Report No. 380596-01

Test Report

Product	UHF Base Station
Name and address of the applicant	Q-Free ASA Strindfjordvegen 1 NO-7053 Ranheim, Trondheim, Norway
Name and address of the manufacturer	Q-Free ASA Strindfjordvegen 1 NO-7053 Ranheim, Trondheim, Norway
Model	ITS950
Rating	48V PoE or 10-30V DC
Trademark	ITS-950 ParQSense Base Station
Serial number	00010058
Additional information	/
Tested according to	**FCC Part 15.249** Operation within the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5875 MHz, and 24.0-24.25 GHz **Industry Canada RSS-210, Issue 9, Annex B10** Bands 902-928 MHz, 2400-2483.5 MHz and 5725-5875 MHz
Order number	380596
Tested in period	2019-09-13 to 2019-09-17
Issue date	2019-09-17
Name and address of the testing laboratory	Nemko Instituttveien 6 Kjeller, Norway www.nemko.com CAB Number: FCC: NO0001 ISED: NO470 TEL: +47 22 96 03 30 FAX: +47 22 96 05 50 ilac-MRA NORWEGIAN ACCREDITATION TEST 033 **An accredited technical test executed under the Norwegian accreditation scheme**

Prepared by [Frode Sveinsen]	Approved by [G.Suhantakumar]

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ENTERPRISE NUMBER NO974404532

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1 INFORMATION

1.1 Test Item

Name	ITS950 UHF Base Station
FCC ID	2AO69-950A
ISED ID	3610A-950A
Model/version	ITS950
Serial number	00010058
Hardware identity and/or version	3
Software identity and/or version	1.11
Frequency Range	902.050 – 927.950 MHz
Channel Spacing	100 kHz
Number of Channels	259
Operating Modes	Frequency Hopping
Type of Modulation	FSK
User Frequency Adjustment	None
Type of Power Supply	48V Power over Ethernet or 10-48V DC
Antenna Connector	The EUT uses a unique antenna coupling/ non-detachable antenna to the intentional radiator. An internal U-FL connector is connected to either the internal antenna or to an external RP-SMA connector. The Laird omnidirectional antenna is connected via a cable to the RP-SMA connector.
Number of Antennas	1
Type of Antenna	3 dBi Internal antenna or Laird FG9023 omnidirectional antenna with 5.14 dBi gain.

Description of Test Item

This is a UHF base station for receiving and forwarding messages from a back-office system.

1.2 Normal test condition

Temperature:	20 - 24 °C
Relative humidity:	20 - 50 %
Normal test voltage:	48V DC PoE

The values are the limit registered during the test period.

1.3 Test Engineer(s)

Frode Sveinsen

1.4 Description of modification for Modification Filing

SAW filter in RX path is changed to a new sharper filter.

Frequency range of transmitter is changed in software from 926.640-927.975 MHz to 902.050-927.950 MHz.

1.5 Family List Rational

Not Applicable.

1.6 Antenna Requirement

Professional installation required?	☒ Yes	☐ No
Is the antenna detachable?	☒ Yes	☐ No
If detachable, is the antenna connector non-standard?	☒ Yes	☐ No

Type of antenna connector: Internal U-FL connector and external RP-SMA connector

Ref. FCC §15.203

1.7 Worst-Case Configuration and Mode

Radiated Emissions were tested with the EUT transmitting on highest lowest and a channel in the middle of the band.

1.8 Comments

This test reports cover extra tests after modification of already certified EUT.

All measurements were performed with the EUT powered from a PoE switch.

2 TEST REPORT SUMMARY

2.1 General

All measurements are tracable to national standards.

The tests were conducted for demonstrating compliance with FCC CFR 47 Part 15, paragraph 15.249 and Industry Canada RSS-210 Issue 9 and RSS-GEN Issue 5.

Tests were performed in accordance with ANSI C63.4-2014 and and ANSI C63.10-2013.

Radiated tests were made in a semi-anechoic chamber at measuring distances of 3m.

A description of the test facility is on file with FCC and ISED.

☐ New Submission
☒ Class II Permissive Change
DXT Equipment Code
☒ Production Unit
☐ Pre-production Unit
☐ Family Listing

THIS TEST REPORT APPLIES ONLY TO THE ITEM(S) AND CONFIGURATIONS TESTED.

Deviations from, additions to, or exclusions from the test specifications are described in “Summary of Test Data”.

2.2 Test Summary

Name of test	FCC Part 15 reference	RSS-247 Issue 2, RSS-GEN Issue 5 reference	ANSI C63.10-2013 Reference	Result
Supply Voltage Variations	15.31(e)	6.11 (RSS-GEN)	5.13	N/A
Number of Frequencies	15.31(m)	6.9 (RSS-GEN)	N/A	N/A
Antenna Requirement	15.203	6.8 (RSS-GEN)	5.8	Complies
Power Line Conducted Emission	15.107(a) 15.207(a)	7.2 / 8.8 (RSS-GEN)	6.2	N/A
Occupied (Emission) Bandwidth	15.215(c)	6.7 (RSS-GEN)	6.9.3	Complies
Field Strength of Fundamental	15.249(a)(c)(e)	B.10(a) (RSS-210)	6.6	Complies
Radiated Emissions	15.249(a)(c)(d)(e) 15.209(a)	B.10(a)(b) (RSS-210) 7.3 (RSS-GEN) 8.9 (RSS-GEN)	6.3, 6.5, 6.6 6.10	Complies

