel

RBW ≥ 1% of the 20 dB bandwidth
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

The EUT should be transmitting at its maximum data rate. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 20 dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation. The EUT was tested in TxRx mode on a single frequency.

7.4 Test Result

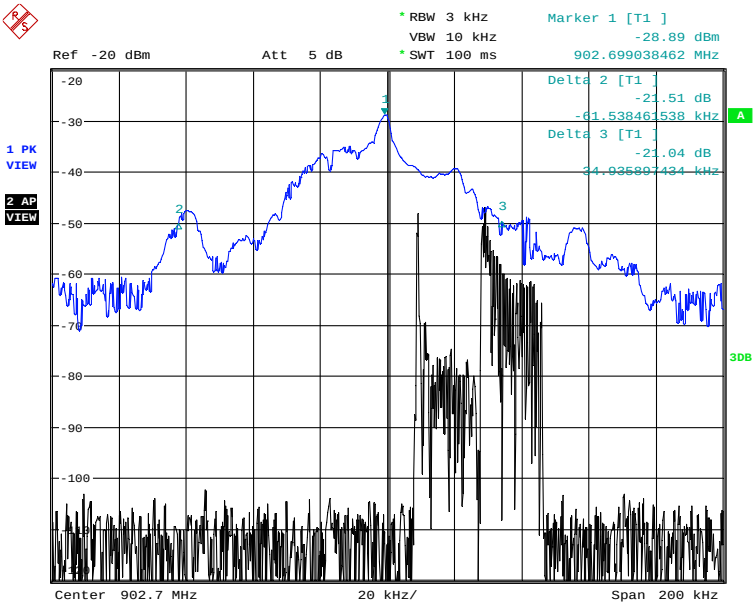
EUT mode	20 dB Bandwidth	Limit
	kHz	kHz
Sample #2, TxRx 902 MHz	96.4	< 500
Sample #2, TxRx 915 MHz	56.4	< 500
Sample #2, TxRx 927 MHz	55.1	< 500

Manufacturer: Micro-Sensys GmbH
Device: RFID Pen Style Read/Write Unit
Type(s): ilD PENsolid UHFcc
Serial No(s): Sample #2, 103014
Test date: 2016-04-20

The EUT meets the requirements of this section.

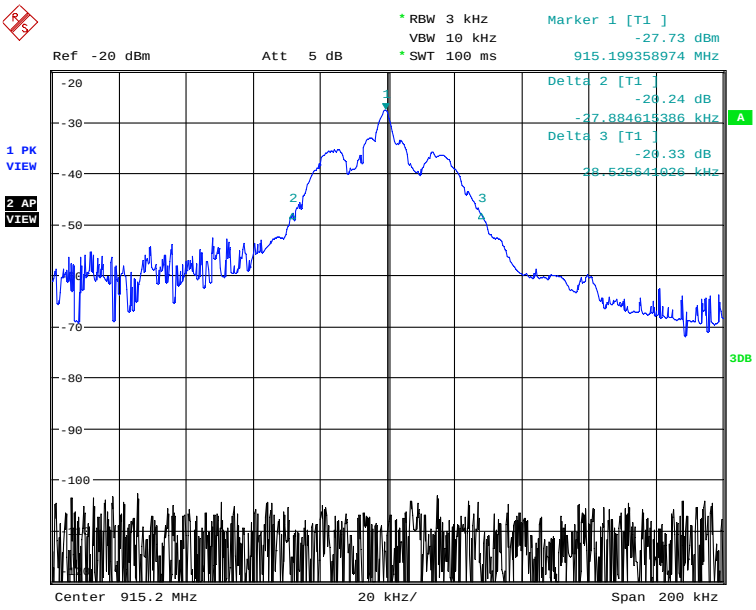
7.5 Measurement Plot

EUT #2 Mode: TxRx 902 MHz



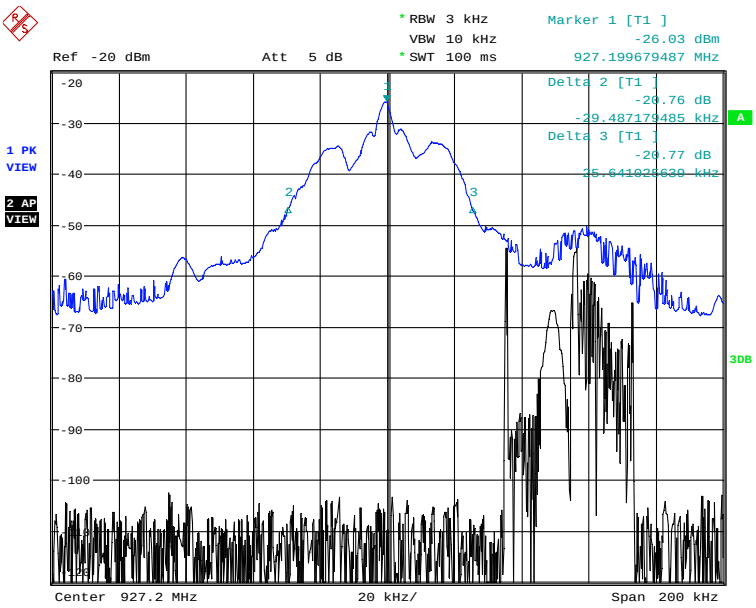
EUT: 103014; Mode TxRx 902 MHz
Date: 20.APR.2016 13:06:13

EUT #2 Mode: TxRx 915 MHz



EUT: 103014; Mode TxRx 915 MHz
Date: 20.APR.2016 14:22:39

EUT #2 Mode: TxRx 927 MHz



EUT: 103014; Mode TxRx 927 MHz
Date: 20.APR.2016 15:02:45

8 CARRIER FREQUENCY SEPARATION

Test Requirement: FCC 47 CFR, 15.247, IC RSS-247 Issue 1 (2015-05),5.1(1)
Test Procedure: ANSI C63.10-2013, DA 00-705

8.1 Regulation

FCC 15.247
(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

(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. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

IC RSS-247 5.1
…
(2) FHSs 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. Alternatively, FHSs operating in the band 2400-2483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or two thirds of the -20 dB bandwidth of the hopping channel, whichever is greater, provided that the systems operate with an output power no greater than 0.125 W. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

8.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
Log Per. Antenna	Schwarzbeck VUSLP 9111B	3203	2015-05	2017-05
EMI Test Receiver	Rohde & Schwarz ESU8	3846	2015-08	2016-08

8.3 Test Procedures

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = wide enough to capture the peaks of two adjacent channels

Resolution (or IF) Bandwidth (RBW) ≥ 1% of the span

Video (or Average) Bandwidth (VBW) ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section. Submit this plot.

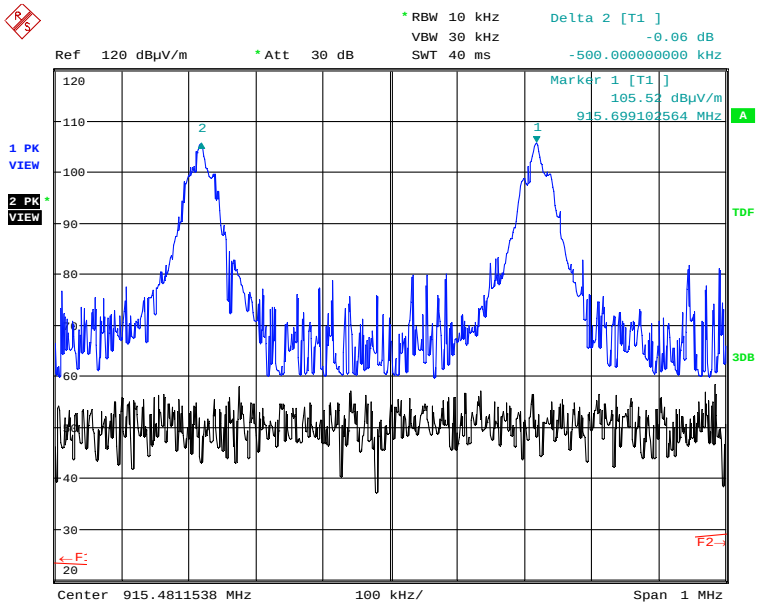
8.4 Test Result

EUT, mode	Channel separation	Limit (20dB bandwidth)
	kHz	kHz
Sample #1, normal operation	500	> 96.4

Manufacturer: Micro-Sensys GmbH
Device: RFID Pen Style Read/Write Unit
Type(s): ilD PENsolid UHFcc
Serial No(s): Sample #1 103015
Test date: 2016-02-11

The EUT meets the requirements of this section.

8.5 Result Plot



EUT: 103015; Mode: Normal TransmitReceive Pol. Hor
Date: 11.FEB.2016 11:11:10

9 TIME OF OCCUPANCY (DWELL TIME)

Test Requirement: FCC 47 CFR, 15.247, IC RSS-247 Issue 1 (2015-05),5.1(1)
Test Procedure: ANSI C63.10-2013, DA 00-705

9.1 Regulation

FCC 15.247

…
(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; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

IC RSS-247 5.1

…
(3) For FHSs in the band 902-928 MHz: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 20-second period. If the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 10-second period. The maximum 20 dB bandwidth of the hopping channel shall be 500 kHz.

9.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
Log Per. Antenna	Schwarzbeck VUSLP 9111B	3203	2015-05	2017-05
EMI Test Receiver	Rohde & Schwarz ESU8	3846	2015-08	2016-08

9.3 Test Procedures

The EUT must have its hopping function enabled. Use the following spectrum analyser settings:

Span = zero span, centred on a hopping channel

RBW = 1 MHz
VBW ≥ RBW
Sweep = as necessary to capture the entire dwell time per hopping channel
Detector function = peak
Trace = max hold

If possible, use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s). An oscilloscope may be used instead of a spectrum analyser.

The EUT was configured to hop on one single Channel at 915 MHz to measure the on time and the repetition time. The calculation for 20 seconds was done for an equal distribution of the 50 channels in the default hopping sequence.

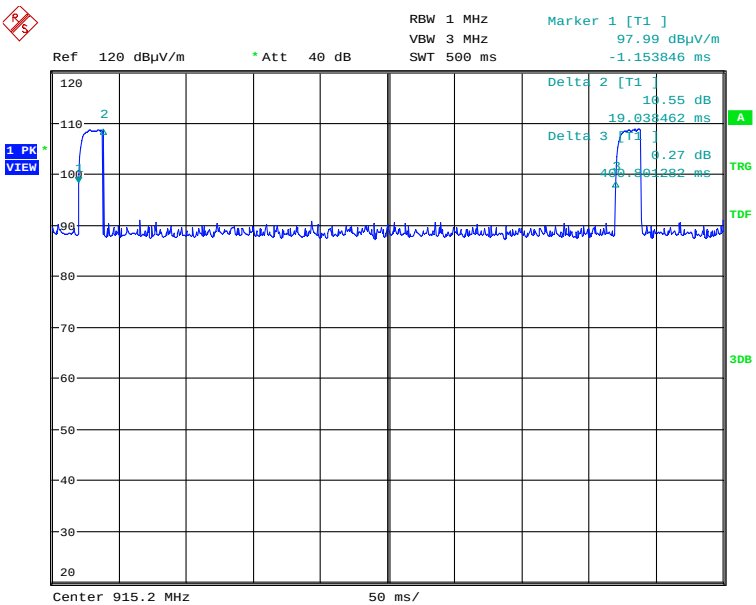
9.4 Test Result

EUT, mode	Time on	Repetition time	Number of Channels	Time of Occupancy (Dwell Time) in 20 s per channel	Limit
	[ms]	[ms]		[ms]	[ms]
Sample #1, TxRx 915 MHz	19.0	400.8	50	19.0	400

Manufacturer: Micro-Sensys GmbH
Device: RFID Pen Style Read/Write Unit
Type(s): ilD PENsolid UHFcc
Serial No(s): Sample #1 103015
Test date: 2016-02-16

The EUT meets the requirements of this section.

9.5 Measurement Plot



EUT: 103015; Mode: Normal TransmitReceive Pol. Hor
Date: 16.FEB.2016 16:50:05

10 PEAK OUTPUT POWER

Test Requirement: FCC 47 CFR, 15.247(b), IC RSS-247 Issue 1 (2015-05),5.4(1)
Test Procedure: ANSI C63.10-2013, DA 00-705

10.1 Regulation

FCC 15.247(b)
(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:
…
(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, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

IC RSS-247 5.4(1)
(1) For FHSs operating in the band 902-928 MHz, the maximum peak conducted output power shall not exceed 1.0 W, and the e.i.r.p. shall not exceed 4 W if the hopset uses 50 or more hopping channels; the maximum peak conducted output power shall not exceed 0.25 W and the e.i.r.p. shall not exceed 1 W if the hopset uses less than 50 hopping channels.

10.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
Log Per. Antenna	Schwarzbeck VUSLP 9111B	3203	2015-05	2017-05
EMI Test Receiver	Rohde & Schwarz ESU8	3846	2015-08	2016-08

10.3 Test Procedures

Use the following spectrum analyzer settings:

Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel
RBW > the 20 dB bandwidth of the emission being measured
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power (see the NOTE above regarding external attenuation and cable loss). The limit is specified in one of the subparagraphs of this Section. Submit this plot. A peak responding power meter may be used instead of a spectrum analyzer.

10.4 Peak Power Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor. The basic equation with a sample calculation is as follows:

FS = RA +107dB + AF + CF
where
FS = Field Strengh in dBµV/m
RA = Receiver Amplitude in dBm
AF = Antenna Factor in dB(1/m)
CF = Cable Attenuation Factor in dB

Assume a receiver reading of -27.9 dBm is obtained. The Antenna Factor of 21.7 dB(1/m) and a Cable Factor of 3.1 dB are added, giving a field strength of 103.9 dBµV/m. The 32 dBµV/m value can be mathematically converted to its corresponding level in µV/m.
FS = -27.9 +107 + 21.7 + 3.1 = 103.9 [dBµV/m]

The peak power is calculated using the equation from DA 00-705:

$$P = \frac{(E * d)^2}{30 * G}$$

where
P = Power in W
FS = Field Strengh in V/m
d = Distance antenna EUT in m
G = numeric gain of the transmitting antenna.

The antenna gain is <0 dBi according to the customer.
Assume a field strength of 0.15 V/m (103.9 dBµV/m) and a distance from the EUT to the antenna is 3 m and a gain *of 1 (0dBi)* the peak power calculates to dBm.
P = 103.9 - 104.77 + 20 log(3) = 8.7 [dBm]

The correction includes the cable loss (CF) and the antenna factor (AF).

10.5 Test Result

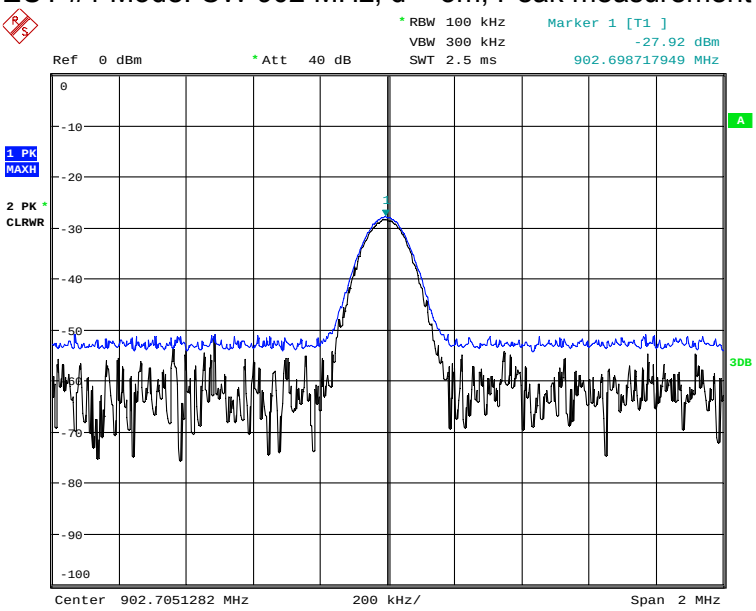
EUT mode	Frequency	Reading	d	Correction	Field strength @ 3m	Peak Power	Limit	Margin
	MHz	dBm	m	dB	dBµV/m	dBm	dBm	dB
CW 902 MHz	902.7	-27.9	3	24.80	103.9	8.7	30	21.3
CW 915 MHz	915.2	-25.7	3	24.87	106.2	11.0	30	19.0
CW 927 MHz	927.2	-25.2	3	24.91	106.7	11.5	30	18.5

Manufacturer: Micro-Sensys GmbH
Device: RFID Pen Style Read/Write Unit
Type(s): ilD PENsolid UHFcc
Serial No(s): Sample #1 103015
Test date: 2016-02-11

The EUT meets the requirements of this section.

