RF Test Report

As per

RSS-210 Issue 9:2016
&
FCC Part 15 Subpart 15.209:2016

Low Power Licence Exempt Radio Communication Devices Intentional Radiators

on the

RINM Series, model: Insync Wall Reader

Canada

Choose certainty. Add value.

Issued by:

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Testing produced for

See Appendix A for full client & EUT details.

Industry Canada
Registration # 6844B-1

ACCREDITED
Testing Laboratory
Certificate #2955.02

FEDERAL COMMUNICATIONS COMMISSION · USA ·
Registration # 382292

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Report Scope

This report addresses the EMC verification testing and test results of the **RINM Series, model: Insync Wall Reader**, and is herein referred to as EUT (Equipment Under Test). The EUT was tested for compliance against the following standards:

RSS-210 Issue 9:2016

FCC Part 15 Subpart C 15.209:2016

Test procedures, results, justifications, and engineering considerations, if any, follow later in this report.

This report does not imply product endorsement by any government, accreditation agency, or TÜV SÜD Canada Inc.

Opinions or interpretations expressed in this report, if any, are outside the scope of TÜV SÜD Canada Inc accreditations. Any opinions expressed do not necessarily reflect the opinions of TÜV SÜD Canada Inc, unless otherwise stated.

Summary

The results contained in this report relate only to the item(s) tested.

EUT	RINM Series, model: Insync Wall Reader
FCC Certification #, FCC ID:	2AHFM-RINM
Industry Canada Certification #, IC:	21164-RINM
EUT passed all tests performed	Yes
Tests conducted by	Abderrahmane Ferhat

For testing dates, see "Testing Environmental Conditions and Dates".

Test Results Summary

Standard/Method	Description	Class/Limit	Result
FCC 15.203	Antenna Requirement	Unique	Pass See Justification
FCC 15.209 RSS-GEN (Table 4)	Transmitter Spurious Radiated Emissions	Quasi-Peak	Pass
FCC 15.207 RSS-GEN (Table 3)	Power Line Conducted Emissions	Quasi-Peak, Average	N/A, See Justification
FCC 15.215 (c) C63.10 Section 6.9	Occupied Bandwidth	20dB OBW	Pass
RSS-GEN Section 6.6	Occupied Bandwidth	99% OBW	Pass
Overall Result			**Pass**

If the product as tested or otherwise complies with the specification, the EUT is deemed to comply with the requirement and is deemed a 'PASS' grade. If not 'FAIL' grade will be issued. Note that 'PASS' / 'FAIL' grade is independent of any measurement uncertainties. A 'PASS' / 'FAIL' grade within measurement uncertainty is marked with a '*'.

Notes, Justifications, or Deviations

The following notes, justifications for tests not performed or deviations from the above listed specifications apply:

For the antenna requirement specified in FCC 15.203, the unit uses a custom loop antenna which is also not meant to be replaceable by the user. Refer to Figure 4 of the Internal Photos exhibit.

For the Restricted Bands of operation, the EUT is designed to operate at 125 kHz.

The EUT was mounted in three orthogonal axis. Worst case results were obtained with the EUT in the X-axis. Worst case results are presented. See Appendix B for axis details.

Power line conducted emissions was not applicable since the EUT is a battery operated device or DC supplied.

All the tests were performed with DC supplied.

The EUT does not have an antenna port and all measurements were performed using the radiated method.

Sample Calculation(s)

Radiated Emission Test

Margin = Limit – (Received Signal + Antenna Factor + Cable Loss – Pre-Amp Gain)
Margin = 50.5dBµV/m – (50dBµV + 10dB + 2.5dB – 20dB)
Margin = 8.0 dB (pass)

Applicable Standards, Specifications and Methods

ANSI C63.4:2014	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10:2013	American National Standard For Testing Unlicensed Wireless Devices
CFR 47 FCC 15 Subpart C:2016	Code of Federal Regulations – Radio Frequency Devices, Intentional Radiators
ICES-003 Issue 6 2016	Digital Apparatus - Spectrum Management and Telecommunications Policy Interference-Causing Equipment Standard
RSS-GEN Issue 4 2014	General Requirements and Information for the Certification of Radio Apparatus
RSS-210 Issue 9:2016	Licence-Exempt Radio Apparatus: Category I Equipment
ISO 17025:2005	General Requirements for the Competence of Testing and Calibration Laboratories

Document Revision Status

Revision 0 - February 8, 2018. Initial Release

Definitions and Acronyms

The following definitions and acronyms are applicable in this report.
See also ANSI C63.14.

AE – Auxiliary Equipment. A digital accessory that feeds data into or receives data from another device (host) that in turn, controls its operation.

BW – Bandwidth. Unless otherwise stated, this is refers to the 20 dB bandwidth.

EMC – Electro-Magnetic Compatibility. The ability of an equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment.

EMI – Electro-Magnetic Immunity. The ability to maintain a specified performance when the equipment is subjected to disturbance (unwanted) signals of specified levels.

EUT – Equipment Under Test. A device or system being evaluated for compliance that is representative of a product to be marketed.

ITE – Information Technology Equipment with a primary function(s) of entry, storage, display, retrieval, transmission, processing, switching, or control, of data.

LISN – Line Impedance Stabilization Network

NCR – No Calibration Required

RF – Radio Frequency

Testing Facility

Testing for EMC on the EUT was carried out at TÜV SÜD Canada testing lab in Laval, near Montréal, Québec, Canada. The testing lab has a calibrated 3m semi-anechoic chamber which allows measurements on an EUT that has a maximum width or length of up to 2m and a height of up to 3m. The chamber is equipped with a turntable that is capable of testing devices up to 3300lb in weight. This facility is capable of testing products that are rated for 120Vac and 240Vac single phase, or devices that are rated for a 208Vac 3 phase input. DC capability is also available for testing. The chamber is equipped with a mast that controls the polarization and height of the antenna. Control of the mast occurs in the control room adjoining the shielded chamber. Radiated emission measurements are performed using a BiLog antenna and a Horn antenna where applicable. Conducted emissions, unless otherwise stated, are performed using a LISN and using the Vertical Ground plane if applicable. For ESD testing, the HCP is 1.6m x 0.8m and the VCP is 0.5m x 0.5m. The reference ground plane, when applicable, is 1.6m x 1.6m.