Revision history

Version	Date	Comment	Sign
1.0	2019.09.17	First edition	FS

3 TEST RESULTS

3.1 Occupied (Emission) Bandwidth

FCC Part 15.215 (c)

ISED Canada RSS-GEN Issue 5, Clause 6.7

Measurement procedure: ANSI C63.10-2013 Clause 6.9.3

Test Results: Complies

Measurement Data:

Carrier Frequency	**OBW (99% BW)**	**Emission BW (20dB BW)**
902.050 MHz	**91.3 kHz**	**93.4 kHz**
927.950 MHz	**90.0 kHz**	**92.9 kHz**

Carrier Frequency	20 dBc Frequency cross	Limit	Margin
902.050 MHz	902.00280 MHz	902.000 MHz	2.80 kHz
927.950 MHz	927.99595 MHz	928.000 MHz	4.05 kHz

See attached plots.

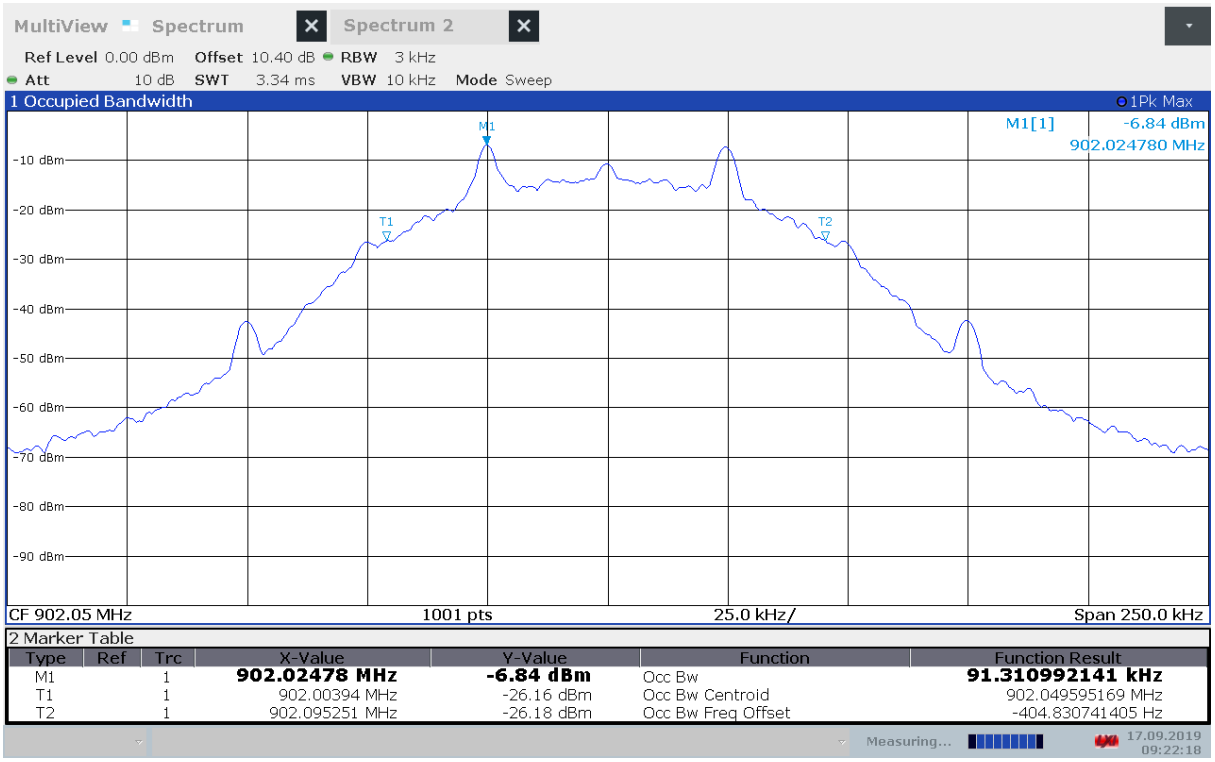
Requirements:

FCC

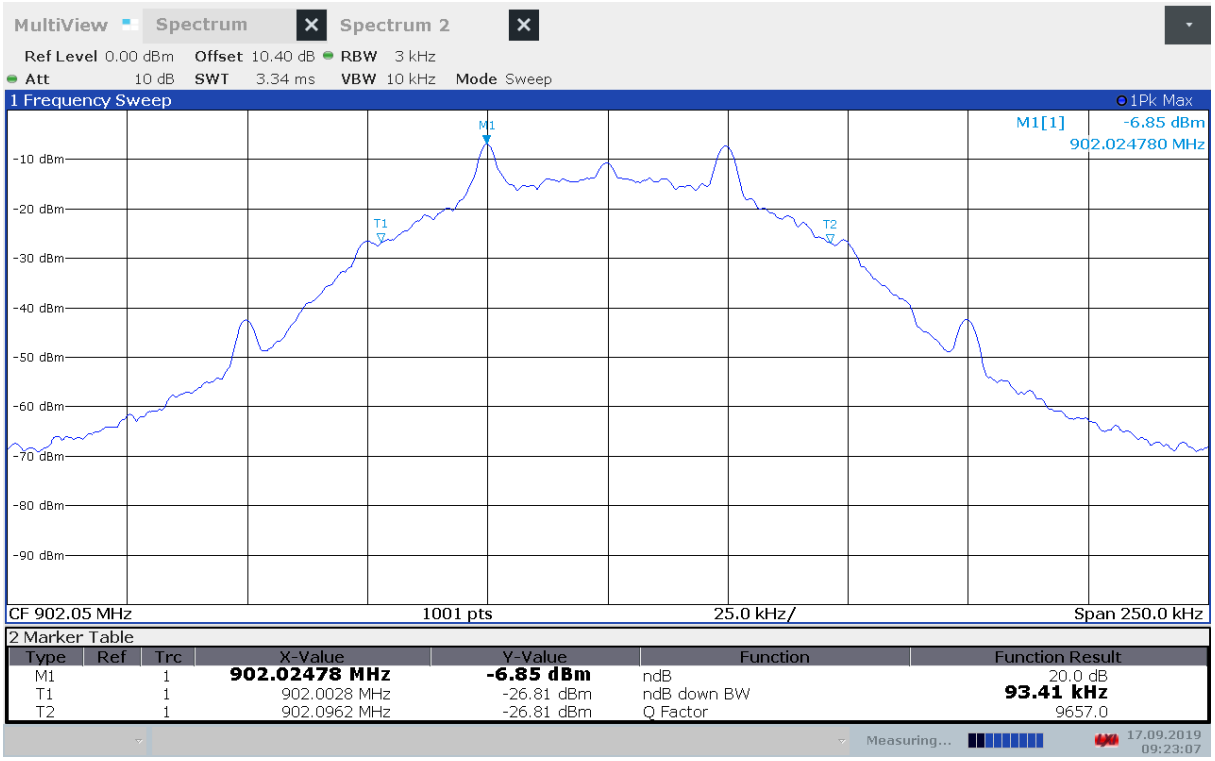
Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80 % of the permitted band in order to minimize the possibility of out-of-band operation.

ISED

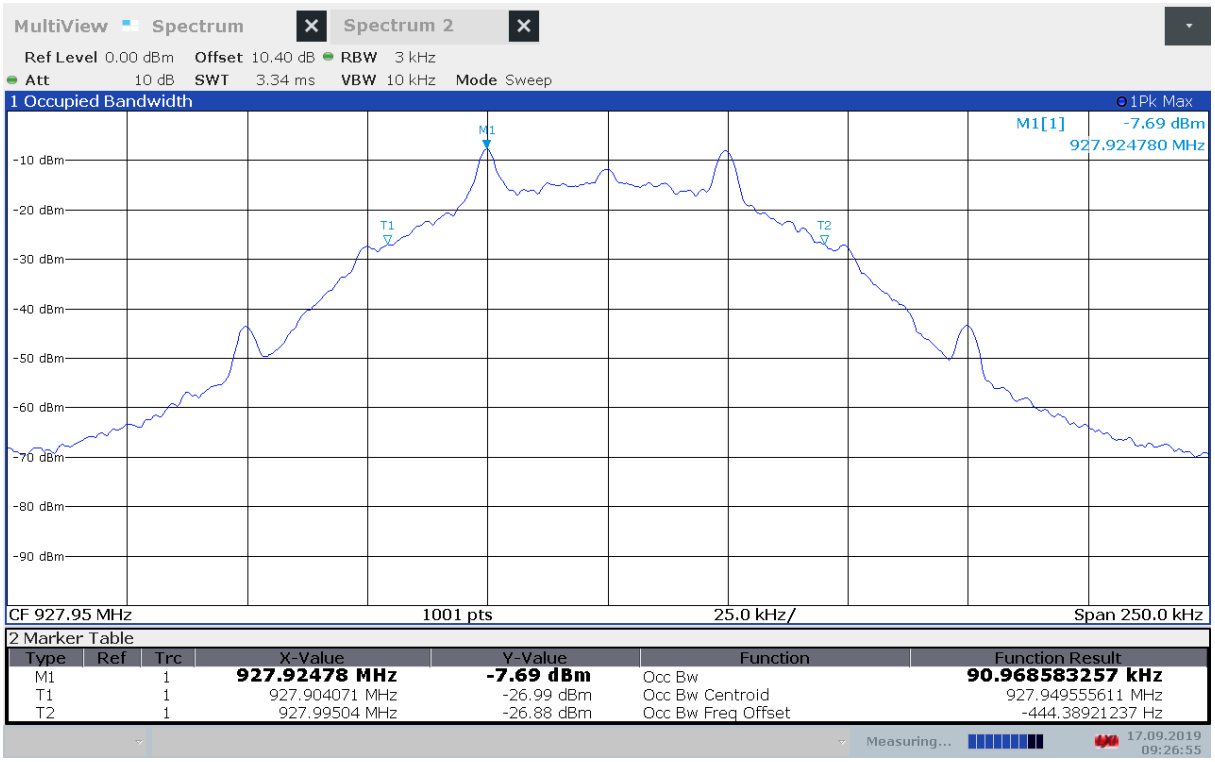
The occupied bandwidth or the "99% emission bandwidth" is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.