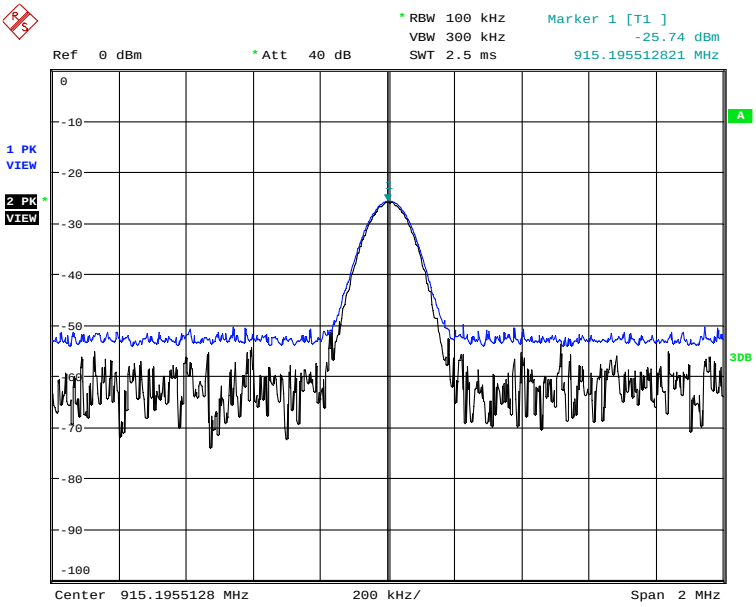
10.6 Measurement Plot(s)

EUT #1 Mode: CW 902 MHz, d = 3m, Peak measurement



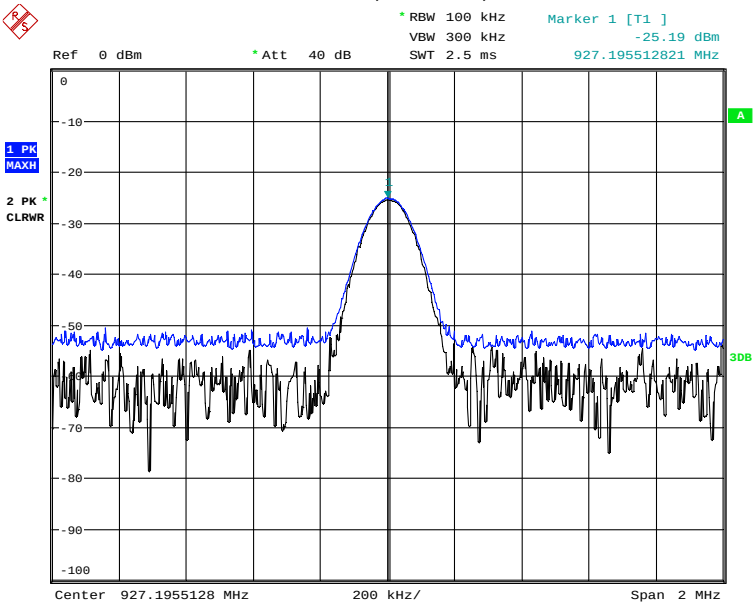
EUT: 103015; Mode: CW 902 MHz; Max Carrier, Pol. Hor
Date: 11.FEB.2016 15:34:24

EUT #1 Mode: CW 915 MHz, d = 3m, Peak measurement



EUT: 103015; Mode: CW 915 MHz; Max Carrier, Pol. Hor
Date: 11.FEB.2016 15:05:31

EUT #1 Mode: CW 927 MHz, d = 3m, Peak measurement



EUT: 103015; Mode: CW 927 MHz; Max Carrier, Pol. Hor
Date: 11.FEB.2016 15:25:41

11 RADIATED EMISSIONS 9 kHz – 10 GHz

Test requirement: FCC 47 CFR, 15.209, 15.247, IC RSS-247 Issue 1 (2015-05),5.5
IC RSS-Gen Issue 4, 8.9, RSS-210 A2.6
Test procedure: ANSI C63.10-2013, RSS-Gen

11.1 Regulation

FCC 15.33 Frequency range of radiated measurements:
(a) Unless otherwise noted in the specific rule section under which the equipment operates for an intentional radiator the spectrum shall be investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz […]

FCC 15.35 Measurement detector functions and bandwidths.

The conducted and radiated emission limits shown in this Part are based on the following, unless otherwise specified elsewhere in this Part:
(a) On any frequency or frequencies below or equal to 1000 MHz, the limits shown are based on measuring equipment employing a CISPR quasi-peak detector function and related measurement bandwidths, unless otherwise specified.
(c) Unless otherwise specified, e.g. Section 15.255(b), when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. The exact method of calculating the average field strength shall be submitted with any application for certification or shall be retained in the measurement data file for equipment subject to notification or verification.

FCC 15.209

(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency	Field Strength		Measurement distance
[MHz]	[µV/m]	[dB(µV/m)]	[m]
0.009–0.490	2400/F[kHz]	67.6 – 20 logF[kHz]	300
0.490–1.705	24000/F[kHz]	87.6 – 20 logF[kHz]	30
1.705–30.0	30	29.5	30

(b) In the emission table above, the tighter limit applies at the band edges.
(c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other sections within this part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
(d) The emission limits shown in the above table are based on measurements employing a CISPR quasi peak detector except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.
(e) The provisions in §§ 15.31, 15.33, and 15.35 for measuring emissions at distances other than the distances specified in the above table, determining the frequency range over which radiated emissions are to be measured, and limiting peak emissions apply to all devices operated under this part.

FCC 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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

IC RSS-Gen 8.9 Transmitter Emission Limits for Licence-Exempt Radio Apparatus
Except when the requirements applicable to a given device state otherwise, emissions from licence-exempt transmitters shall comply with the field strength limits shown in Table 4 or Table 5 below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

Table 4 – General Field Strength Limits for Licence-Exempt Transmitters at Frequencies Above 30 MHz

Frequency (MHz)	Field Strength (µv/m at 3 metres)
30-88	100
88-216	150
216-960	200
Above 960*	500

* Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for licence-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.

Note: Transmitting devices are not permitted in restricted frequency bands unless stated otherwise in the specific RSS.

Table 5 - General Field Strength Limits for Licence-Exempt Transmitters at Frequencies Below 30 MHz)

Frequency	Electric Field Strength (µV/m)	Magnetic Field Strength (H-Field) (µA/m)	Measurement Distance (metres)
9-490 kHz	2,400/F (F in kHz)	2,400/377F (F in kHz)	300
490-1,705 kHz	24,000/F (F in kHz)	24,000/377F (F in kHz)	30
1,705-30 MHz	30	N/A	30

Note: The emission limits for the bands 9-90 kHz and 110-490 kHz are based on measurements employing a linear average detector. Transmitting devices are not permitted in restricted frequency bands unless stated otherwise in the relevant RSS

11.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
Spectrum Analyser	Rohde & Schwarz FSU	3831	2015-07	2016-07
Double Ridged Guide Ant.	Schwarzbeck BBHA 9120D	3235	2015-06	2017-06
EMI Test Receiver	Rohde & Schwarz ESS	303	2016-04	2017-04
EMI Test Receiver	Rohde & Schwarz ESU	3846	2015-08	2016-08
Loop Antenna	Rohde & Schwarz	374	2014-06	2016-06
Bicon. Antenna	Schwarzbeck VHA 9103	899	2015-05	2017-05
Logper. Antenna	Schwarzbeck VUSLP 9111B	3203	2015-05	2017-05

11.3 Test Procedures

Measurement was performed in a semi-anechoic room at a test distance of 3 m. A calibrated loop antenna as specified in ANSI C63.4 clause 4.5 was positioned with its plane vertical at the test distance from the EUT and rotated about its vertical axis for maximum response at each azimuth about the EUT. For certain applications, the loop antenna may also need to be positioned horizontally at the specified distance from the EUT. Instead of changing the loop antenna polarization to horizontal the EUT antenna was rotated by 90 degrees. I.e. tests performed for 2 EUT antenna polarizations. The center of the loop antenna was 1 m above the ground.
The EUT was tested on a 0.8 meter high tabletop in 3 orientations.
The EUT was standalone, without connection, in continues transmit mode.
In certain applications, a remotely located device may be connected to the EUT. In these cases, it is permissible for cabling from the remotely located device to the EUT or accessories to be placed directly on the reference groundplane or, if normally installed beneath the reference groundplane, beneath it. The remotely located device shall be located at a distance sufficient to ensure that it does not contribute to the measured level. This procedure evaluates the interference potential of the EUT, its accessories, and interconnecting cables or wires standing apart from the remotely located device, which in turn shall be evaluated separately, if required.
Measurement initially performed as a pre-scan in the full frequency range in order to find worst case emissions. Final measurement performed at worst-case emission frequencies in a FCC and IC listed semi-anechoic room at the specified 3 m test distance. Pre-scan and final measurement performed in continues transmit mode.
Worst case emissions are listed under chapter: Final test results.

Radiated Emissions Test Characteristics	
Frequency range	9 kHz – 10 GHz
Test distance	3 m
Test instrumentation resolution bandwidth	200 Hz (9 kHz – 150 kHz)
	10 kHz (150 kHz - 30 MHz)
	120 kHz (30 MHz - 1,000 MHz)
	1 MHz (1,000 MHz – 25 GHz)
Test instrumentation video bandwidth	3 MHz (10 Hz**)
Receive antenna scan height	1 m - 4 m
Receive antenna polarization	Horizontal (H-field, f < 30 MHz)
	Vertical/Horizontal (E-field, f > 30 MHz)

* According to Section 15.31 (f)(1): At frequencies at or above 30 MHz, measurements may be performed at a distance other than what is specified provided: measurements are not made in the near field except where it can be shown that near field measurements are appropriate due to the characteristics of the device; and it can be demonstrated that the signal levels needed to be measured at the distance employed can be detected by the measurement equipment. (...) When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse linear-distance for field strength measurements; inverse-linear-distance-squared for power density measurements). According to Section 15.31 (f)(2) At frequencies below 30 MHz, measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field. Pending the development of an appropriate measurement procedure for measurements performed below 30 MHz, when performing measurements at a closer distance than specified, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade).

H-field measurement up to 30 MHz was performed in a semi-anechoic room at a test distance of 3 m. A calibrated loop antenna as specified in ANSI C63.4 clause 4.1.5.1 was positioned with its plane vertical at the test distance from the EUT and rotated about its vertical axis for maximum response at each azimuth about the EUT. For certain applications, the loop antenna may also need to be positioned horizontally at the specified distance from the EUT. Instead of changing the loop antenna polarization to horizontal the EUT antenna was rotated by 90 degrees. I.e. tests performed for 2 EUT antenna polarizations. The center of the loop antenna was 1 m above the ground.

** Average measurement was performed with a 10 Hz video bandwidth.

11.4 Calculation of Field Strength Limits

The maximum permitted unwanted emission level – except for the specified frequency band (902-928 MHz) and the harmonics - is the general radiated limits in §15.209 (54 dBµV/m for frequencies above 960 MHz). → Above 960 MHz the applicable limit) is 54 dBµV/m.

For harmonics a limit of 20 dB below the level of the intentional radiated 100 kHz bandwidth applies.

11.5 Calculation of Average Correction Factor

The average correction factor is computed by analyzing the "worst case" on time in any 100 mSec time period and using the formula:

Corrections Factor (dB) = 20*log (worst case on time/100 mSec)

Procedure during test:
The relationship between average and peak mode reading has been confirmed by direct measurement using video averaging for the fundamental frequency level measurement. The obtained by measurement correction factor (difference between peak measurement with VBW of 3 MHz and peak measurement with VBW of 10 Hz) for the fundamental level was used for calculation of the average reading of the spurious emission level. This calculation performed for peak results higher or close to the average limit, only. [N.A. CW peak results are below AV limit.]

11.6 Field Strength Calculation

All emission measurements performed using the test receiver's transducer factor setting capability, i.e. the field strength value measured directly without the necessity of additional correction factors.
For test distance other than what is specified, but fulfilling the requirements of Section 15.31 (f)(2) the field strength is calculated by adding additionally an extrapolation factor of 40 dB/decade (inverse linear-distance for field strength measurements). The basic equation with a sample calculation is as follows:

FS = FST + DF + fc

where

FS = Field Strength in dBµV/m in semi-anechoic room (SAC)
FST = Field Strength at test distance in dBµV/m
f_C = correlation factor from SAC to open field site field strength
DF = Distance Extrapolation Factor in dB,
where DF = 40 log (Dtest/Dspec) where Dtest = Test Distance and Dspec = Specified Distance

Assume the tests performed at a reduced Test Distance of 3 m instead of the Specified Distance of 30 m giving a Distance Extrapolation Factor of DF = 40 log (3 m/30 m) = -40 dB.
Assuming a measured field strength level of 58.8 dBµV/m is obtained. The Distance Factor of -40 dB is added, giving a field strength of 18.8 dBµV/m. The 18.8 dBµV/m value can be mathematically converted to its corresponding level in µV/m.

FS = 58.8 - 40 = 18.8 [dBµV/m]
Level in µV/m = Common Antilogarithm (18.8/20) = 8.7

11.7 Final Test Results

9 kHz – 30 MHz:

EUT: Sample #1 mode CW 915 MHz

All emissions 20 dB below margin. For further details refer to the pre-scan test plots on following pages.

30MHz – 1 GHz:

EUT: Sample #1 mode CW, EUT frequency 915 MHz

EUT mode	Frequency	RA	AF + CF	Result	Limit	Margin
	MHz	dBµV	dB (1/m)	dBµV/m	dBµV/m	dB
CW 915MHz	41.76	-2.2	14.8	12.6	40	27.4

The table above contains worst-case emissions, only. For further details refer to the measurement plot.

1 GHz – 10 GHz:

EUT: Sample #1 mode CW, EUT frequency: 902 MHz, 915 MHz, 927 MHz

EUT mode	Spurious Emission Frequency	Peak Result	Average Result	RBW	Carrier level of EUT freq @ 3m	Limit	Margin
	MHz	dBµV/m	dBµV/m	MHz	dBµV/m	dBµV/m	dB
CW 902 MHz	6314	50.4		0.1	105	85	34.6
CW 902 MHz	7222		55.85	0.1	105	85	20
CW 915 MHz	7320		53.15	1		54	1.85
CW 927 MHz	7400		51.93	1		54	2.07
CW 927 MHz	9276	47.42		0.1	106.7	86.7	39.3

The table above contains worst-case emissions only. For further details refer to the pre-scan test plots on following pages.

Manufacturer:	Micro-Sensys GmbH
Device:	RFID Pen Style Read/Write Unit
Type(s):	ilD PENsolid UHFcc
Serial No(s):	Sample #1 103015
Test date:	2016-02-09/10/15, 2016-0215

All emissions in the range 9 kHz to 10 GHz are below the specified limits.

The EUT meets the requirements of this section.