Calibrations and Accreditations

The 3m semi-anechoic chamber is registered with Federal Communications Commission (FCC, 382292) and Industry Canada (IC, 6844B-1). This chamber was calibrated for Normalized Site Attenuation (NSA) using test procedures outlined in ANSI C63.4 "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz". The chamber is lined with ferrite tiles and absorption cones to minimize any undesired reflections. The NSA data is kept on file at TÜV SÜD Canada. For radiated susceptibility testing, a 16 point field calibration has been performed on the chamber. The field uniformity data is kept on file at TÜV SÜD Canada. TÜV SÜD Canada Inc is accredited to ISO 17025 by A2LA with Testing Certificate #2955.02. The laboratory's current scope of accreditation listing can be found as listed on the A2LA website. All measuring equipment is calibrated on an annual or bi-annual basis as listed for each respective test.

Testing Environmental Conditions and Dates

Following environmental conditions were recorded in the facility during time of testing

Date	Test	Initials	Temperature (ºC)	Humidity (%)	Pressure (kPa)
2017-10-01	Radiated Emissions	AF	20 – 24	40 – 51	98.0 – 102.0

Detailed Test Results Section

Radiated Emission Field Strength

Purpose

The purpose of this test is to ensure that the RF energy emitted from the EUT does not exceed the limits listed below as defined in the applicable test standard, as measured from a receiving antenna. This helps protect other devices which may be using the same spectrum allocations for similar or other purposes and also ensures the transmit range of the device is within the pre-determined suitable range. This also ensures public safety by not exceeding a level which has been deemed safe for human exposure.

Limits and Method

The limits are defined in FCC Part 15.209(a).
Method is using a loop antenna and converting to voltage based on the impedance of free space.

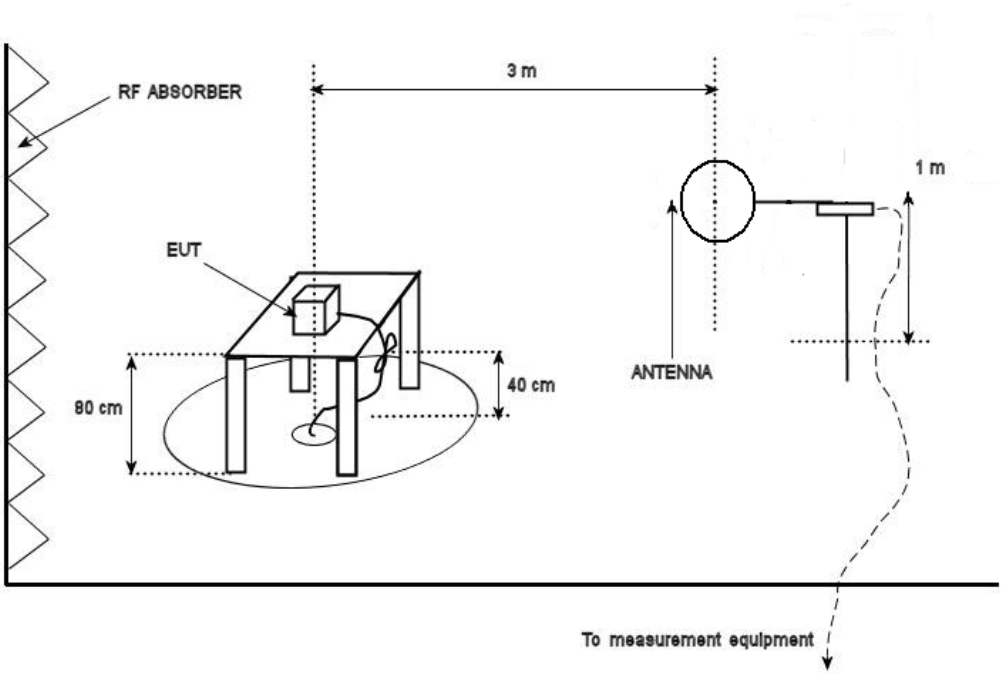
Fundamental Frequency (kHz)	Field Strength Limit (uV/m) at 300m	Limit (dBuV/m)[1] at 3m	Limit (dBuV/m)[1] at 1m
125kHz	2400/F (kHz)	105.66	124.7

[1]Limit is with a Quasi-Peak detector with bandwidths as defined in CISPR-16-1-1

Based on ANSI C63.4 Section 4.2, if the Peak detector measurements do not exceed the Quasi-Peak limits, where defined, then the EUT is deemed to have passed the requirements.

In accordance with FCC Part 15, section 15.31(f)(2), testing was performed at a 3 meter test distance and an extrapolation factor of 40 dB/decade was applied. For example, an extrapolation of 300m to 3m is 20Log(uV/m) + 40Log(300m/3m).

Typical Radiated Emissions Setup



Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is ±4.25dB for 30MHz – 1GHz and ±4.93dB for 1GHz – 18GHz with a 'k=2' coverage factor and a 95% confidence level.

Preliminary Graphs

The graphs shown below are maximized peak measurement graphs over a full 0-360°. The loop was orientated at 0 degrees and 90 degrees and a maximized reading is shown. The marker shows the raw value. See the Final Measurements section below for corrected values.

To obtain the maximum emission, the loop antenna is positioned with its plane vertical and rotated about its vertical axis at the maximum azimuth position. This is then repeated with its plane horizontal, and rotated about the horizontal axis. The maximum obtained emission is presented.

Final Measurements

To obtain the maximum emission, the EUT is rotated over a full 0-360°. With the EUT at the azimuth position of the maximum emissions, the loop antenna is positioned with its plane vertical and rotated about its vertical axis. This is then repeated with its plane horizontal, and rotated about the horizontal axis. The maximum obtained emission is presented.

Emissions Table

Test Freq. (MHz)	Detect. Peak/ QP	EUT Axis	Received Signal (dBµV)	dBuA/ dBuV Conv. factor	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-Amp (dB)	Level (dBµV/ m)	Emission Limit dB(µV/m)	Margin dB	Result
0.125	X	45.6	3	0	51.5	8.1	-30.9	77.3	124.8	47.5	Pass
0.125	Z	37.8	3	0	51.5	8.1	-30.9	69.5	124.8	55.3	Pass
0.125	Y	34.5	3	0	51.5	8.1	-30.9	66.2	124.8	58.6	Pass

Note:

Peak = Peak measurement
QP = Quasi-Peak measurement

See 'Appendix B – EUT and Test Setup Photos' for photos showing the test set-up and EUT axis.