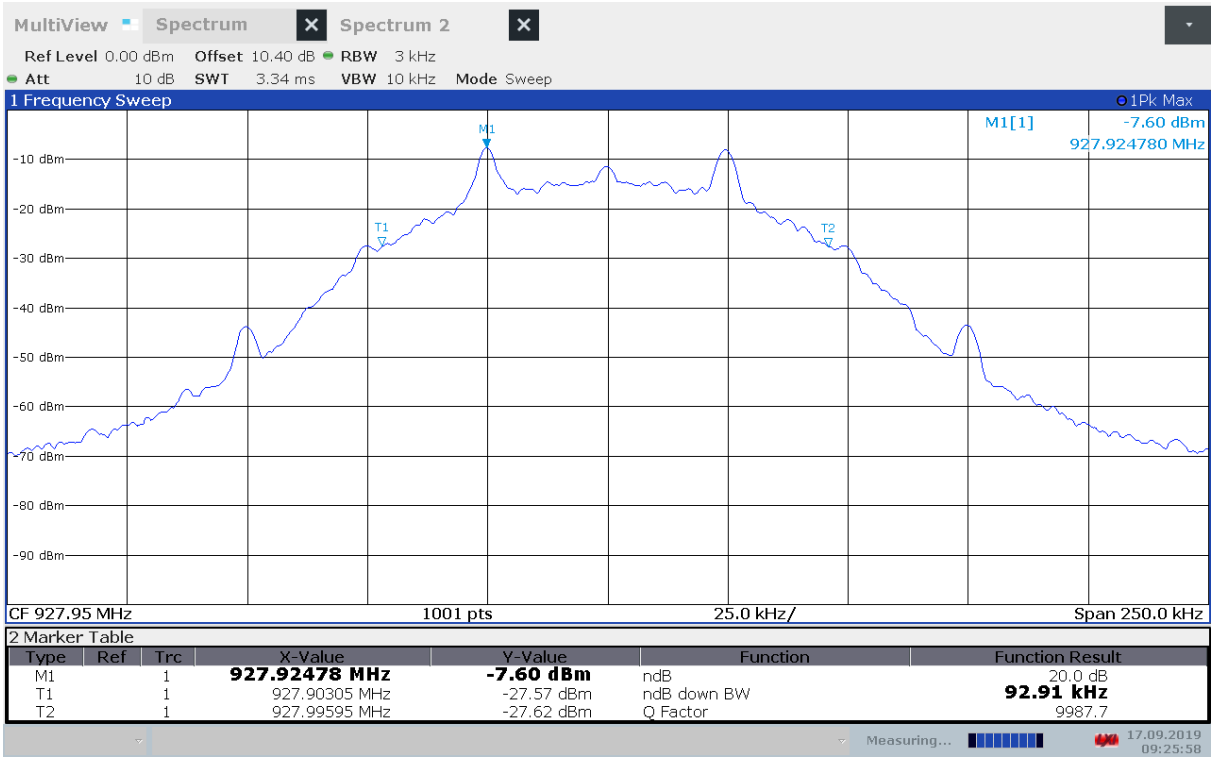
Occupied BW (99% BW), Lower Channel



Emission BW (20 dB BW), Lower Channel



Occupied BW (99% BW), Upper Channel



Emission BW (20 dB BW), Upper Channel

3.2 Field Strength of Fundamental

FCC 15.249 (a)(c)(e)

Ised Canada RSS-210 Issue 9, B.10(a)

Test Results: Complies

Measurement Data:

Maximum Field Strength @3m, Max Power			
	902.050 MHz	**915.000 MHz**	**927.950 MHz**
Peak Field Strength, Internal Antenna	**93.0 dBµV/m**	**92.0 dBµV/m**	**90.5 dBµV/m**
Peak Field Strength, External Antenna	**92.3 dBµV/m**	**90.1 dBµV/m**	**91.5 dBµV/m**
Limit, Peak Field Strength	**94 dBµV/m**		

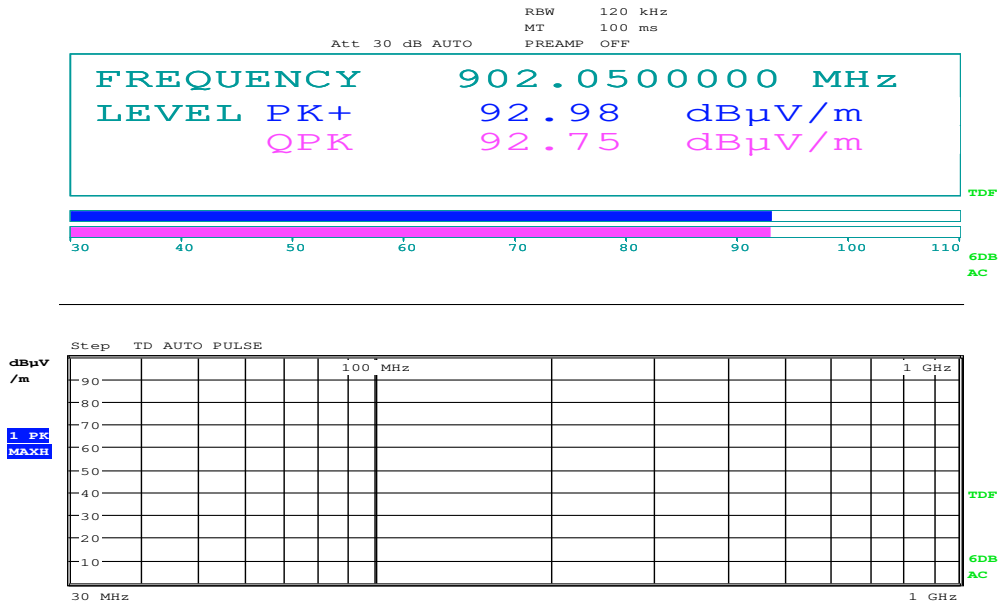
Field Strength reported is Maximum Field Strength.