11.7.1 Magnetic Field (f = 9 kHz to 30 MHz)

Prescan 9kHz -30 MHz, EUT#1, Mode CW, EUT 915MHz

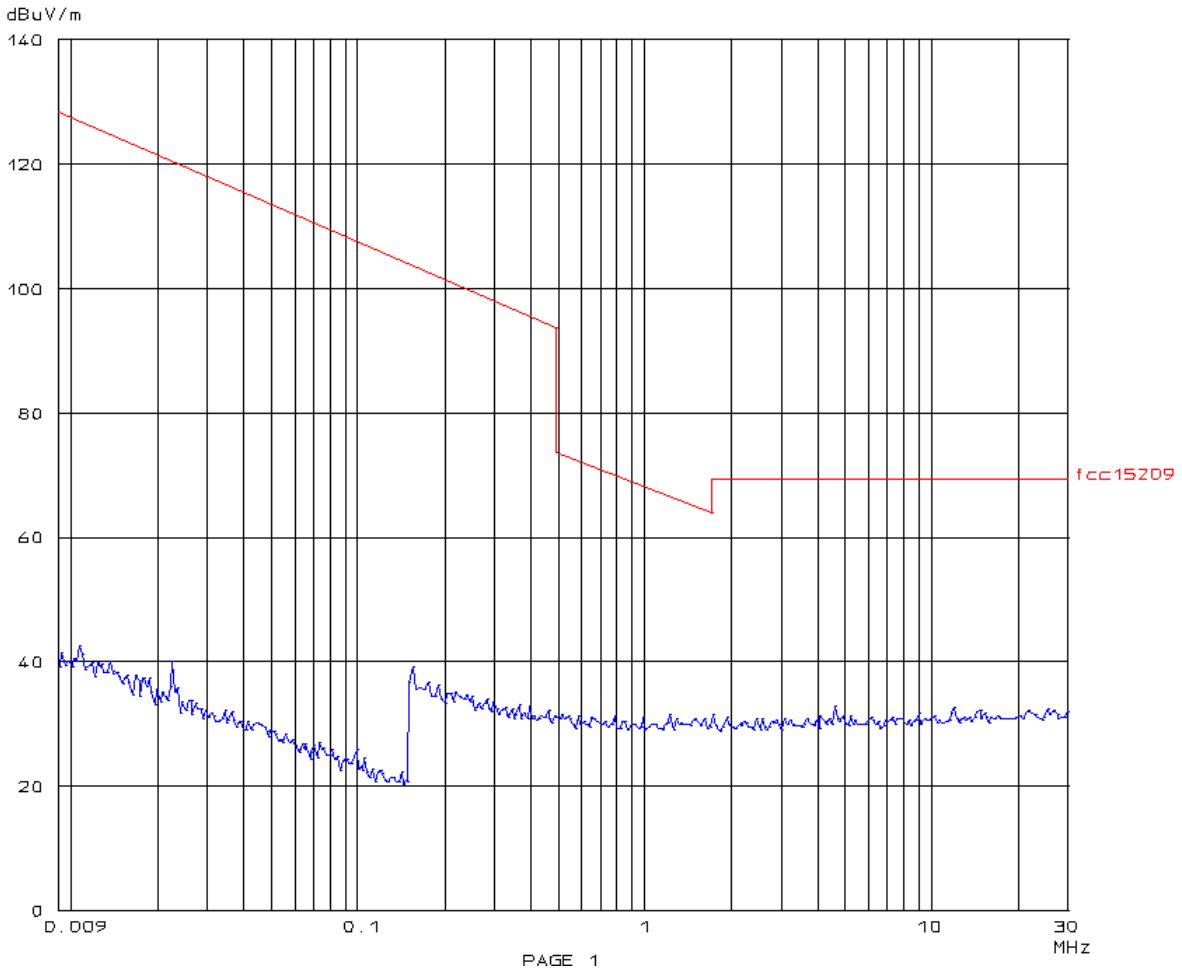
Prescan orientation 1:

```
EMCCons DR. RASEK                                   15. Feb 16  11:15
Radiated Emissions H Field in SAR, d=3m

EUT:            PENsolidUHF SN 103015
Manuf:          Micro Sensys
Op Cond:        915 MHz CW
Operator:       Klg
Test Spec:      FCC 15, RSS-210
Comment:        antenna in 2 orientations
                EUT 4 orient.

Scan Settings (2 Ranges)
|--------- Frequencies -----------||----------- Receiver Settings ------------|
  Start       Stop          Step      IF BW  Detector  M-Time Atten Preamp OpRge
    9k        150k         100Hz       200Hz     PK       1ms AUTO LO OFF   30dB
 150k          30M           5k         10k      PK       1ms AUTO LO OFF   30dB

Final Measurement: x Hor-Max / + Vert-Max
                   Meas Time:     1 s
                   Subranges:    25
                   Acc Margin:   30dB
```



Prescan orientation 2:

EMCCons DR. RASEK 15. Feb 16 12:11

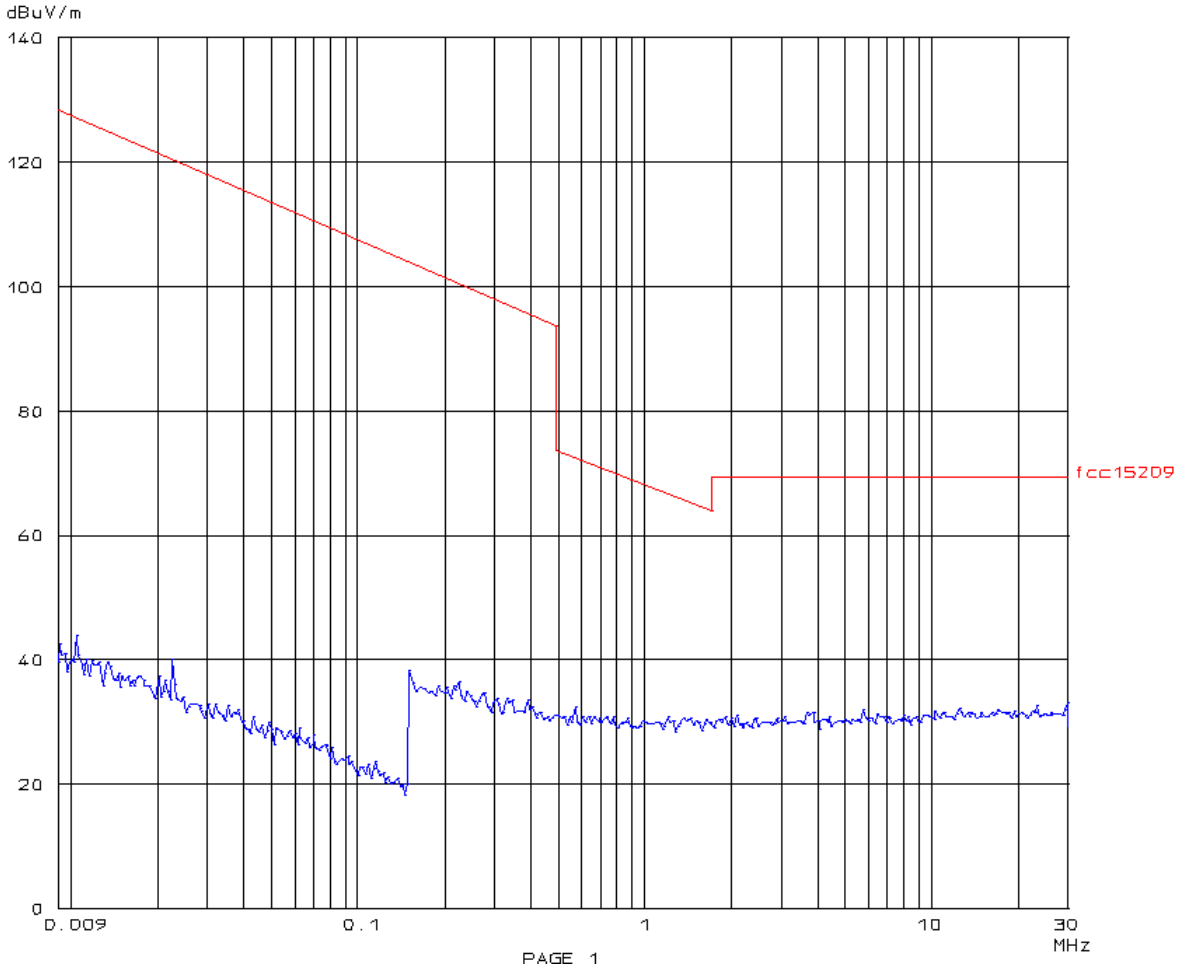
Radiated Emissions H Field in SAR, d=3m

EUT: PENsolidUHF SN 103015
Manuf: Micro Sensys
Op Cond: 915 MHz CW
Operator: Klg
Test Spec: FCC 15, RSS-210
Comment: antenna in 2 orientations
EUT 4 orient., Pos. 2

Scan Settings (2 Ranges)

Frequencies			Receiver Settings				
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
9k	150k	100Hz	200Hz	PK	1ms	AUTO	LO OFF	30dB
150k	30M	5k	10k	PK	1ms	AUTO	LO OFF	30dB

Final Measurement: x Hor-Max / + Vert-Max
Meas Time: 1 s
Subranges: 25
Acc Margin: 30dB



Prescan orientation 3:

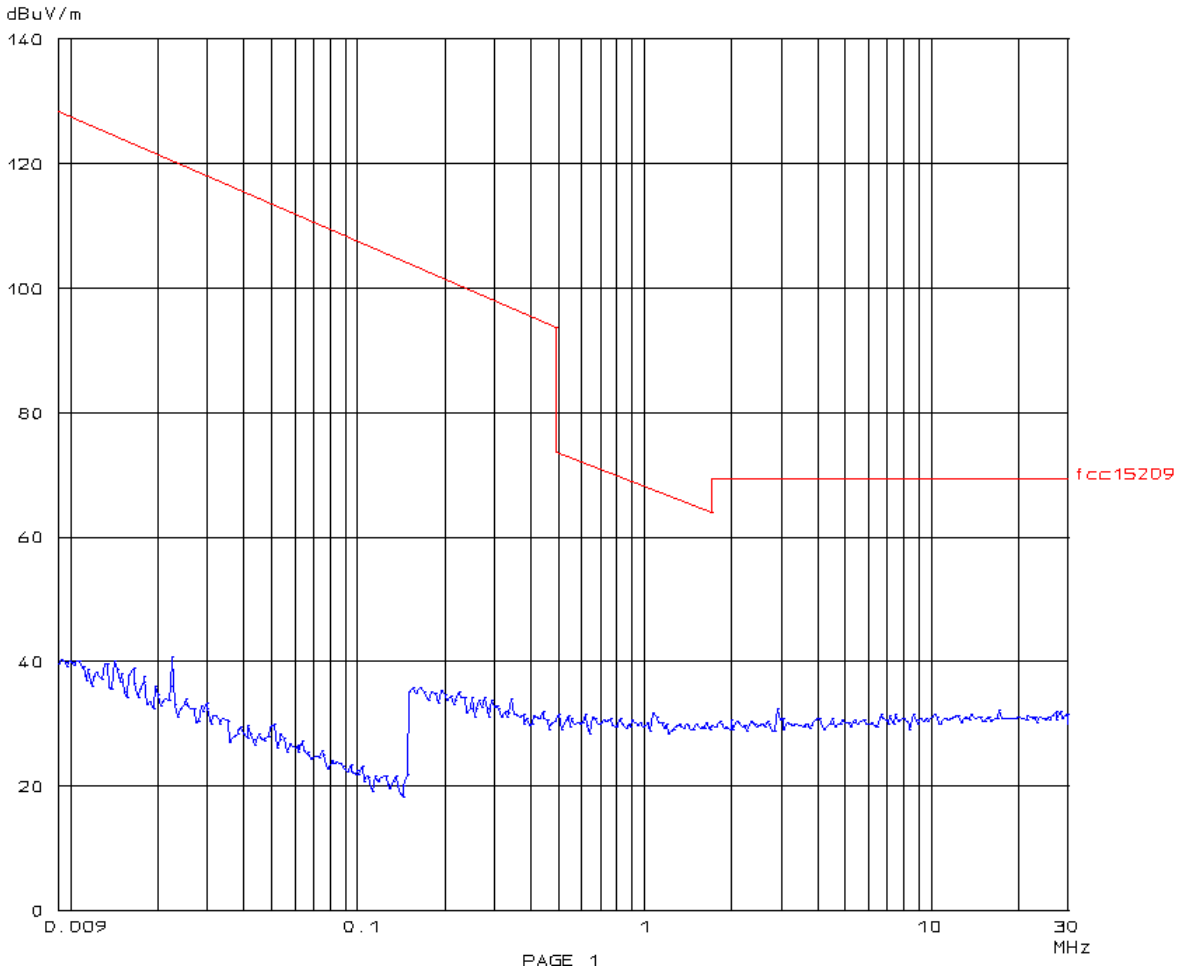
EMCCons DR. RASEK 15. Feb 16 13:13
Radiated Emissions H Field in SAR, d=3m

EUT: PENsolidUHF SN 103015
Manuf: Micro Sensys
Op Cond: 915 MHz CW
Operator: Klg
Test Spec: FCC 15, RSS-210
Comment: antenna in 2 orientations
EUT 4 orient., Pos. 3

Scan Settings (2 Ranges)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
9k	150k	100Hz	200Hz	PK	1ms	AUTO	LO OFF	30dB
150k	30M	5k	10k	PK	1ms	AUTO	LO OFF	30dB

Final Measurement: x Hor-Max / + Vert-Max
Meas Time: 1 s
Subranges: 25
Acc Margin: 30dB



11.7.2 Electric Field (f = 30 MHz to 1 GHz)

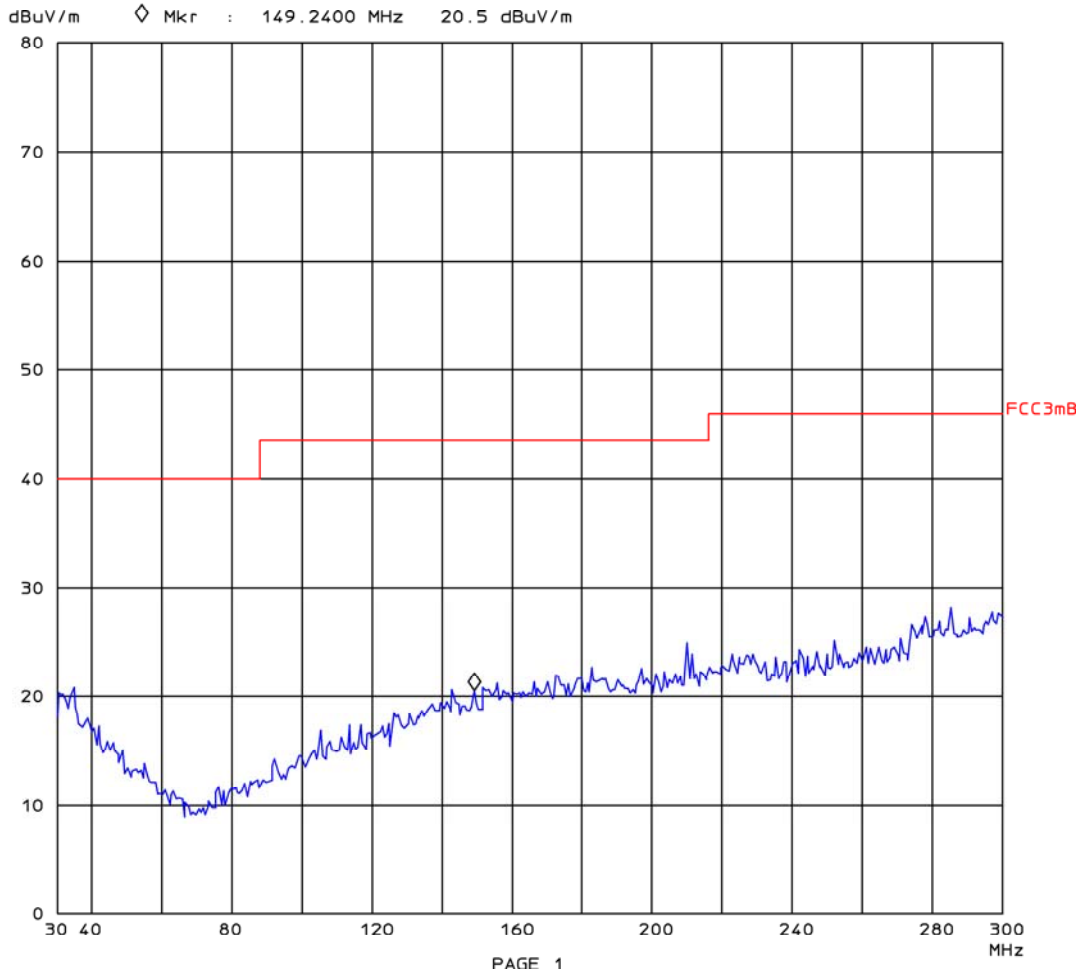
Prescan 30-300 MHz, EUT#1, Mode CW, EUT 915MHz
Prescan orientation 1:

```
EMCC DR. RASEK                                          09. Feb 16   14:24
Radiated Emissions Prescan in SAR, d=3m

EUT:            PENsolidUHF SN.:103015
Manuf:          Micro-Sensys
Op Cond:        Normal Operation
Operator:       L. Kraft
Test Spec:      FCC 15.209
Comment:        4 sides, ant. pol. hor + vert, 3,4 heights
                pen only, 915.2MHz CW

Fast Scan Settings (1 Range)
|--------- Frequencies -----------||----------- Receiver Settings ------------|
  Start       Stop         Step      IF BW  Detector  M-Time Atten Preamp OpRge
  30M        300M         40k        120k      PK     0.10ms   0dBLN ON    60dB

Final Measurement: x Hor-Max / + Vert-Max Transducer No. Start      Stop      Name
                   Meas Time:     1 s                  21    30M      300M      89926k3
                   Subranges:    25
                   Acc Margin:   15dB
```