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration / Verification Date	Next Calibration / Verification Date	Asset #
Spectrum Analyzer	ESU-40	Rohde & Schwarz	2017-04-20	2019-04-20	4092
Loop Antenna	EM 6879	Electro-Metrics	2017-04-19	2019-04-19	4040
Attenuator 3 dB	FP-50-3	Trilithic	NCR	NCR	4028
LNA pre-amp	LNA-1450	RF Bay Inc.	2017-07-22	2019-07-22	4089
RF Cable 10m	LMR-400-10M-50OHM-MN-MN	LexTec	NCR	NCR	4025
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	4026

Transmitter Spurious Radiated Emissions

Purpose

The purpose of this test is to ensure that the RF energy unintentionally emitted from the EUT does not exceed the limits listed below as defined in the applicable test standard, as measured from a receiving antenna. This helps protect broadcast radio services such as television, FM radio, pagers, cellular telephones, emergency services, and so on, from unwanted interference.

Limits and Method

The limits are as defined in FCC Part 15 Section 15.209(a). The method is as defined in ANSI C63.10.

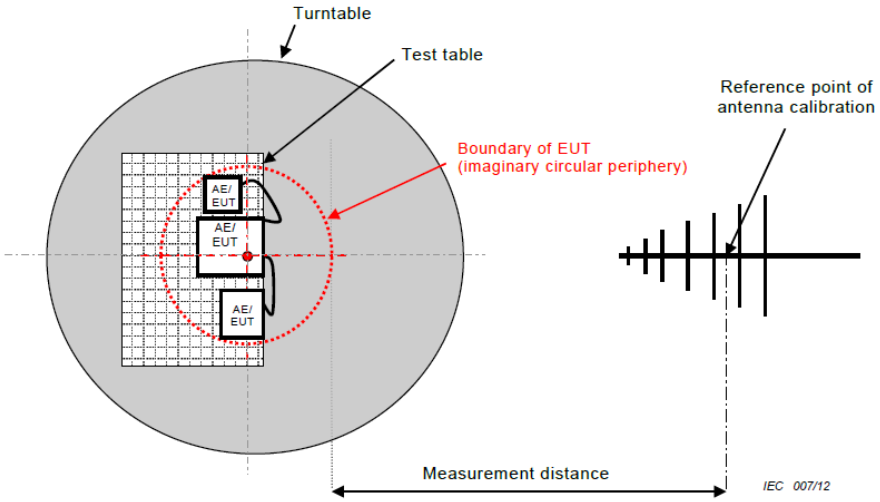
The limits apply for those emissions that fall in the restricted bands, as defined in Section 15.205(a). These emissions must comply with the radiated emission limits specified in Section 15.209(a).

Frequency	Limit at 3m (dBuV/m)
0.009 MHz – 0.490 MHz	128.5 to 93.8[1]
0.490 MHz – 1.705 MHz	73.8 to 63[1]
1.705 MHz – 30 MHz	69.5[1]
30 MHz – 88 MHz	40.0[1]
88 MHz – 216 MHz	43.5[1]
216 MHz – 960 MHz	46.0[1]
Above 960 MHz	54.0[1]
Above 1000 MHz	54.0[2]
Above 1000 MHz	74.0[3]

[1]Limit is with Quasi-Peak detector with bandwidths as defined in CISPR-16-1-1 except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz where an Average detector is used.
[2]Limit is with 1 MHz measurement bandwidth and using an Average detector
[3]Limit is with 1 MHz measurement bandwidth and using a Peak detector

Based on ANSI C63.4 Section 4.2, if the Peak detector measurements do not exceed the Quasi-Peak limits, where defined, then the EUT is deemed to have passed the requirements

Typical Radiated Emissions Setup



Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is ±4.25dB for 30MHz – 1GHz and ±4.93dB for 1GHz – 18GHz with a 'k=2' coverage factor and a 95% confidence level.

Preliminary Graphs

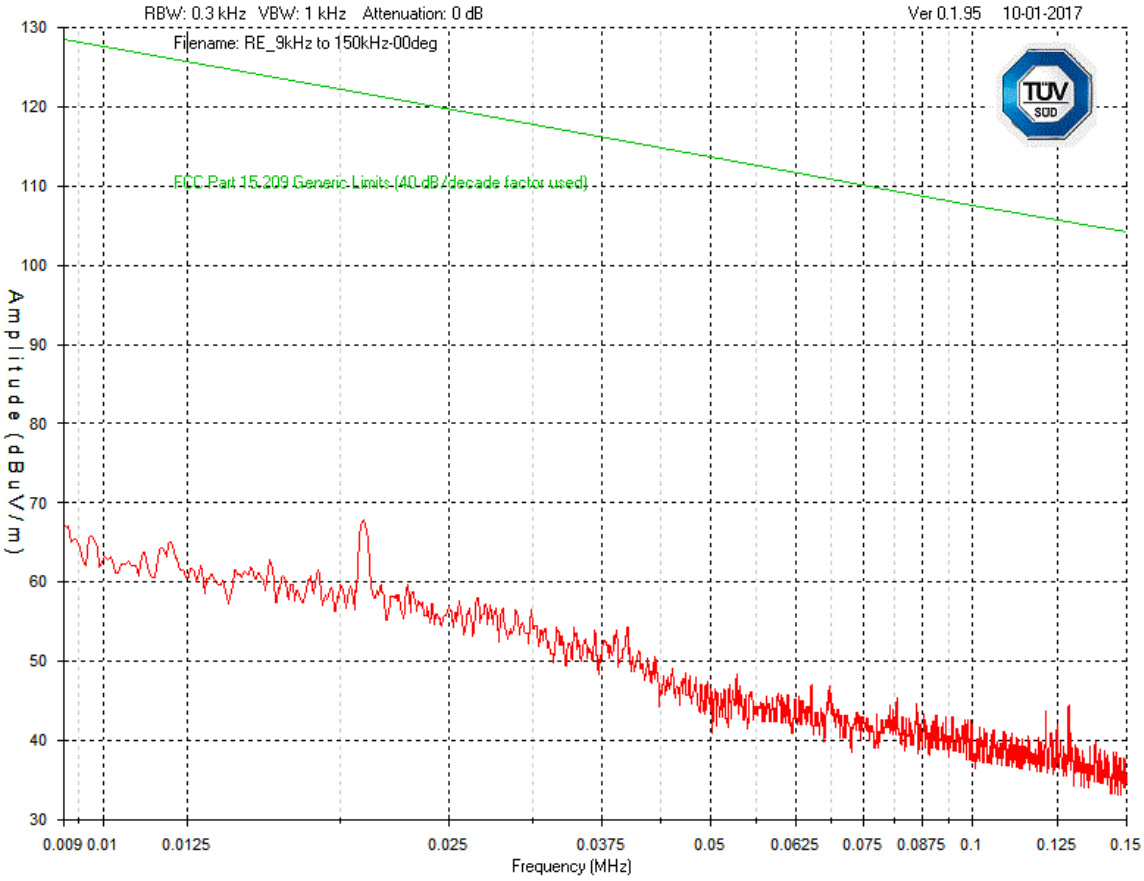
The graphs shown below are obtained at a 3m test distance and are maximized peak measurement graphs measured with a resolution bandwidth greater than or equal to the final required detector over a full 0-360°. This peaking process is done as a worst case measurement and enables the detection of frequencies of concern for final measurement. For final measurements with the appropriate detector, where applicable, please refer to the tables under Final Measurements.