See attached plots.

Requirements:

The field strength of fundamental, measured at 3 m, shall not exceed 50 mV/m (94 dBµV/m).

The field strength limits shall be measured using an average detector, except for the fundamental emission in the frequency band 902-928 MHz, which is based on measurements using an International Special Committee on Radio Interference (CISPR) quasi-peak detector.



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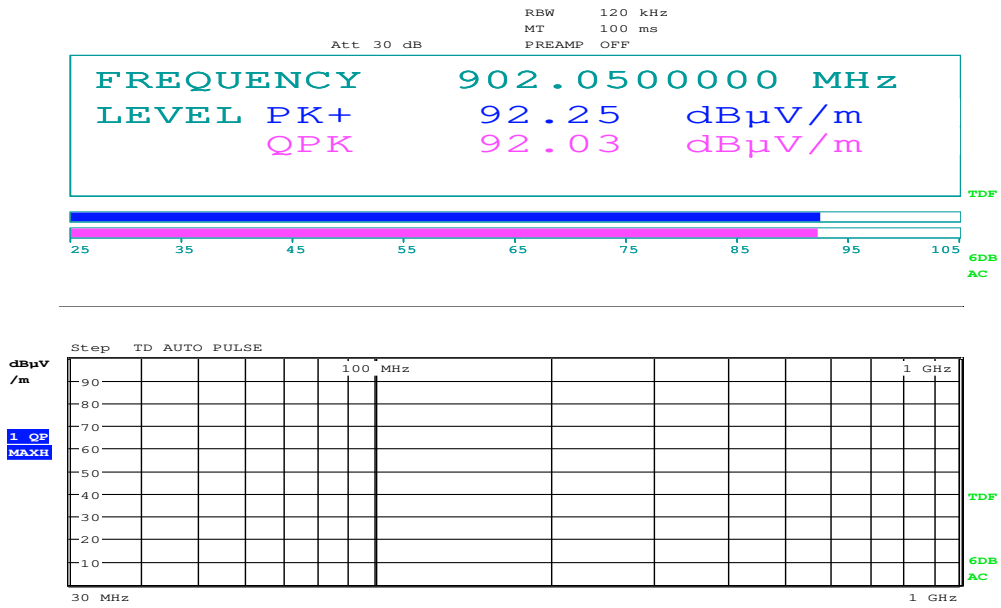
Field Strength of Fundamental, Lower Channel, Internal Antenna



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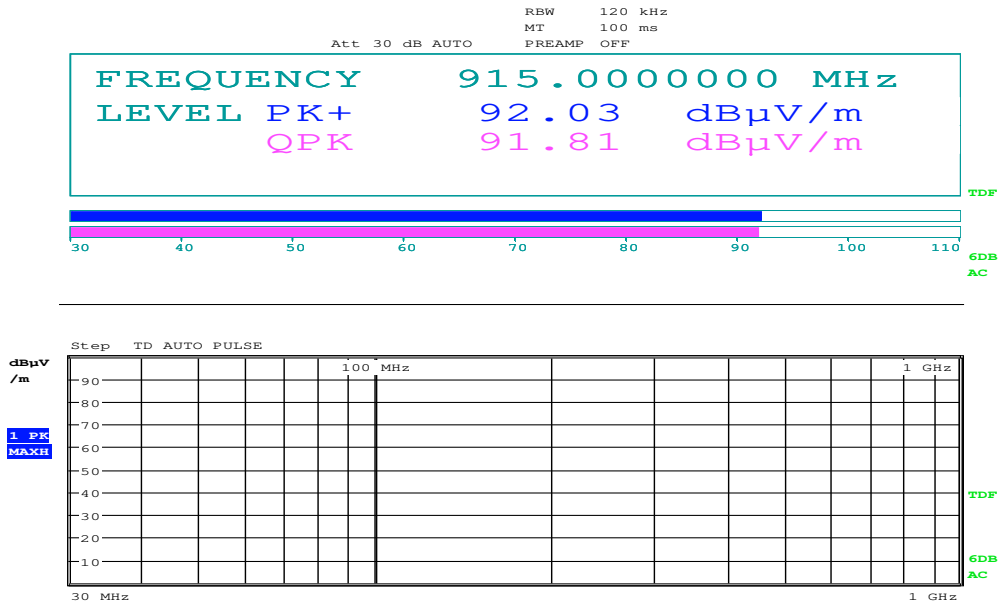
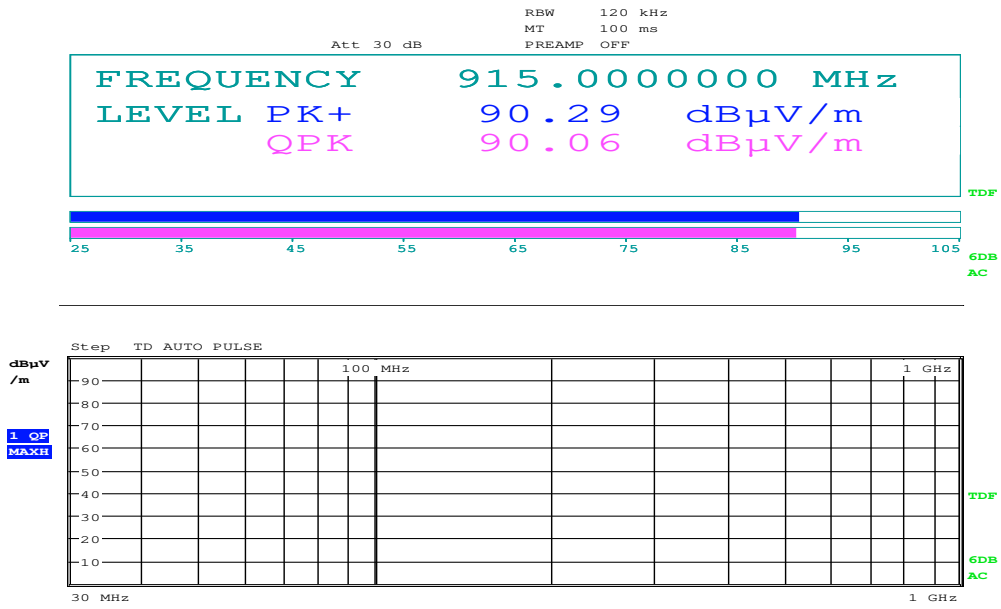
Field Strength of Fundamental, Lower Channel, External Antenna