Prescan 300- 1000 MHz, EUT#1, Mode CW, EUT 915MHz

Prescan orientation 1:

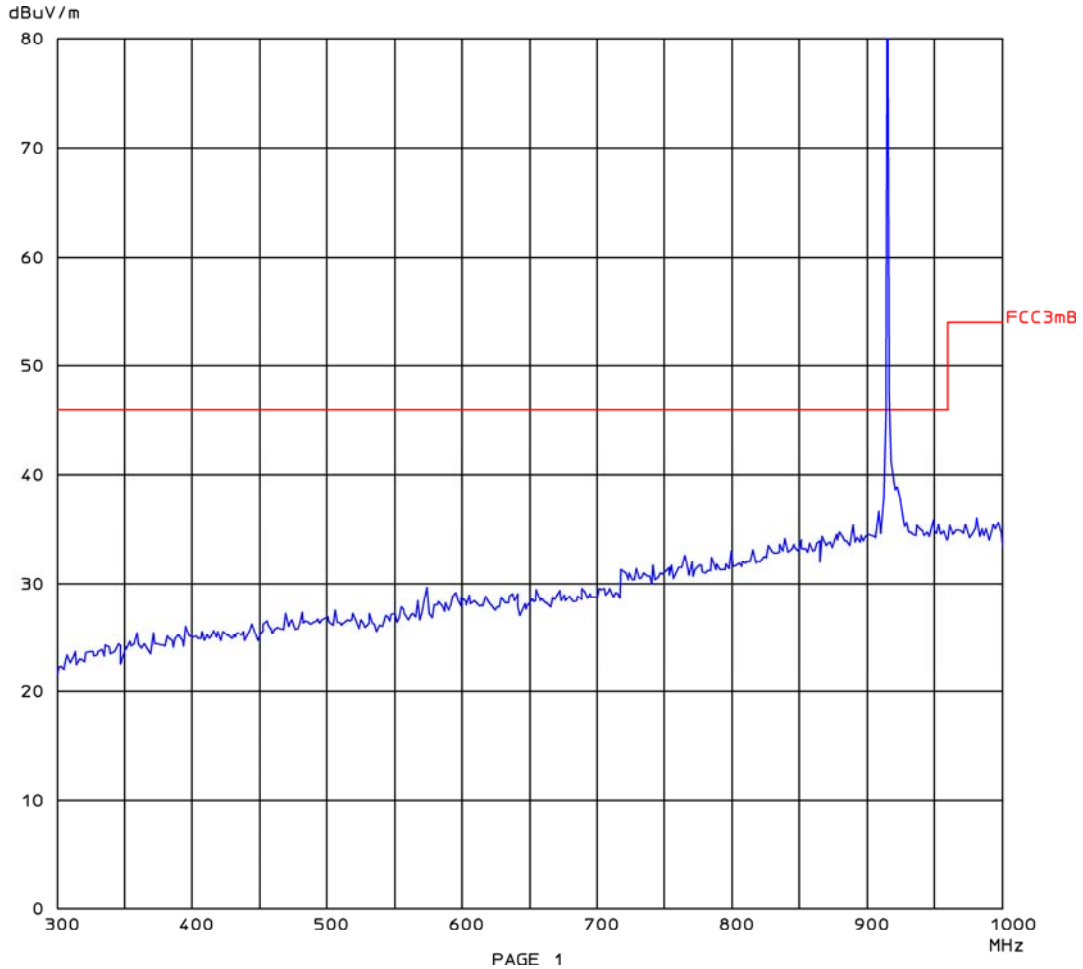
EMCC DR. RASEK 09. Feb 16 13:34

Radiated Emissions Prescan in SAR, d=3m

```
EUT:            PENsolidUHF SN.:103015
Manuf:          Micro-Sensys
Op Cond:        Normal Operation
Operator:       L. Kraft
Test Spec:      FCC 15.209
Comment:        4 sides, ant. pol. hor & ver, 3,4 heights
                pen only

Fast Scan Settings (1 Range)
|--------- Frequencies -----------||----------- Receiver Settings ------------|
  Start       Stop         Step      IF BW  Detector  M-Time Atten Preamp OpRge
 300M        1000M         40k        120k      PK     0.10ms   0dBLN ON    60dB

                                  Transducer No. Start      Stop      Name
                                               22   300M     1000M     320326k3
```



Carrier of intentional radiator at 915 MHz above the limit.

Prescan 30- 300 MHz, EUT#1, Mode CW, EUT 915MHz

Prescan orientation 2:

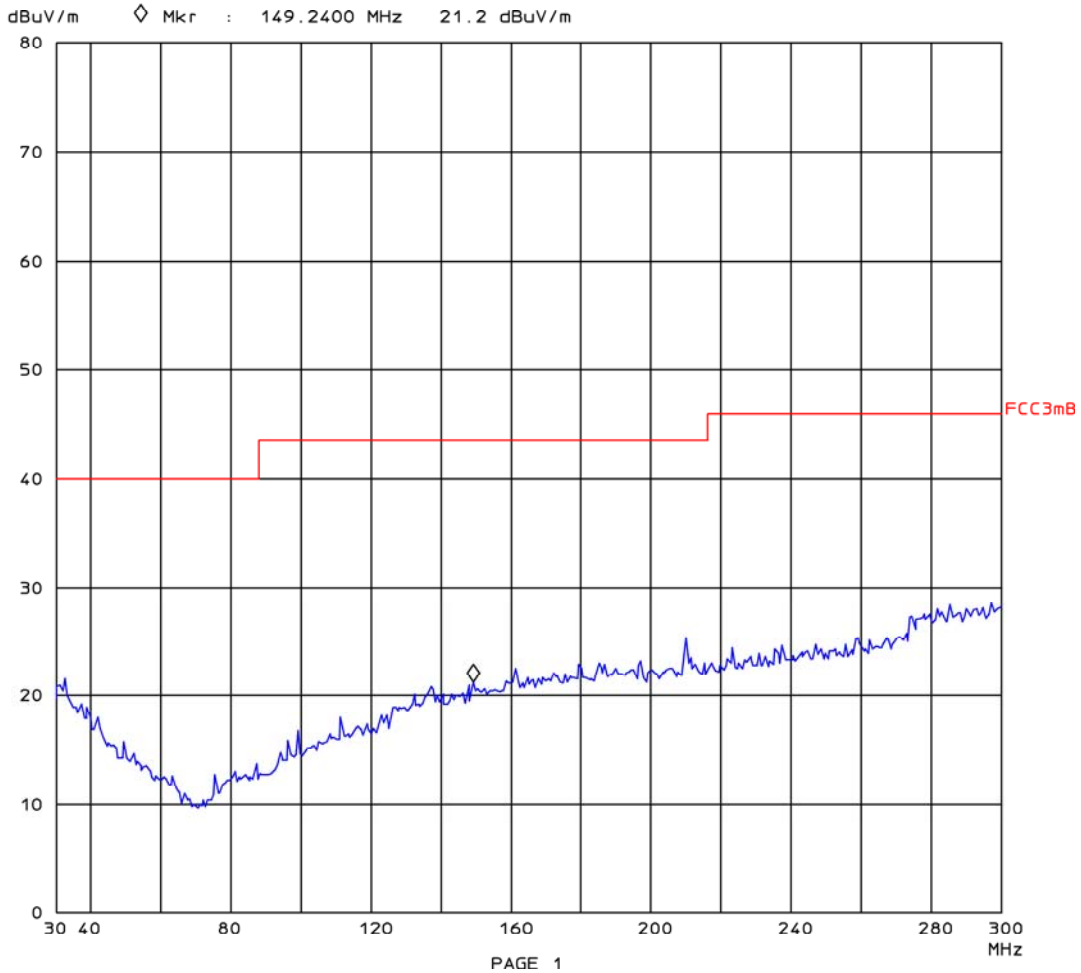
EMCC DR. RASEK 16. Feb 16 07:53
Radiated Emissions Prescan in SAR, d=3m

EUT: PENsolidUHF SN.:103015
Manuf: Micro-Sensys
Op Cond: CW 915 MHz
Operator: L. Kraft
Test Spec: FCC 15.209
Comment: 4 sides, ant. pol. hor + vert, 3,4 heights
pen only, pos. 2

Fast Scan Settings (1 Range)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
30M	300M	40k	120k	PK	0.10ms	0dBLN	ON	60dB

Transducer	No.	Start	Stop	Name
	21	30M	300M	89926k3



Prescan 300- 1000 MHz, EUT#1, Mode CW, EUT 915MHz

Prescan orientation 2:

EMCC DR. RASEK 16. Feb 16 12:02

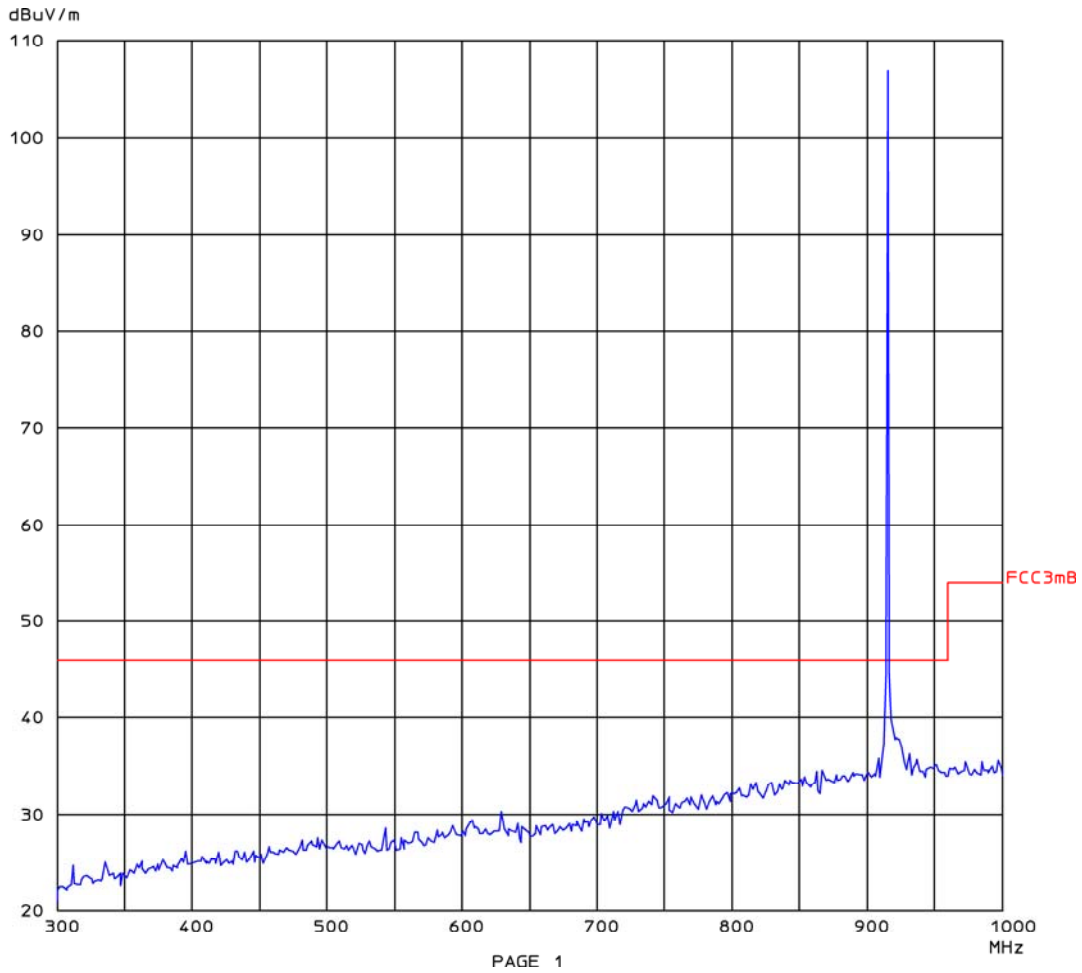
Radiated Emissions Prescan in SAR, d=3m

EUT: PENsolidUHF SN.:103015
Manuf: Micro-Sensys
Op Cond: CW 915 MHz
Operator: L. Kraft
Test Spec: FCC 15.209
Comment: 4 sides, ant. pol. hor & ver, 3,4 heights
pen only, pos. 2

Fast Scan Settings (1 Range)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
300M	1000M	40k	120k	PK	0.10ms	0dBLN	ON	60dB

Transducer	No.	Start	Stop	Name
	22	300M	1000M	320326k3



Carrier of intentional radiator at 915 MHz above the limit.