In accordance with FCC Part 15, Subpart A, Section 15.33(a), the device is scanned to at least the 10^{th} harmonic (A minimum of 1.25MHz).

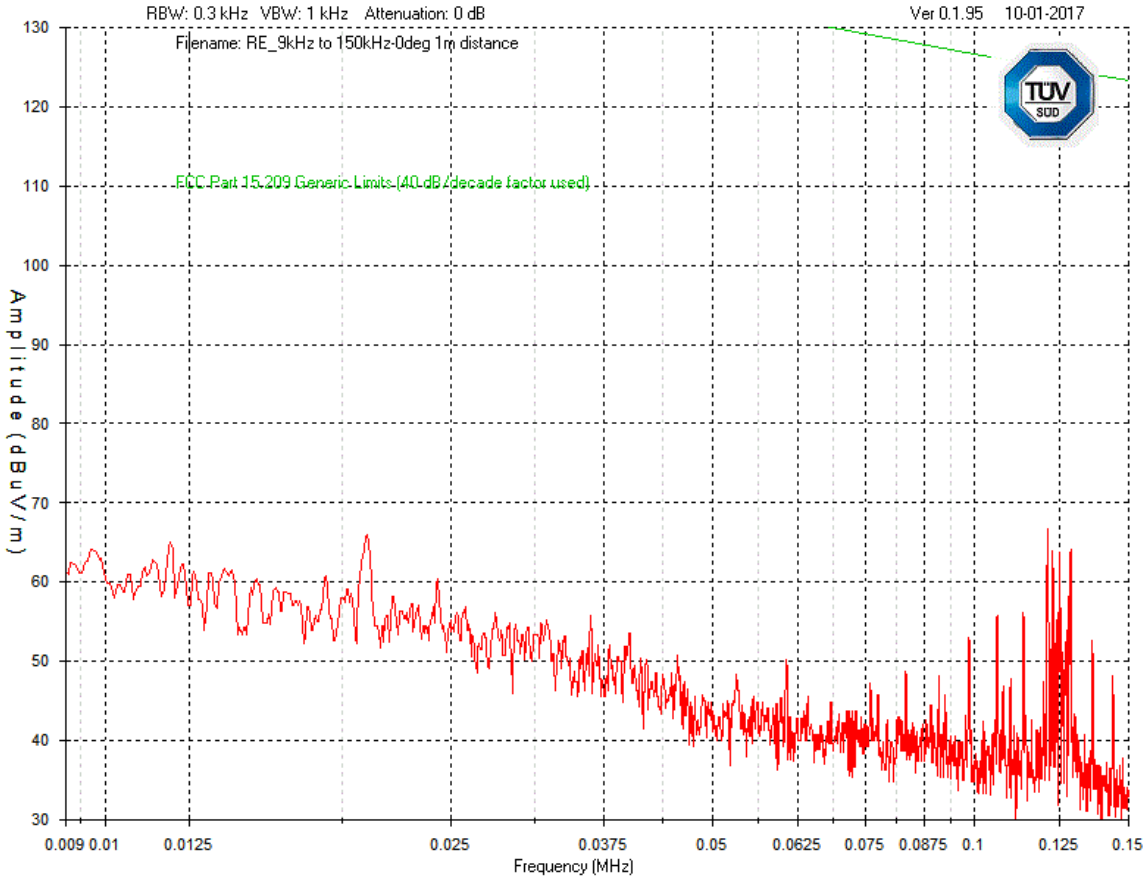
Devices scanned may be scanned at alternate test distances, and in accordance with FCC Part 15, Subpart A, Section 15.31(f), an extrapolation factor of 20 dB/decade was used above 30 MHz and 40 dB/decade below 30 MHz. For example, an extrapolation of 30m to 3m for frequencies below 30MHz is 20Log(uV/m) + 40Log(30m/3m).

The EUT was checked in three orthogonal axes. However, the worst case graphs are presented from the Z-axis.

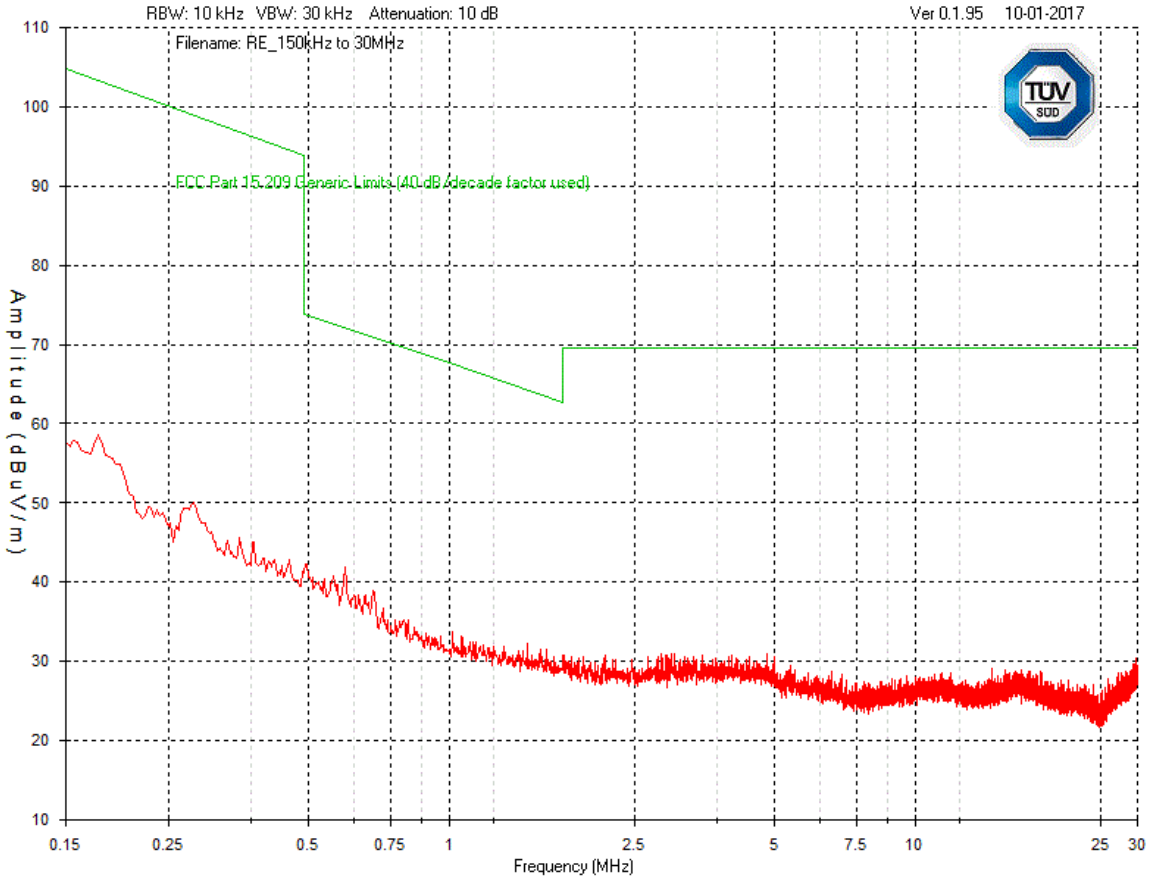
9 kHz – 150 kHz
Peak Emission Graph @ 3m