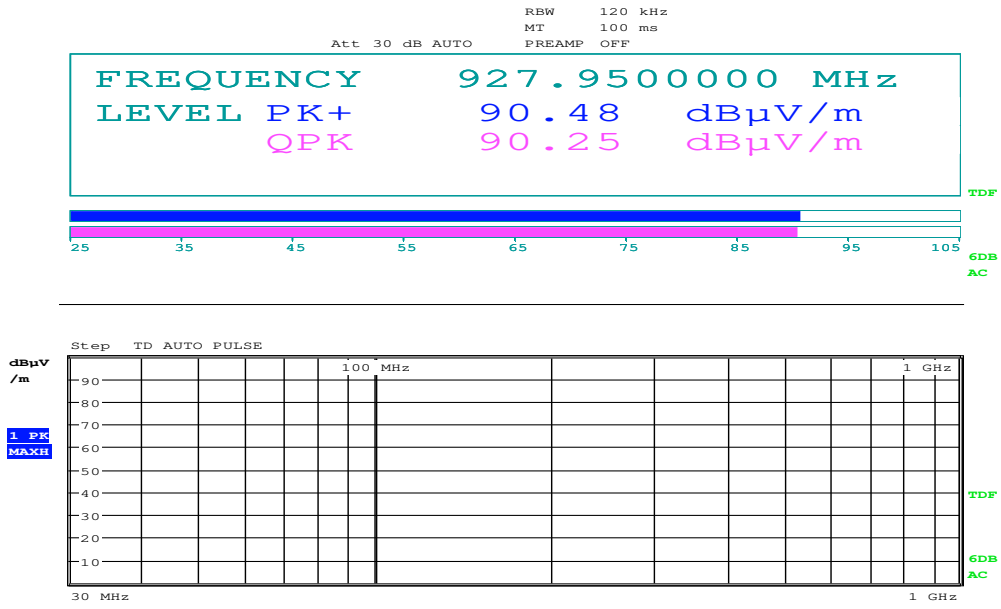
Date: 13.SEP.2019 11:14:43

Field Strength of Fundamental, Middle Channel, Internal Antenna



Date: 13.SEP.2019 13:31:08

Field Strength of Fundamental, Middle Channel, External Antenna



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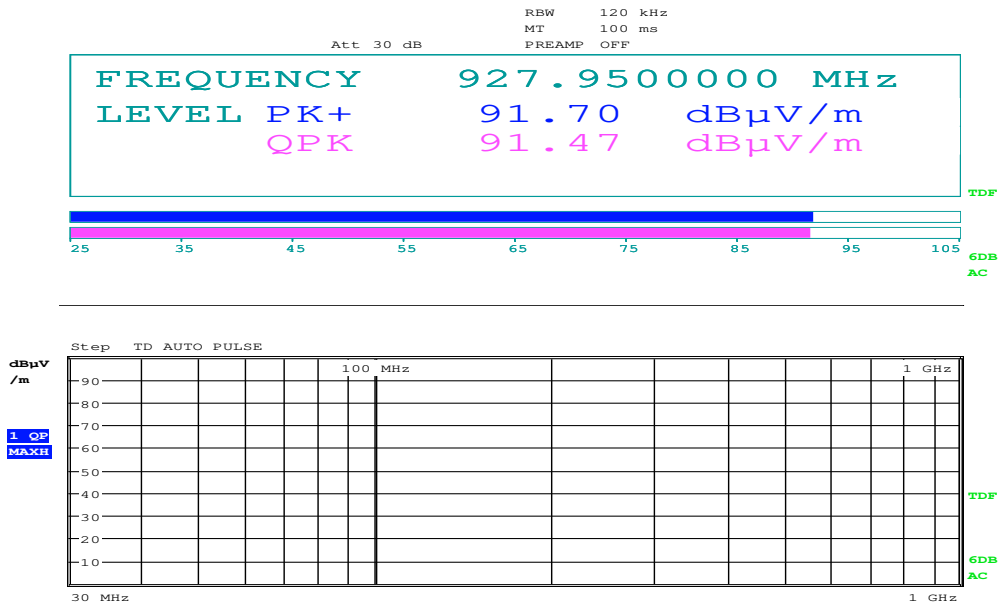
Field Strength of Fundamental, Upper Channel, Internal Antenna