Prescan 30- 300 MHz, EUT#1, Mode CW, EUT 915MHz

Prescan orientation 3:

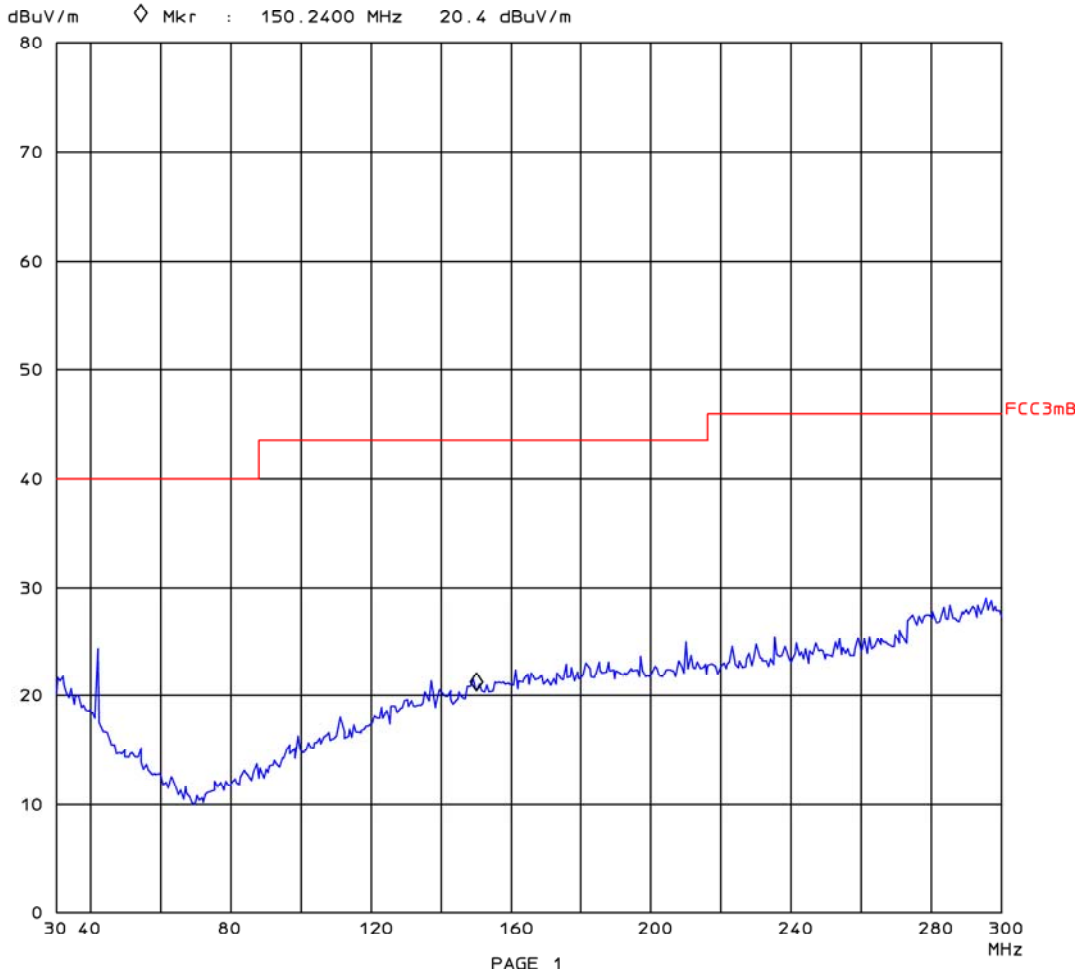
EMCC DR. RASEK 16. Feb 16 08:48
Radiated Emissions Prescan in SAR, d=3m

EUT: PENsolidUHF SN.:103015
Manuf: Micro-Sensys
Op Cond: CW 915 MHz
Operator: L. Kraft
Test Spec: FCC 15.209
Comment: 4 sides, ant. pol. hor + vert, 3,4 heights
pen only, pos. 3

Fast Scan Settings (1 Range)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
30M	300M	40k	120k	PK	0.10ms	0dBLN	ON	60dB

Transducer	No.	Start	Stop	Name
	21	30M	300M	89926k3



Prescan 300- 1000 MHz, EUT#1, Mode CW, EUT 915MHz

Prescan orientation 3:

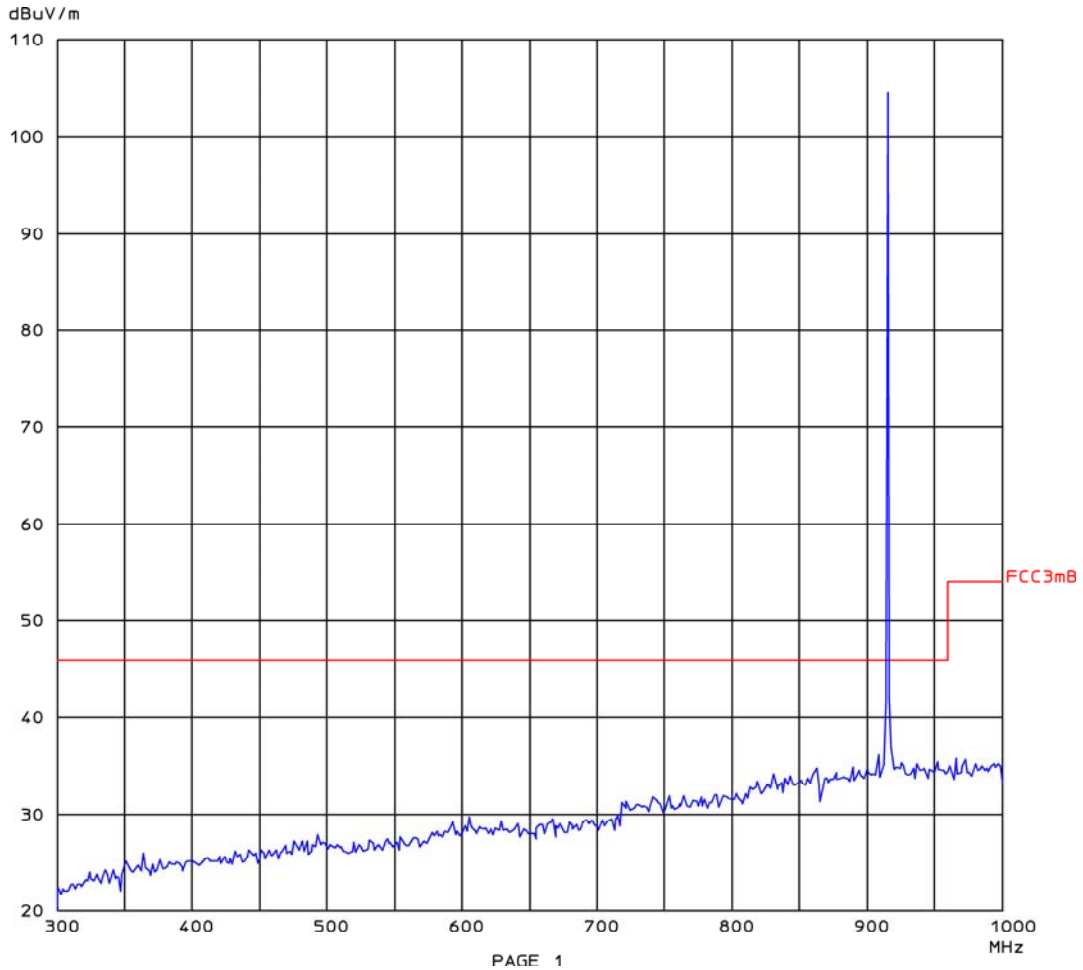
EMCC DR. RASEK 16. Feb 16 10:45

Radiated Emissions Prescan in SAR, d=3m

```
EUT:            PENsolidUHF SN.:103015
Manuf:          Micro-Sensys
Op Cond:        CW 915 MHz
Operator:       L. Kraft
Test Spec:      FCC 15.209
Comment:        4 sides, ant. pol. hor & ver, 3,4 heights
                pen only, pos. 3

Fast Scan Settings (1 Range)
|--------- Frequencies -----------||----------- Receiver Settings ------------|
  Start       Stop         Step       IF BW  Detector  M-Time Atten Preamp OpRge
 300M        1000M         40k         120k      PK     0.10ms   0dBLN ON    60dB

                                    Transducer No. Start      Stop      Name
                                                 22   300M     1000M     320326k3
```



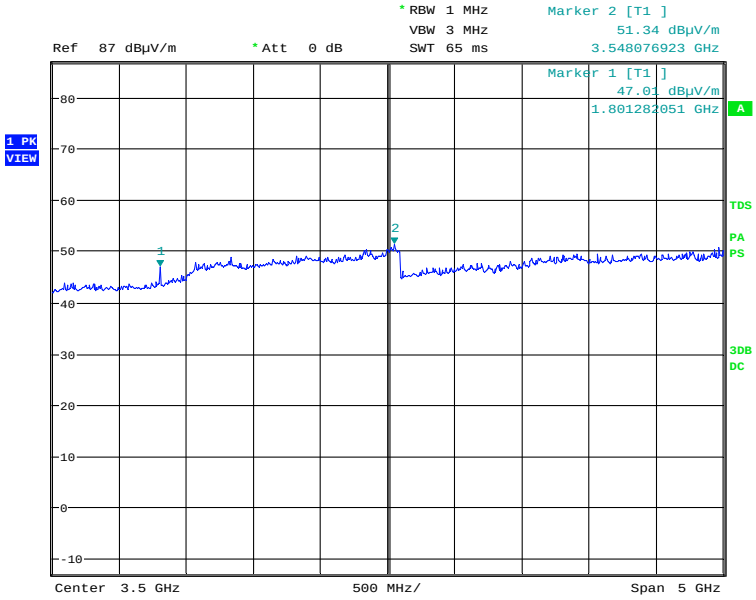
Carrier of intentional radiator at 915 MHz above the limit.

11.7.3 Electric Field (f = 1 GHz to 10 GHz)

Prescan and final measurements were performed at 3 m distance

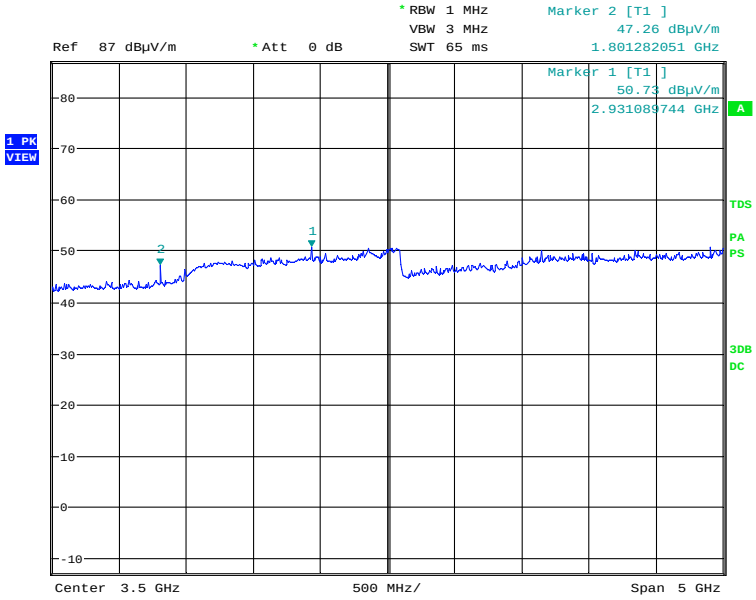
Only orientation 1 plots provided as worst case.

Prescan 1-6 GHz, Pol. hor., EUT#1, Mode CW, EUT 902MHz



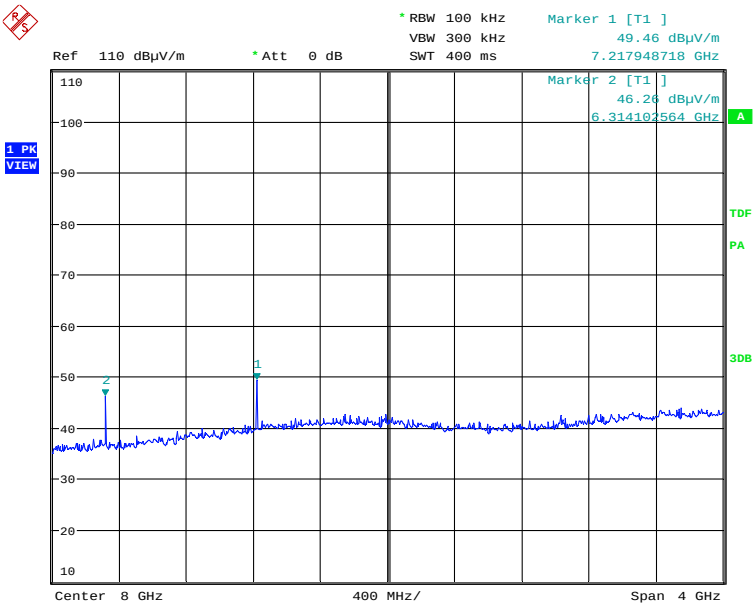
EUT: 103015; Mode: CW 902 MHz; Pol: Hor
Date: 10.FEB.2016 13:22:25

Prescan 1-6 GHz, Pol. vert., EUT#1, Mode CW, EUT 902MHz



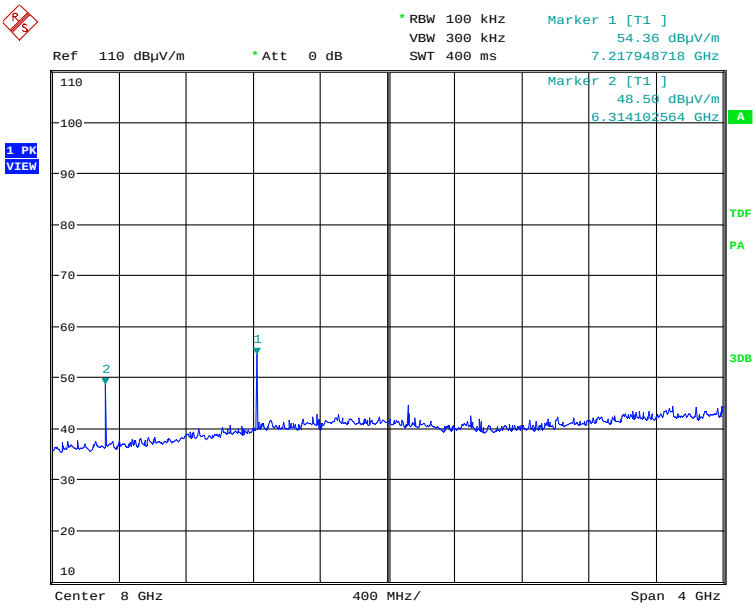
EUT: 103015; Mode: CW 902 MHz; Pol: Ver
Date: 10.FEB.2016 13:18:38

Prescan 6-10 GHz, Pol. hor, EUT#1, Mode CW, EUT 902MHz



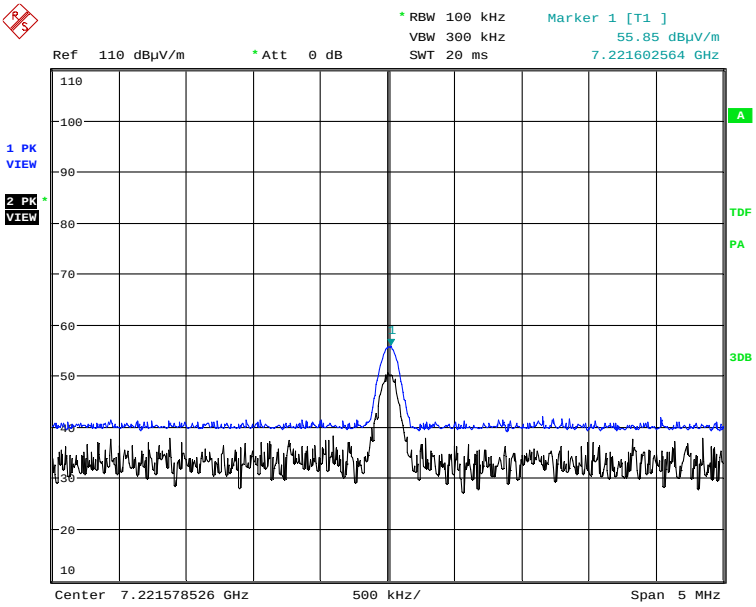
EUT: 103015; Mode: CW 902 MHz; Pol: Hor
Date: 10.FEB.2016 13:56:41

Prescan 6-10 GHz, Pol. vert., EUT#1, Mode CW, EUT 902MHz



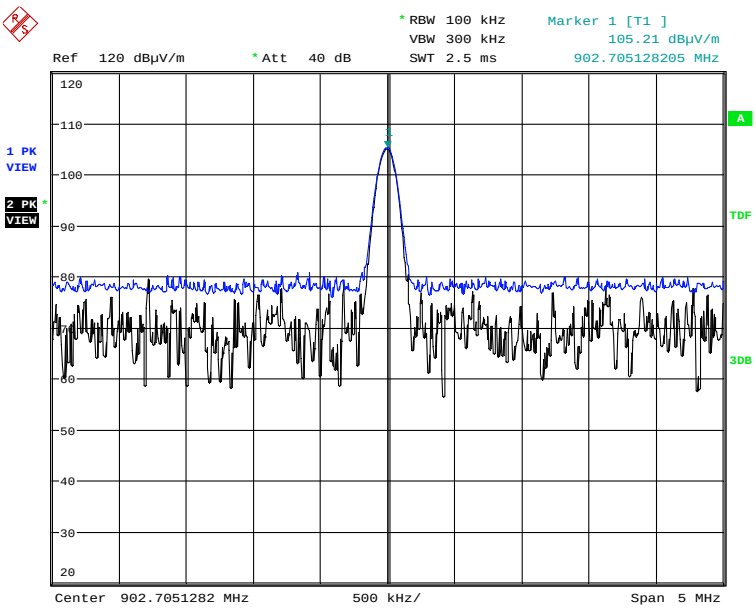
EUT: 103015; Mode: CW 902.2MHz; Pol: Ver
Date: 10.FEB.2016 11:03:48