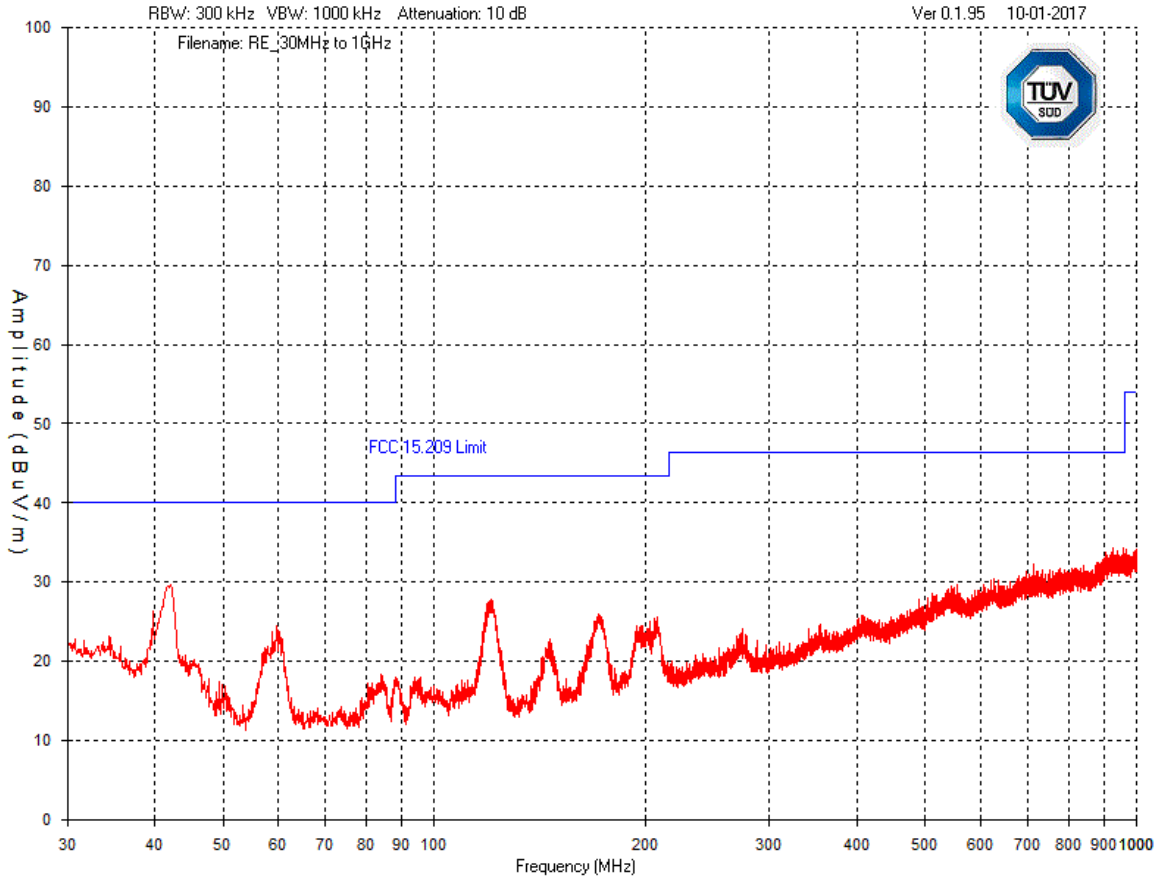
9 kHz – 150 kHz
Peak Emission Graph @ 1m