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Field Strength of Fundamental, Upper Channel, External Antenna

3.3 Restricted Bands of operation

Restricted Bands of operation for FCC and ISED are defined in FCC Part 15.205 and ISED RSS-GEN, Issue 5 clause 8.10.

Generally, no fundamentals are allowed in the restricted bands and all emissions must comply with the limits in FCC 15.209 or RSS-GEN, Issue 5, clause 8.9.

FCC (MHz)	ISED (MHz)	FCC (GHz)	ISED (GHz)
0.090-0.110		**0.96-1.24** **1.3-1.427**	**0.96-1.427**
0.495-0.505		1.435-1.6265	
2.1735-2.1905		1.6455-1.6465	
	3.020-3.026	1.660-1.710	
4.125-4.128		1.7188-1.7222	
4.17725-4.17775		2.2-2.3	
4.20725-4.20775		2.31-2.39	
	5.677-5.683	2.4835-2.5	
6.215-6.218		**2.69-2.9**	**2.655-2.9**
6.26775-6.26825		3.26-3.267	
6.31175-6.31225		3.332-3.339	
8.291-8.294		3.3458-3.358	
8.362-8.366		**3.6-4.4**	**3.5-4.4**
8.37625-8.38675		4.5-5.15	
8.41425-8.41475		5.35-5.46	
12.29-12.293		7.25-7.75	
12.51975-12.52025		8.025-8.5	
12.57675-12.57725		9.0-9.2	
13.36-13.41		9.3-9.5	
16.42-16.423		10.6-12.7	
16.69475-16.69525		13.25-13.4	
16.80425-16.80475		14.47-14.5	
25.5-25.67		15.35-16.2	
37.5-38.25		17.7-21.4	
73-74.6		22.01-23.12	
74.8-75.2		23.6-24.0	
108-121.94 **123-138**	**108-138**	31.2-31.8	
149.9-150.05		36.43-36.5	
156.52475-156.52525		Above 38.6	
156.7-156.9			
162.0125-167.17			
167.72-173.2			
240-285			
322-335.4			
399.9-410			
608-614			

Frequencies in **Bold** text are specific for FCC or ISED, all other frequencies are common.

3.4 Radiated Emission, 30 – 1000 MHz.

FCC Part 15.209(a) / 15.249(a)

ISED Canada RSS-210 issue 9, B.10 (a)(b)

ISED Canada RSS-GEN Issue 5, Clause 7.3 / 8.9

Measurement procedure: ANSI C63.10-2013 Clause 6.5

Test Results: Complies

Measurement Data:

Detector: Peak (found frequencies were measured with Quasi-Peak Detector)

Measuring distance: 3 m

No transmitter related emissions exceed the General Emission limit.

The EUT is a Class A Digital Device.

See attached plots

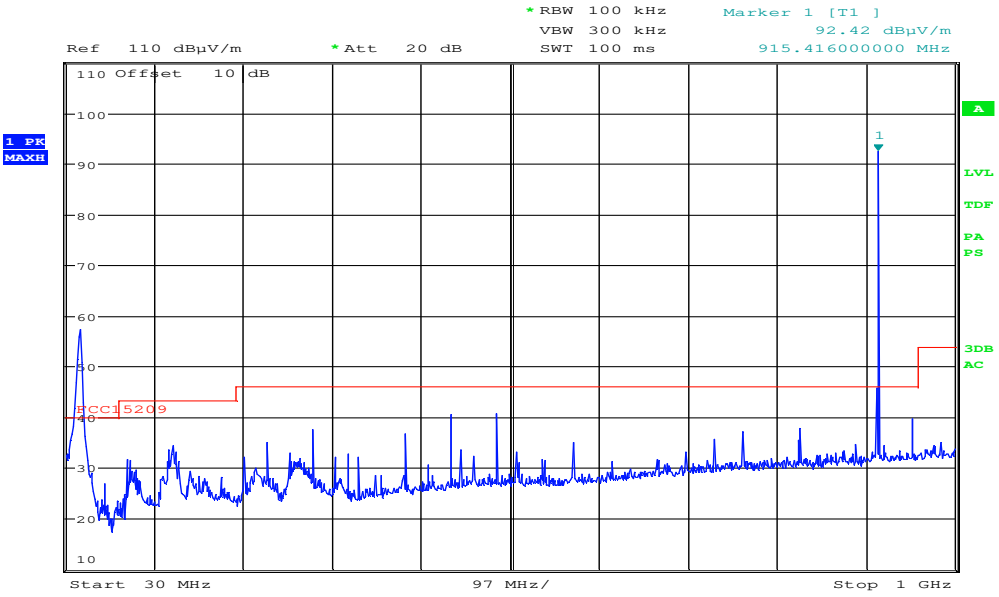
Requirements/Limit

The field strength of harmonic emissions, measured at 3 m, shall not exceed 0.5 mV/m (54 dBµV/m).