Maximum 7.22 GHz, RBW 100kHz, Pol. vert., EUT#1, Mode CW, EUT 902MHz



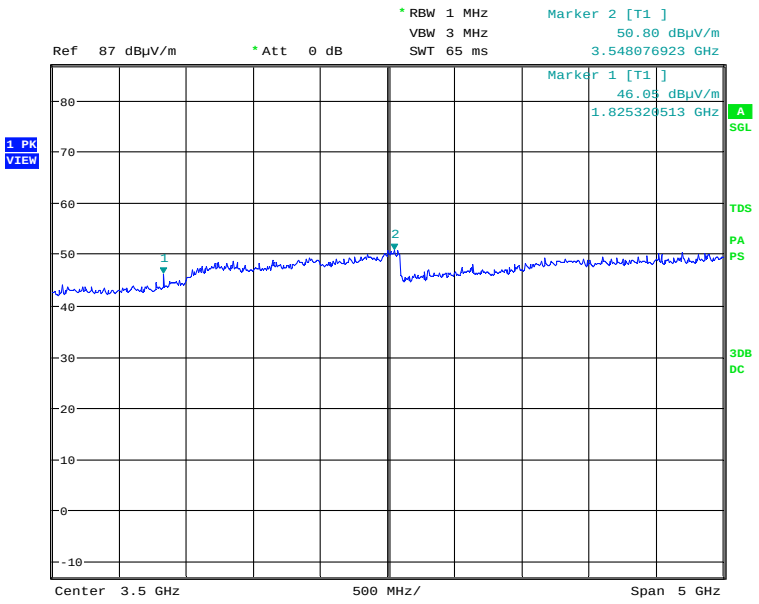
EUT: 103015; Mode: CW 902 MHz; Pol: Ver: Max
Date: 10.FEB.2016 16:46:49

Maximum Carrier, EUT#1, Mode CW, EUT 902 MHz



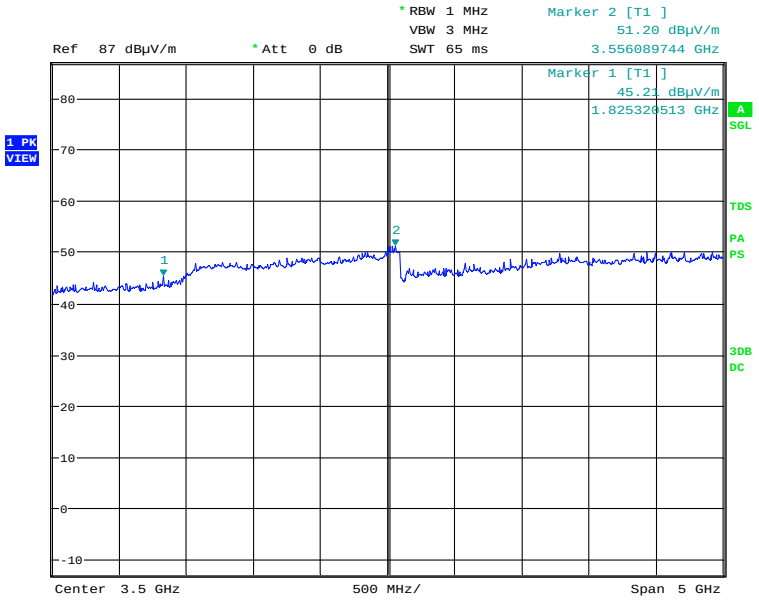
EUT: 103015; Mode: CW 902 MHz; Max Carrier, Pol. Hor
Date: 10.FEB.2016 17:18:23

Prescan 1-6 GHz, Pol. hor., EUT#1, Mode CW, EUT 915 MHz



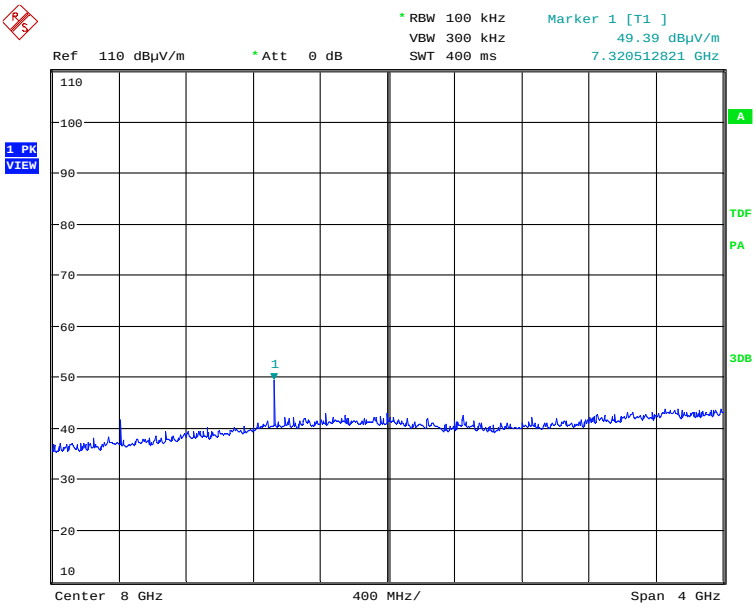
PENsolidUHF915,2; Hor
Date: 19.APR.2016 17:42:16

Prescan 1-6 GHz, Pol. vert., EUT#1, Mode CW, EUT 915 MHz



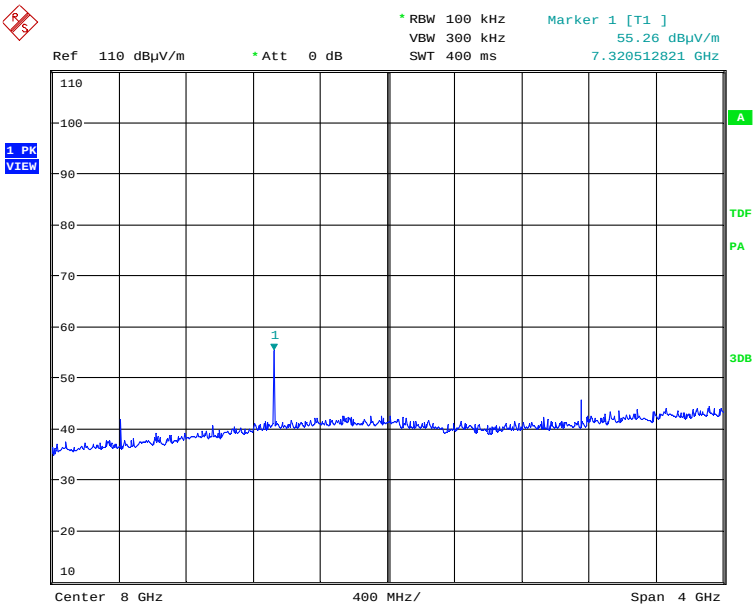
PENsolidUHF915,2; Ver
Date: 19.APR.2016 17:41:11

Prescan 6-10 GHz, Pol. hor., EUT#1, Mode CW, EUT 915 MHz



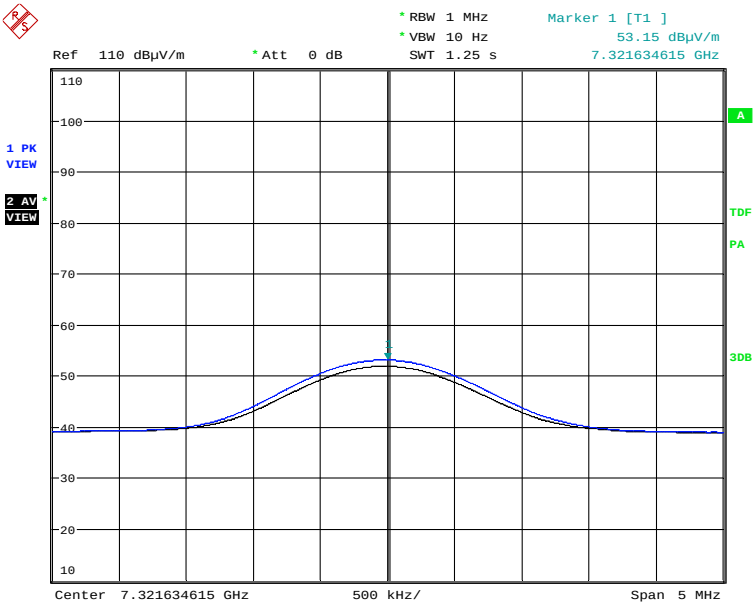
EUT: 103015; Mode: CW 915.2MHz; Pol: Hor
Date: 10.FEB.2016 10:32:29

Prescan 6-10 GHz, Pol. vert., EUT#1, Mode CW, EUT 915 MHz



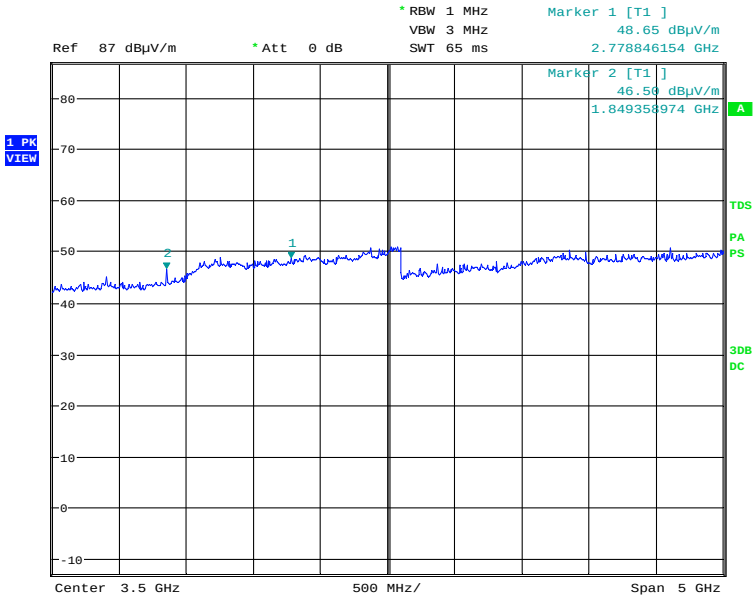
EUT: 103015; Mode: CW 915.2MHz; Pol: Ver
Date: 10.FEB.2016 10:36:49

Maximum 7.32 GHz, RBW 1MHz, Pol. vert., EUT#1, Mode CW, EUT 915MHz



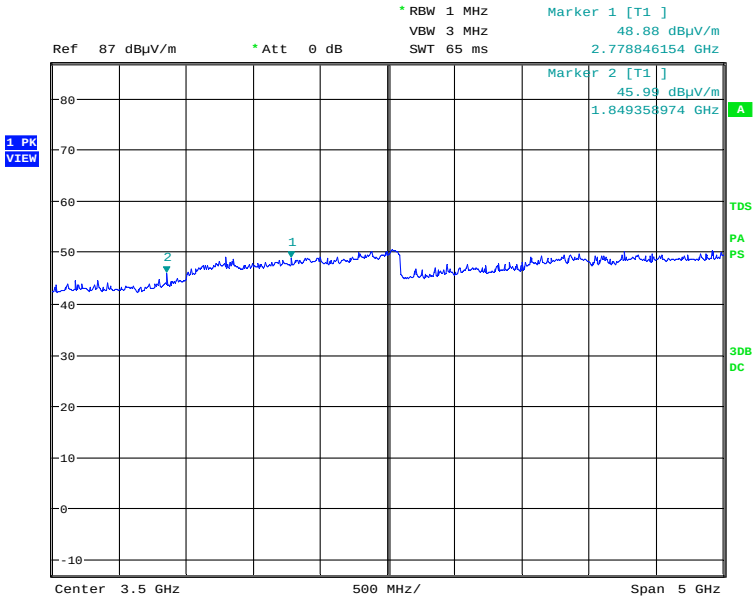
EUT: 103015, Mode: CW 915.2MHz, Pol: vert
Date: 9.FEB.2016 18:08:37

Prescan 1-6 GHz, Pol. hor., EUT#1, Mode CW, EUT 927 MHz



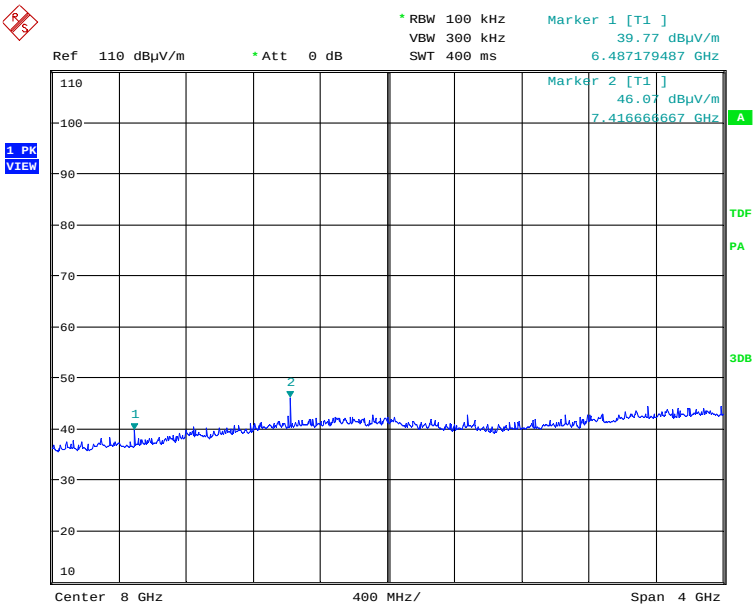
EUT: 103015; Mode: CW 927 MHz; Pol: Hor
Date: 10.FEB.2016 12:22:04

Prescan 1-6 GHz, Pol. vert., EUT#1, Mode CW, EUT 927 MHz



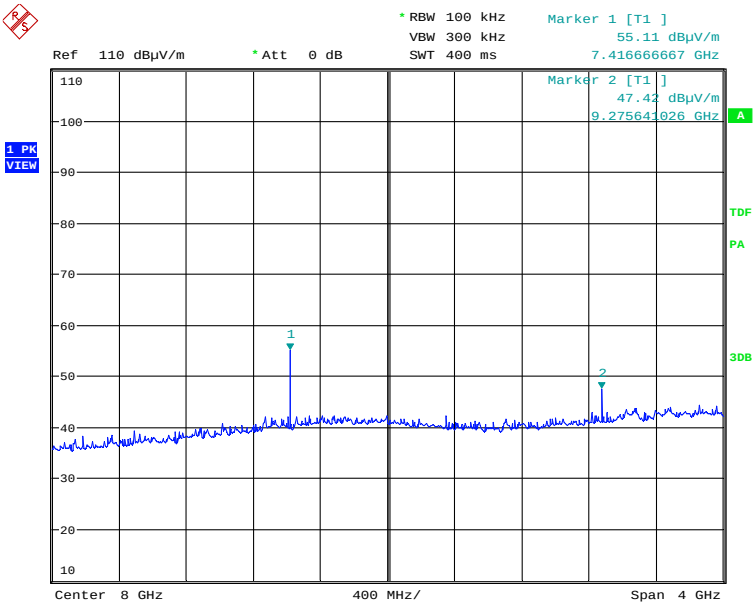
EUT: 103015; Mode: CW 927MHz; Pol: Ver
Date: 10.FEB.2016 12:25:45

Prescan 6-10 GHz, Pol. hor., EUT#1, Mode CW, EUT 927 MHz



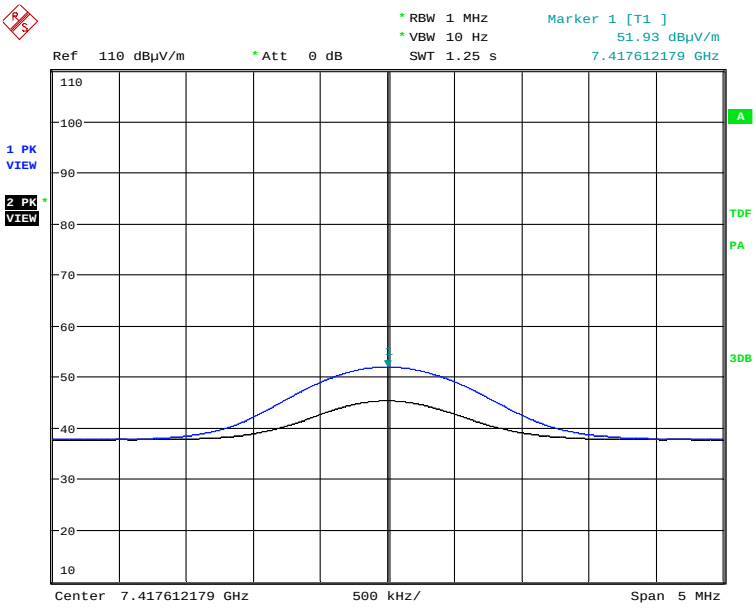
EUT: 103015; Mode: CW 927MHz; Pol: Hor
Date: 10.FEB.2016 12:44:58