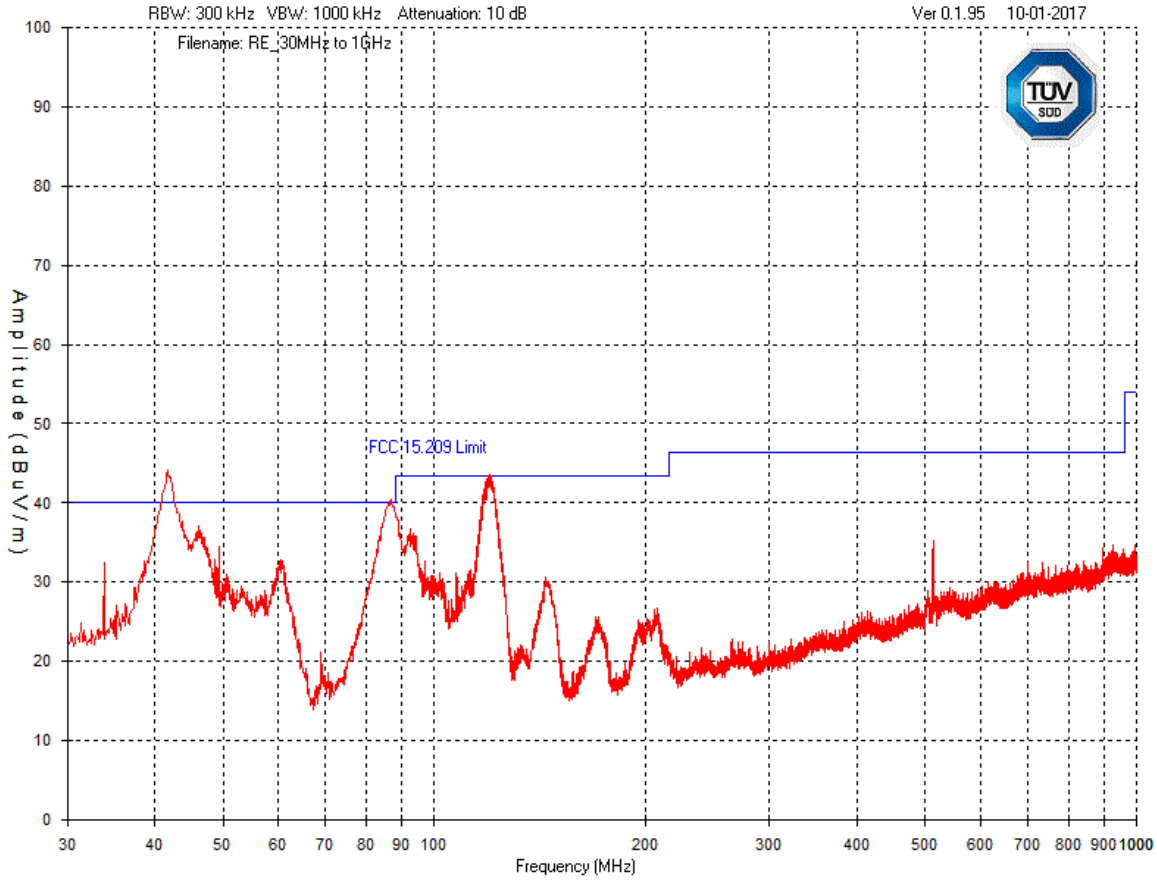
150 kHz – 30 MHz
Peak Emission Graph



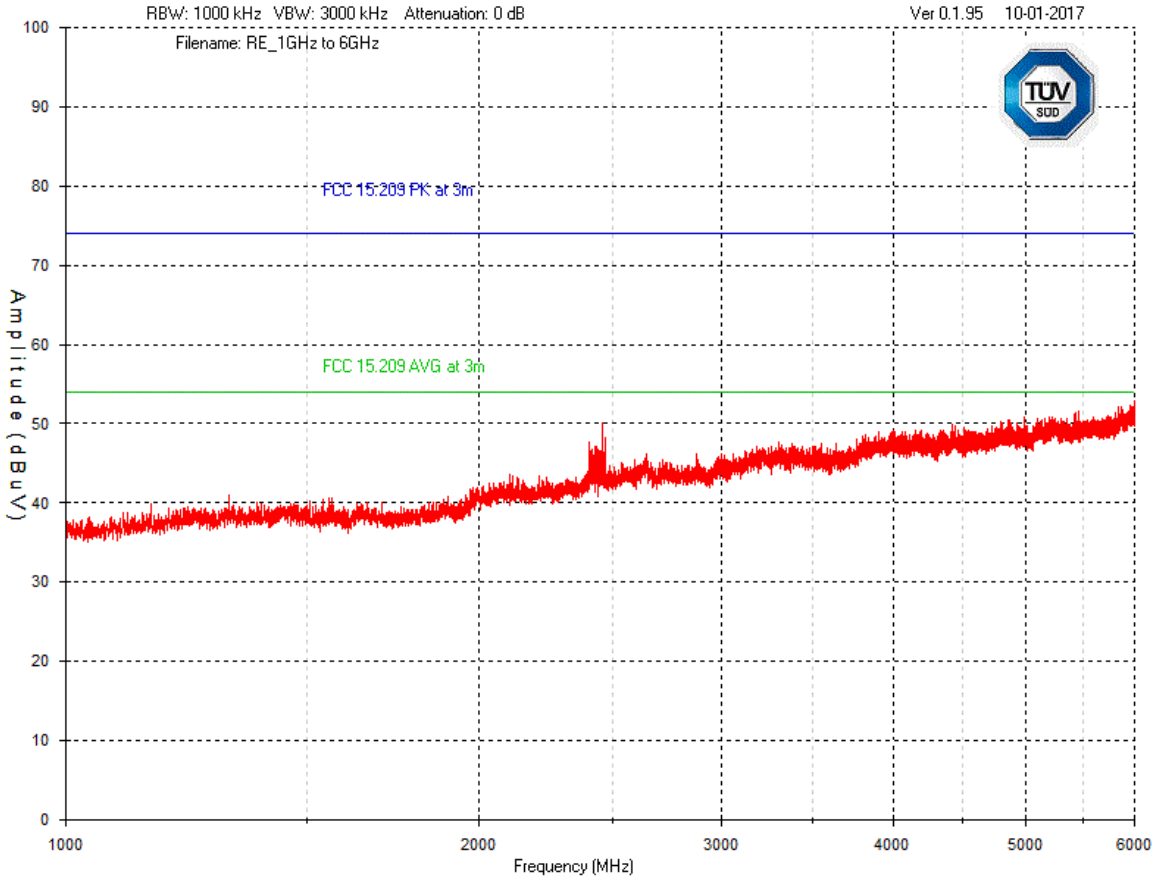
30 MHz – 1 GHz
Horizontal - Peak Emission Graph



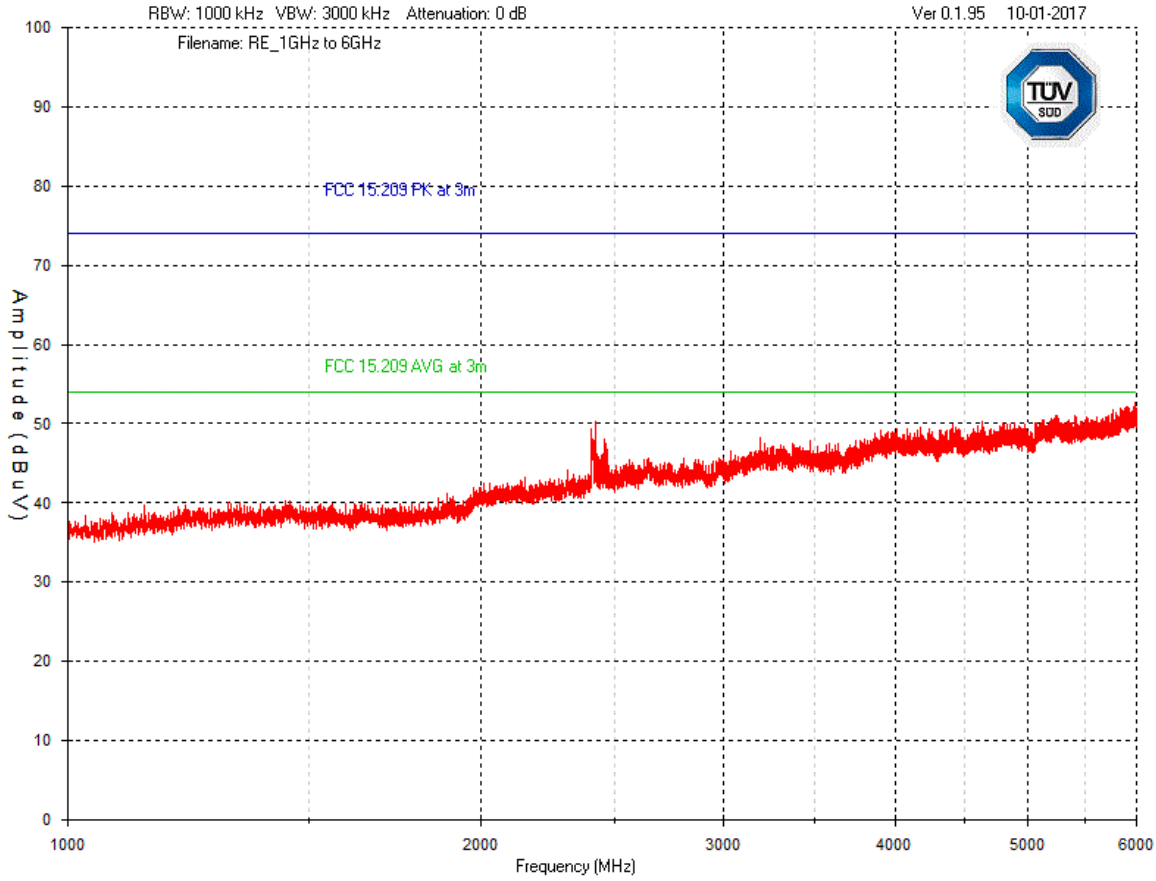
30 MHz – 1 GHz
Vertical - Peak Emission Graph



1GHz –6GHz
Vertical - Peak Emission Graph



1GHz –6GHz
Vertical - Peak Emission Graph



Final Measurements and Results

Peak/ Quasi-Peak Emission vs Quasi-Peak Limits Table

Supply			12VDC							
Freq. (MHz)	**Detector Peak/ QP**	**Received Signal (dBµV)**	**Antenna Factor (dB/m)**	**Atten Factor (dB)**	**Cable Factor (dB)**	**Pre-Amp (dB)**	**Level (dBµV/m)**	**QP Limit (dB)**	**QP Margin (dB)**	**Pass / Fail**
Horizontal Antenna Polarization										
42.04	Peak	47.5	11.5	3	0.7	-32.9	29.8	40	10.2	Pass
59.7117	Peak	46.2	8	3	0.8	-33.3	24.7	40	15.3	Pass
120.592	Peak	48.7	8.6	3	1	-33.5	27.8	43.5	15.7	Pass
171.568	Peak	45.6	9.5	3	1.3	-33.4	26	43.5	17.5	Pass
207.688	Peak	43	11.5	3	1.4	-33.3	25.6	43.5	17.9	Pass
145.837	Peak	43	9.2	3	1.1	-33.4	22.9	43.5	20.6	Pass
Vertical Antenna Polarization										
41.5767	QP	48.2	11.7	3	0.7	-32.9	30.7	40	9.3	Pass
86.6076	QP	50.1	7.3	3	0.9	-33.4	27.9	40	12.1	Pass
119.799	QP	60.9	8.6	3	1	-33.5	40	43.5	3.5	Pass
49.2287	QP	37.3	8.4	3	0.7	-33.3	16.1	40	23.9	Pass
60.3914	QP	48.2	8	3	0.8	-33.3	26.7	40	13.3	Pass
107.286	QP	46.7	9.3	3	1	-33.5	26.5	43.5	17	Pass

Note:
See 'Appendix B – EUT and Test Setup Photos' for photos showing the test set-up for the highest radiated emission.

The measurements were maximized by rotating the turn table over a full 0-360 rotation and the antenna height was varied from 1 m to 4 m.

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration / Verification Date	Next Calibration / Verification Date	Asset #
Spectrum Analyzer	ESU-40	Rohde & Schwarz	2017-04-20	2019-04-20	4092
BiLog Antenna	3142-E	ETS	2016-11-16	2018-11-16	4002
Horn Antenna	ATH1G18G	AR	2017-04-25	2019-04-25	4003
Biconical Antenna	EM-6913	Electro-Metrics	2017-05-02	2019-05-02	4060
Log Periodic Antenna	LPA-25	Electro-Metrics	2017-04-20	2019-04-20	4087
Loop Antenna	EM 6879	Electro-Metrics	2017-04-19	2019-04-19	4040
Attenuator 3 dB	FP-50-3	Trilithic	NCR	NCR	4028
LNA pre-amp	LNA-1450	RF Bay Inc.	2017-07-22	2019-07-22	4089
1-26.5GHz preamp	8449B	Agilent	2017-09-09	2019-09-09	4006
RF Cable 10m	LMR-400-10M-50OHM-MN-MN	LexTec	NCR	NCR	4025
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	4026
Emission software	0.1.95	Global EMC	NCR	NCR	58

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20dB and 99% Occupied Bandwidth

Purpose

The purpose of this test is to verify that intentional radiators operating under the alternative provisions to the general emission limits are designed to ensure the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. This helps ensure the utilization of the frequency allocation and prevent corruption of data by ensuring adequate data separation to distinguish the reception of the intended information.

Limits and Method

The limit is as specified in FCC Part 15.215(c) and RSS-GEN Section 6.6 and the method is given in ANSI C63.10.