Prescan 6-10 GHz, Pol. vert., EUT#1, Mode CW, EUT 927 MHz



EUT: 103015; Mode: CW 927MHz; Pol: Ver
Date: 10.FEB.2016 12:32:43

Maximum 7.42 GHz, RBW 1MHz, Pol. vert., EUT#1, Mode CW, EUT 927 MHz



EUT: 103015; Mode: CW 927MHz; Pol: Ver
Date: 10.FEB.2016 12:38:52

12 BAND-EDGE EMISSIONS

Test Requirement: FCC 47 CFR 15.247, IC RSS-247 Issue 1 (2015-05), 5.5; RSS-Gen Issue 4 (2014-11), 8.9, 8.10, IC RSS-Gen Issue 4, 8.9, RSS-210 A2.6
Test Procedure: ANSI C63.10-2013, IC RSS-Gen

12.1 Regulation

FCC 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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

RSS-247 5.5 Unwanted Emissions

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

12.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
Logper. Antenna	Schwarzbeck VUSLP 9111B	3203	2015-05	2017-05
Receiver (20 Hz - 8 GHz)	Rohde & Schwarz ESU8	3846	2015-08	2016-08

12.3 Test Procedures

Span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation

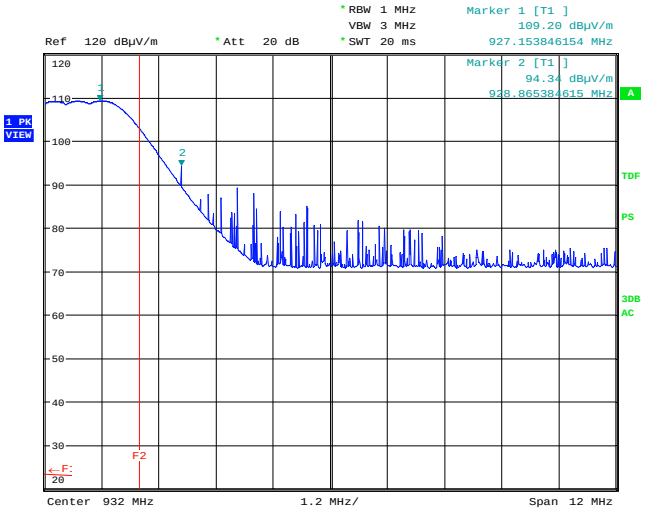
RBW = 1 MHz
VBW = 3 MHz
Sweep = auto
Detector function = peak
Trace = max hold

The hopping function of the EUT was enabled. The max. hold function was used to identify the max. peak. The bandedge and the max peak outside of the band was then tested with max hold QP detector and 120kHz RBW.
Applying worst case requirements per § 15.209.

12.4 Test Results

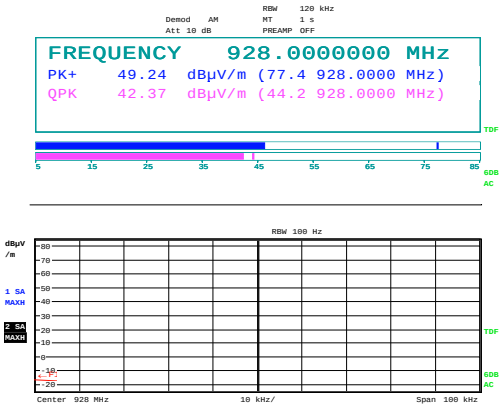
Frequency	RBW	Level QP detector	Limit	Margin
MHz	kHz	dBµV/m	dBµV/m	dB
928	120	44.2	46	2.8
928.86	120	43.0	46	3
902	120	43.1	46	2.9
901.4	120	42.2	46	2.8

Bandedge 928 MHz: EUT#1 with FW 3.00.05), Mode normal operation

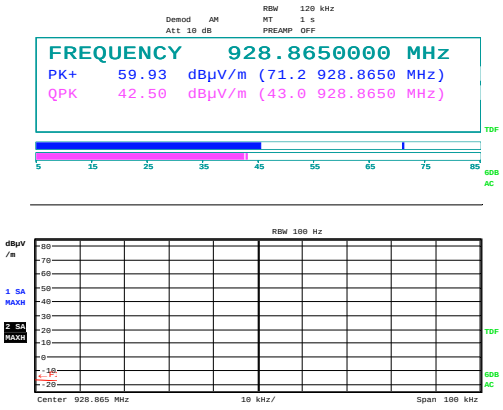


EUT: PENsolidUHF 103015 new FW 3.00.05, Mode: Normal Operati
on
Date: 3.MAR.2016 15:54:43

Retest with QP and 120 kHz RBW.

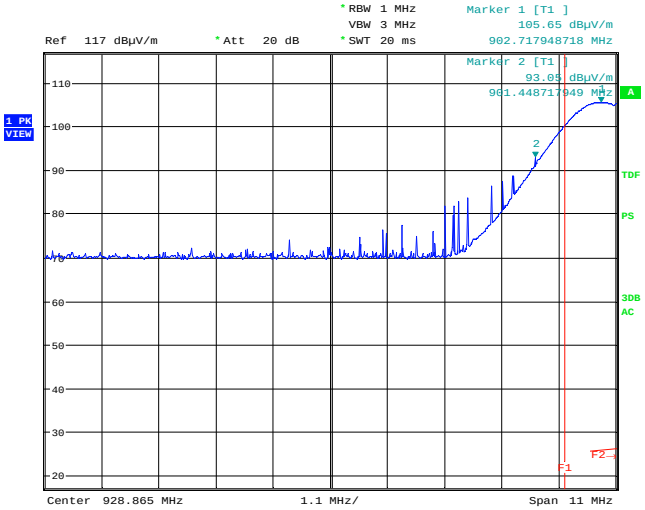


EUT: PENsolidUHF 103015 new FW 3.00.05, Mode: Normal Operati
on
Date: 3.MAR.2016 16:18:11



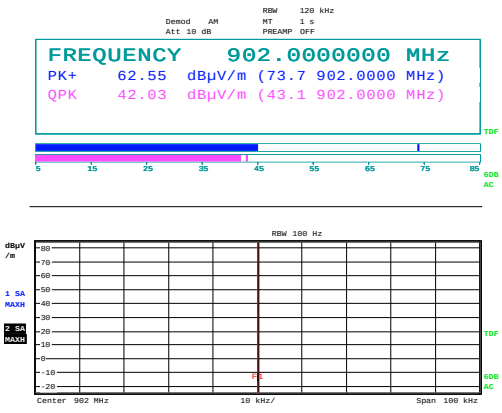
EUT: PENsolidUHF 103015 new FW 3.00.05, Mode: Normal Operati
on
Date: 3.MAR.2016 16:24:03

Bandedge 902 MHz: EUT#1 with FW 3.00.05), Mode normal operation

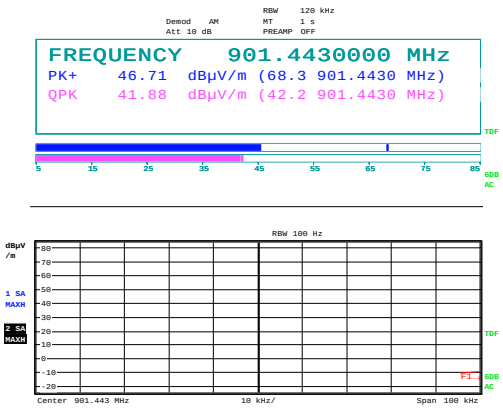


EUT: PENsolidUHF 103015 new FW 3.00.05, Mode: Normal Operati
on
Date: 3.MAR.2016 16:31:43

Retest with QP and 120 kHz RBW.



EUT: PENsolidUHF 103015 new FW 3.00.05, Mode: Normal Operati
on
Date: 3.MAR.2016 16:49:41



EUT: PENsolidUHF 103015 new FW 3.00.05, Mode: Normal Operati
on
Date: 3.MAR.2016 16:58:16

Manufacturer:	Micro-Sensys GmbH
Device:	RFID Pen Style Read/Write Unit
Type(s):	ilD PENsolid UHFcc
Serial No(s):	Sample #1 103015 (with new FW 3.00.05)
Test date:	2016-02-29 / 2016-03-02

The EUT meets the requirements of this section.

13 RADIOFREQUENCY RADIATED EXPOSURE EVALUATION

Test Requirement: FCC 47 CFR, §1.1307, RSS-102 Issue 5 (2015-03), 2.5
Test Procedure: 447498 D01 General RF Exposure Guidance v06, RSS-102 Issue 5 (2015-03), 2.5.1

13.1 Regulation

FCC 1.1307
(b) In addition to the actions listed in paragraph (a) of this section, Commission actions granting construction permits, licenses to transmit or renewals thereof, equipment authorizations or modifications in existing facilities, require the preparation of an Environmental Assessment (EA) if the particular facility, operation or transmitter would cause human exposure to levels of radiofrequency radiation in excess of the limits in §§ 1.1310 and 2.1093 of this chapter. Applications to the Commission for construction permits, licenses to transmit or renewals thereof, equipment authorizations or modifications in existing facilities must contain a statement confirming compliance with the limits unless the facility, operation, or transmitter is categorically excluded, as discussed below. Technical information showing the basis for this statement must be submitted to the Commission upon request. Such compliance statements may be omitted from license applications for transceivers subject to the certification requirement in § 25.129 of this chapter.

IC RSS-102 2.5 Exemption from Routine Evaluation Limits
All transmitters are exempt from routine SAR and RF exposure evaluations provided that they comply with the requirements of sections 2.5.1 or 2.5.2. If the equipment under test (EUT) meets the requirements of sections 2.5.1 or 2.5.2, applicants are only required to submit a properly signed declaration of compliance (see Annex C). The information contained in the RF exposure technical brief may be limited to the value(s) of the maximum output power, the information that demonstrates how the maximum output power of the transmitter was derived and the rationale for the separation distances applied (see Table 1), which must be based on the most conservative exposure condition for the applicable module or host platform test procedure requirements.
If the EUT does not meet the appropriate exemption limit, a complete SAR or RF exposure evaluation shall be performed. However, the power exemption limits in Table 1 can be applied to reduce the number of test configurations (e.g. testing of a tablet edge). The RF exposure technical brief (see Section 2.2) must include a rationale for the separation distances applied based on the applicable module or host platform test procedure requirements.
It must be emphasized that the above exemption from routine evaluation is not an exemption from compliance.

IC RSS-102 2.5.1 Exemption from Routine Evaluation Limits – SAR Evaluation
SAR evaluation is required if the separation distance between the user and/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm, except when the device operates at or below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in Table 1.

Table 1: SAR evaluation – Exemption limits for routine evaluation based on frequency and separation distance

Frequency (MHz)	**Exemption Limits (mW)**				
	At separation distance of ≤5 mm	**At separation distance of** 10 mm	**At separation distance of** 15 mm	**At separation distance of** 20 mm	**At separation distance of** 25 mm
835	17 mW	30 mW	42 mW	55 mW	67 mW

13.2 Test Procedure

Excerpt from D01 General RF Exposure Guidance v06 chapter 4.3.1 Standalone SAR test exclusion considerations.

a) For 100 MHz to 6 GHz and *test separation distances* ≤ 50 mm, the 1-g and 10-g *SAR test exclusion thresholds* are determined by the following:
[(*max. power of channel, including tune-up tolerance, mW*) / (*min. test separation distance, mm*)] · [$\sqrt{f_{(GHz)}}$] ≤ 3.0 for 1-g SAR, and ≤ 7.5 for 10-g extremity SAR,[30] where

- $f_{(GHz)}$ is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation[31]
- The result is rounded to one decimal place for comparison
- The values 3.0 and 7.5 are referred to as *numeric thresholds* in step b) below

The test exclusions are applicable only when the minimum *test separation distance* is ≤ 50 mm, and for transmission frequencies between 100 MHz and 6 GHz. When the minimum *test separation distance* is < 5 mm, a distance of 5 mm according to 4.1 f) is applied to determine SAR test exclusion.

[30] This is equivalent to the formula written as: [(*max. power of channel, including tune-up tolerance, mW*)/(60/$\sqrt{f}$(GHz) mW)]·[20 mm/(*min. test separation distance, mm*)] ≤ 1.0 for 1-g SAR; also see Appendix A for approximate exclusion threshold numerical values at selected frequencies and distances.

[31]Unless stated otherwise, the same rounding requirements should be applied to all similar equations in this document.

Excerpt from D01 General RF Exposure Guidance v06 Appendix A.

SAR Test Exclusion Thresholds for 100 MHz – 6 GHz and ≤ 50 mm
Approximate SAR Test Exclusion Power Thresholds at Selected Frequencies and Test Separation Distances are illustrated in the following Table. The equation and threshold in 4.3.1 must be applied to determine SAR test exclusion.

MHz	5	10	15	20	25	mm
900	16	32	47	63	79	*SAR Test Exclusion Threshold* (mW)

There more stringent limit for 5 mm from D01 General RF Exposure Guidance v06 Appendix A was used. The peak power conducted from chapter 10 was used.

Excerpt from D01 General RF Exposure Guidance v06 chapter 6.3. Low transmission duty factor devices

For devices that only transmit intermittently in data mode, without any voice support, the time-averaged exposure can be low. When transmissions are sporadic and duty factor is not inherently built-in to the device, source-based time-averaging may not be easily applied. These types of operations may include location trackers, emergency alert responders, point of sales devices (POS), certain black & white display e-Readers, and devices supporting location-based services. SAR measurement is not required when an acceptable worst case or most conservative transmission duty factor is determined and the SAR Test Exclusion Threshold conditions are satisfied for the duty factor adjusted maximum output power and minimum test separation distance required for all applicable operating configurations. The supporting details for determining this type of transmission duty factor, with respect to the design and implementation of the device, operating configurations and exposure conditions, must be fully documented in a SAR analysis report, to qualify for SAR test exclusion. When SAR evaluation is required, the duty factor determined in the SAR analysis may be applied to scale the measured SAR, to determine compliance. Voice-mode communication generally does not qualify for low duty factor considerations; however, exceptions may be considered for certain short (e.g. < 30 seconds) and infrequent transmissions.

The peak power radiated from chapter 10 was used and the power e.i.r.p calculated using the equation:

P(e.i.r.p) = E - 104.77 – gi + 20 log d

P(e.i.r.p) = Power e.i.r.p in dBm
E = Radiated fieldstrength in dBµV/m
Gi = isotropic gain in dBi (< 0dBi acc. to customer)
D = Distance EUT to antenna in m

The duty cycle measurement was taken from the chapter 9 to evaluate the average power over the used hopping channels.

$$P(avg) = P(e.i.r.p.) + 10 * \log \frac{T_{ON}}{T_{rep}}$$

P(avg) = average power in dBm
T_{ON} = on time in ms (19 ms)
Trep = repetition time in ms (400.8 ms)

13.2 dB = 10 * log (19/400.8)

13.3 Result

EUT, mode	Frequency	Power e.i.r.p	Power (avg)	Limit	Margin
	MHz	dBm	dBm	dBm	dB
Sample #1, CW	902	8.7	-4.5	12	16.5
Sample #1, CW	915	10.9	-2.3	12	14.3
Sample #1, CW	927	11.5	-1.7	12	13.7

Manufacturer: Micro-Sensys GmbH
Device: RFID Pen Style Read/Write Unit
Type(s): ilD PENsolid UHFcc
Serial No(s): Sample #1 103015
Test date: 2016-02-11

The EUT meets the requirements of this section.

14 MEASUREMENT UNCERTAINTY

Measurement	Measurement Uncertainty
Conducted Emissions (150 kHz – 30 MHz)	± 3.5 dB
Radiated Emissions, H field (9 kHz – 30 MHz)	± 3.0 dB
Radiated Emissions (30 MHz – 1 GHz)	±5.3 dB
Radiated Emissions (1 GHz – 6 GHz)	±5.2 dB

The reported uncertainty values are based on a standard uncertainty multiplied by a coverage factor of k=2.0, providing a level of confidence of 95 %.

The given values have been calculated on the basis of the following documents:
CISPR 16-4: 2002;
UKAS: LAB34, The Expression of Uncertainty in EMC Testing, August 2002;
ISO: Guide to the Expression of Uncertainty in Measurement, 1993.

15 LIST OF ANNEXES

Following annexes are separated parts from this test report.

Description	Pages
Annex 1: Photographs of test set-up	4
Annex 2: External photographs of equipment under test (EUT)	2
Annex 3: Internal photographs of equipment under test (EUT)	2

ANNEX 1 TO TEST REPORT # EMCC-980398GA, 2016-05-03

PHOTOGRAPHS OF TEST SET-UP

EQUIPMENT UNDER TEST:

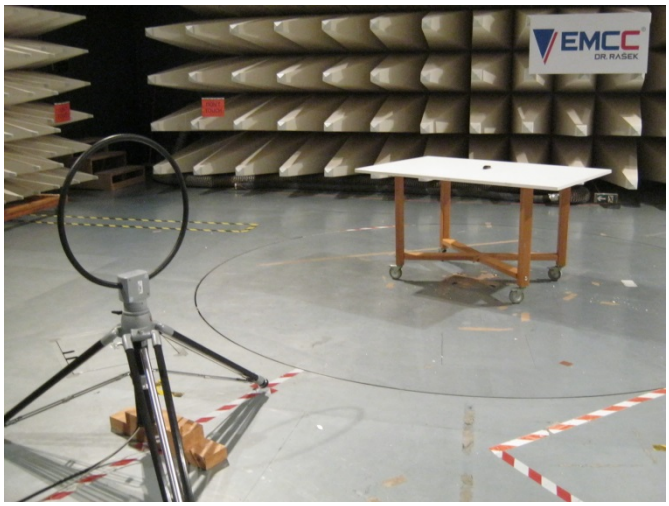
Trade Name:	RFID Pen Style Read/Write Unit
Type Designation(s):	ilD PENsolid UHFcc
Serial Number:	Sample #1: 103015 Sample #2: 103014
Equipment Class:	Low Power Transceiver
Manufacturer:	Micro-Sensys GmbH
Address:	In der Hochstedter Ecke 2 99098 Erfurt Germany
Phone:	+49 361 59874-0
Fax:	+49 361 59874-17

RELEVANT STANDARD(S): 47 CFR Part 15C, RSS-247 Issue 1 (2015-05)

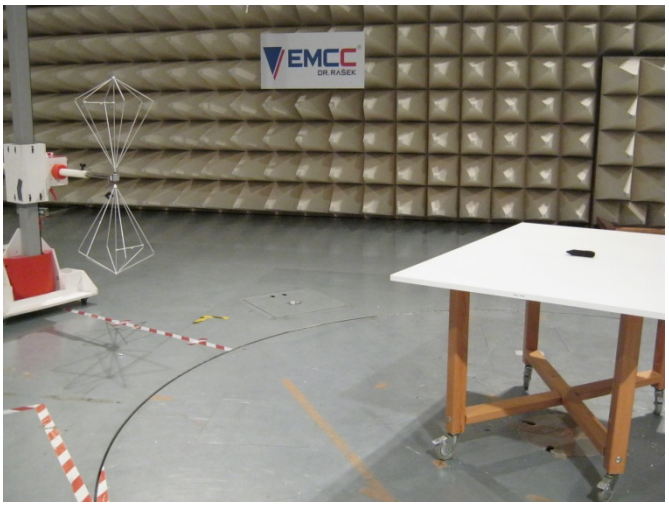
MEASUREMENT PROCEDURE:

☒ ANSI C63.4-2014
☒ RSS-Gen Issue 4 (2014-11)
☒ Other: ANSI C63.10-2013
☒ RSS-102 Issue 5 (2015-03)
☒ D00-705 Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems

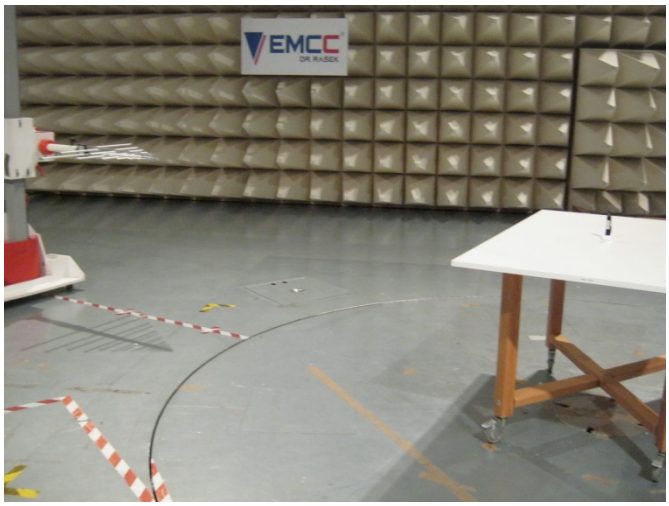
1 RADIATED AND CONDUCTED EMISSIONS TEST



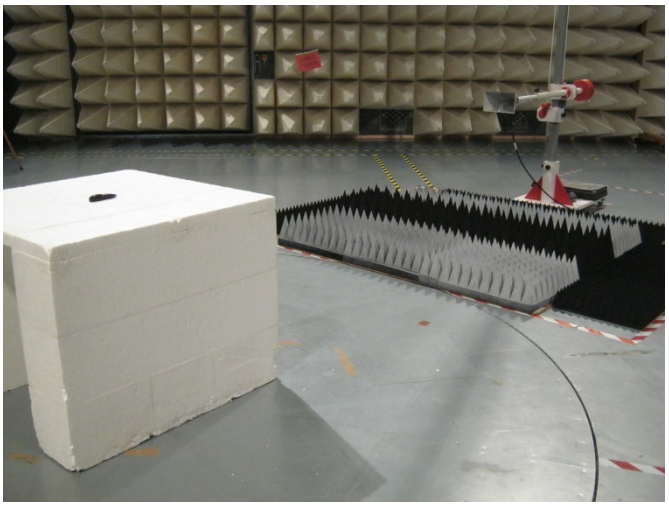
Radiated emissions measurement at 3 m distance in SAC
9 kHz – 30 MHz



Radiated emissions measurement at 3 m distance
30 MHz – 300 MHz

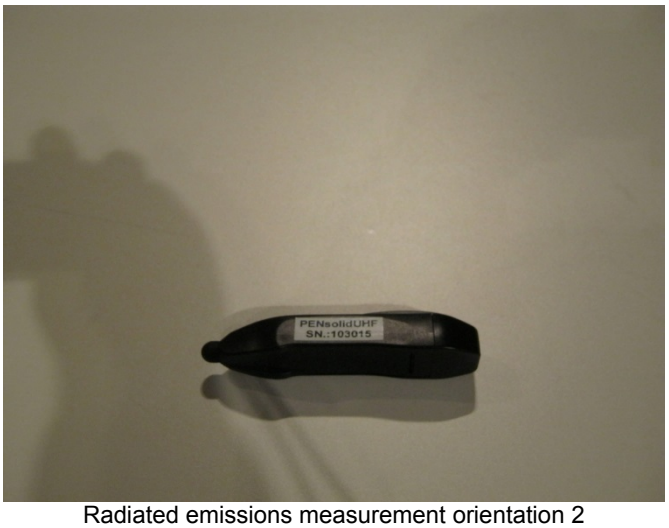


Radiated emissions measurement at 3 m distance
300 MHz – 1000 MHz

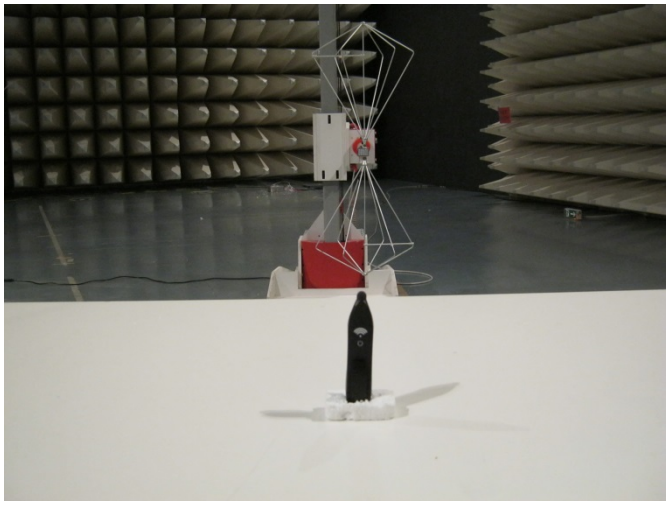


Radiated emissions measurement at 3 m distance
1-10 GHz

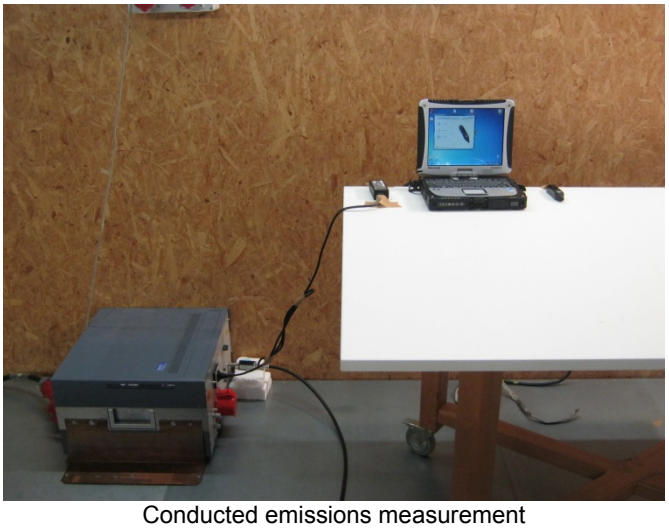
Radiated emissions measurement orientation 1



Radiated emissions measurement orientation 2



Radiated emissions measurement orientation 3



Conducted emissions measurement
150 kHz – 30 MHz

ANNEX 2 TO TEST REPORT # EMCC-980398GA, 2016-05-03

EXTERNAL PHOTOGRAPHS OF EQUIPMENT UNDER TEST (EUT)

EQUIPMENT UNDER TEST:

Trade Name:	RFID Pen Style Read/Write Unit
Type Designation(s):	ilD PENsolid UHFcc
Serial Number:	Sample #1: 103015 Sample #2: 103014
Equipment Class:	Low Power Transceiver
Manufacturer:	Micro-Sensys GmbH
Address:	In der Hochstedter Ecke 2 99098 Erfurt Germany
Phone:	+49 361 59874-0
Fax:	+49 361 59874-17

RELEVANT STANDARD(S): 47 CFR Part 15C, RSS-247 Issue 1 (2015-05)

MEASUREMENT PROCEDURE:

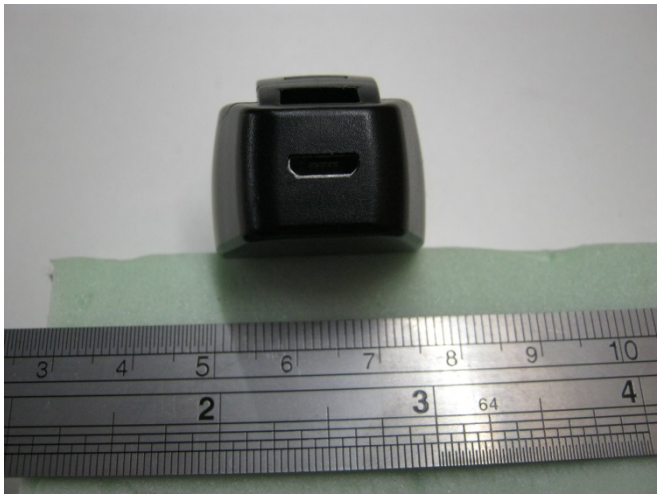
☒ ANSI C63.4-2014
☒ Other: ANSI C63.10-2013
☒ RSS-Gen Issue 4 (2014-11)
☒ RSS-102 Issue 5 (2015-03)
☒ D00-705 Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems

1 PHOTOS OF TEST SAMPLES

Sample #1, side view

Sample #1, top view

Sample #2, top view


Sample #1 , USB connector

ANNEX 3 TO TEST REPORT # EMCC-980398GA, 2016-05-03

INTERNAL PHOTOGRAPHS OF EQUIPMENT UNDER TEST (EUT)

EQUIPMENT UNDER TEST:

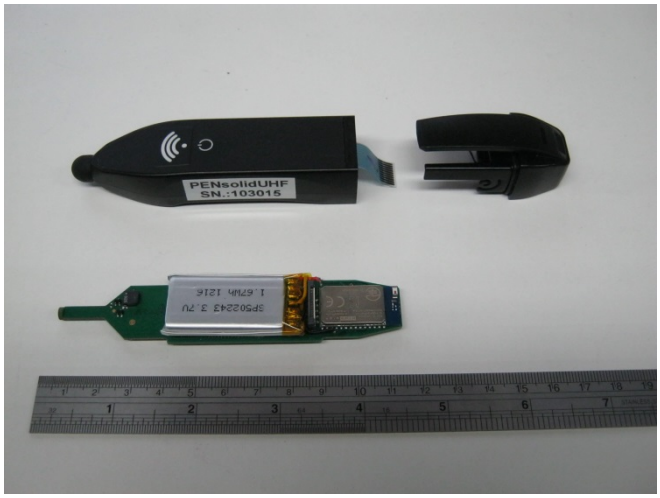
Trade Name:	RFID Pen Style Read/Write Unit
Type Designation(s):	ilD PENsolid UHFcc
Serial Number:	Sample #1: 103015 Sample #2: 103014
Equipment Class:	Low Power Transceiver
Manufacturer:	Micro-Sensys GmbH
Address:	In der Hochstedter Ecke 2 99098 Erfurt Germany
Phone:	+49 361 59874-0
Fax:	+49 361 59874-17

RELEVANT STANDARD(S): 47 CFR Part 15C, RSS-247 Issue 1 (2015-05)

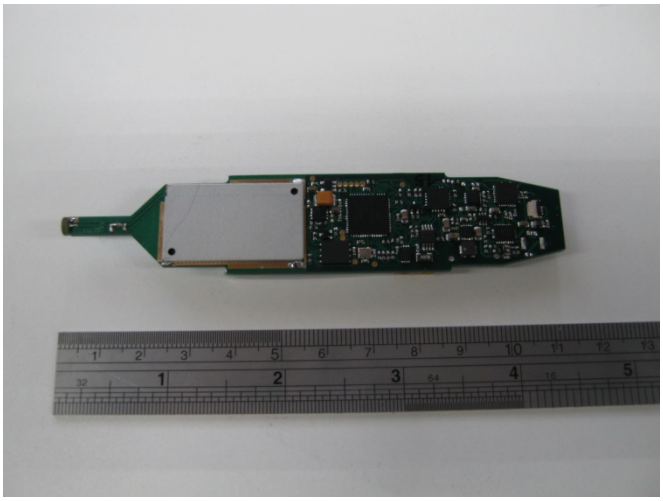
MEASUREMENT PROCEDURE:

☒ ANSI C63.4-2014
☒ Other: ANSI C63.10-2013
☒ D00-705 Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems
☒ RSS-Gen Issue 4 (2014-11)
☒ RSS-102 Issue 5 (2015-03)

1 PHOTOS OF TEST SAMPLES



Sample #1, pcb board top view and cover



Sample #1, pcb bottom view

Sample # pcb top view

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