Results

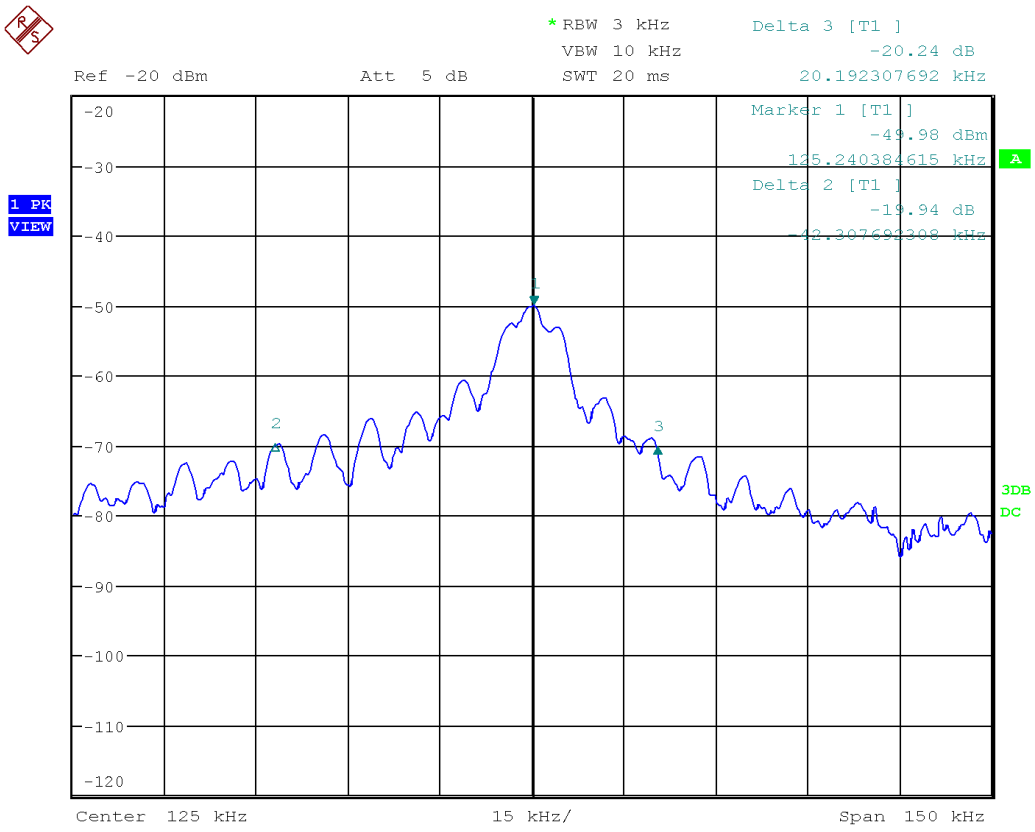
The 99% BW was measured using the 99% BW function of the spectrum analyzer.

Frequency (kHz)	20dB Bandwidth (kHz)	99% Bandwidth (kHz)
125	62.499	91.586

Graphs

The graphs showed below shows the OBW during the operation of the device. This is measured by a max hold on the spectrum analyzer and the highest resolution bandwidth that is sufficiently low to exhibit the bandwidth of a channel during operation of the EUT. Max hold is performed for a duration of not less than 1 minute.

20dB Bandwidth



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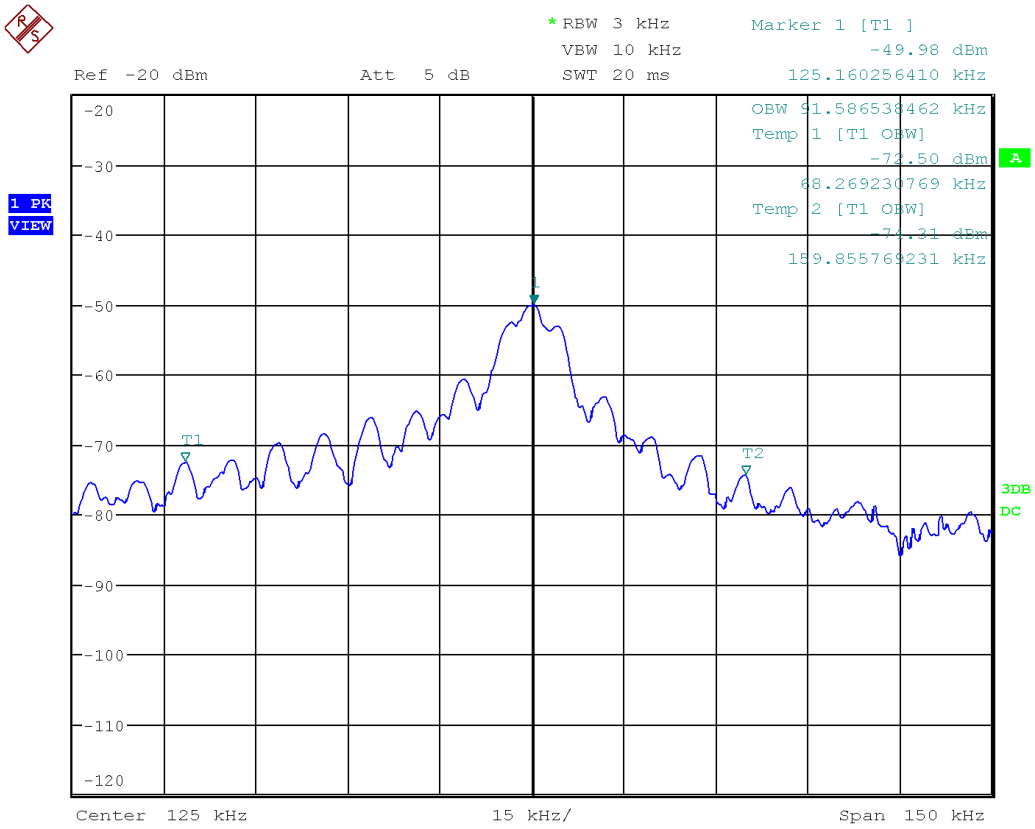
99% Bandwidth



Date: 1.OCT.2017 19:16:28

Note: See 'Appendix B – EUT & Test Setup Photos' for photos showing the test set-up.

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	ESU-40	Rohde & Schwarz	2017-04-20	2019-04-20	4092
Loop Antenna	EM 6879	Electro-Metrics	2017-04-19	2019-04-19	4040
Attenuator 3 dB	FP-50-3	Trilithic	NCR	NCR	4028
LNA pre-amp	LNA-1450	RF Bay Inc.	2017-07-22	2019-07-22	4089
RF Cable 10m	LMR-400-10M-50OHM-MN-MN	LexTec	NCR	NCR	4025
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	4026

Appendix A – EUT Summary

General EUT Description

Client	
Organization / Address	Kaba Mas LLC 749 W Short Street Lexington, KY 40508 USA
Phone	859-977-3452
EUT Details	
EUT Name	RINM Series
EUT Model	Insync Wall Reader
Equipment Category	RFID
Basic EUT Functionality	Battery operated or DC supplied, HiTag Reader for multihousing locking unit
Input Voltage	3VDC
Connectors available on EUT	USB
Peripherals Required for Test	HiTag
Release type	Final
Intentional Radiator Frequency	125kHz for RFID applications
EUT Configuration	Wireless configured to transmit under normal operation

Note the EUT is considered to have been received the date of the commencement of the first test, unless otherwise stated. For a close-up picture of the EUT, see 'Appendix B – EUT and Test Setup Photos'.

Appendix B – EUT and Test Setup Photos

See the Test Setup exhibit which is separate from this test report for the EUT and Test Setup photos.