The field strength limits shall be measured using an average detector.

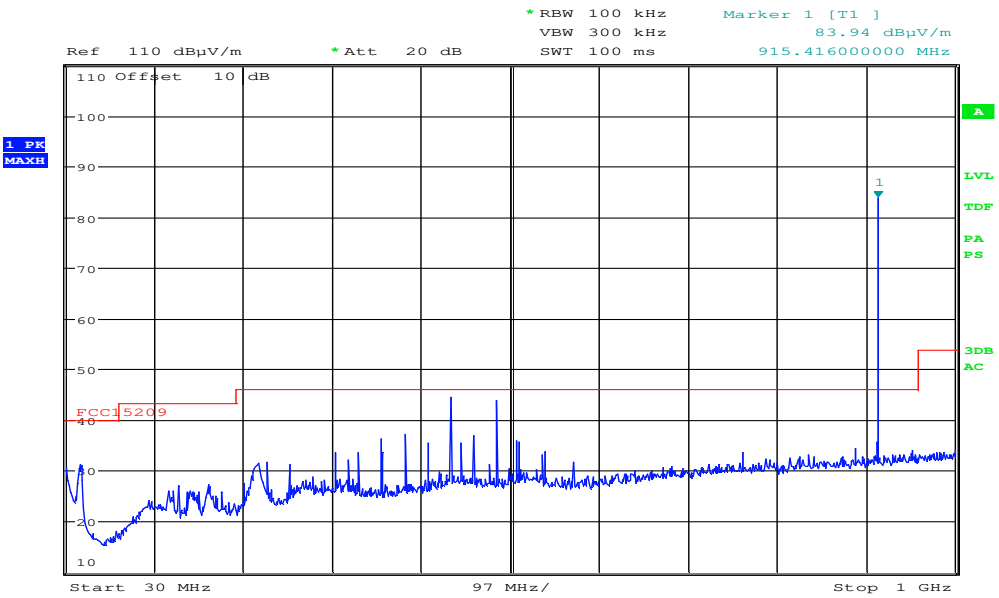
Emissions radiated outside of the specified frequency bands, except for harmonic emissions, shall be attenuated by at least 50 dB below the level of the fundamental emissions or to the general field strength limits listed in RSS-Gen or §15.209, whichever is less stringent.

FCC	Part 15.209 @ frequencies defined in §15.205	
ISED	RSS-GEN Issue 5, Clause 8.9 @ frequencies defined in clause 8.10	
Frequency	Radiated emission limit @3 meters	
30 – 88 MHz	100 µV/m	40.0 dBµV/m
88 – 216 MHz	150 µV/m	43.5 dBµV/m
216 – 960 MHz	200 µV/m	46.0 dBµV/m
960 – 1000 MHz	500 µV/m	54.0 dBµV/m
	Limits above are with Quasi Peak Detector	



Date: 13.SEP.2019 12:46:04

Radiated Emissions, 30-1000 MHz, 915.000 MHz, VP, Internal Antenna



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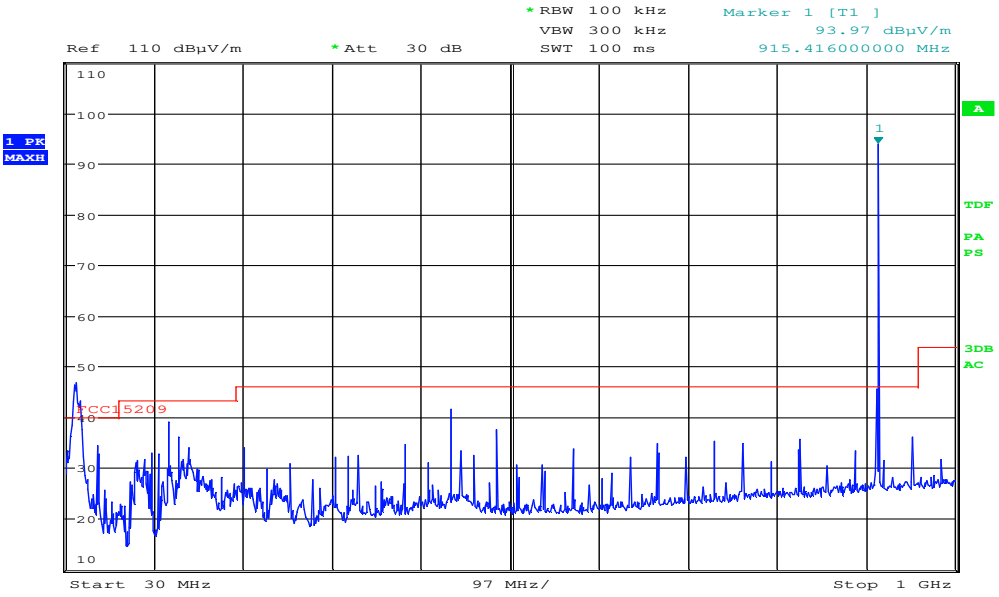
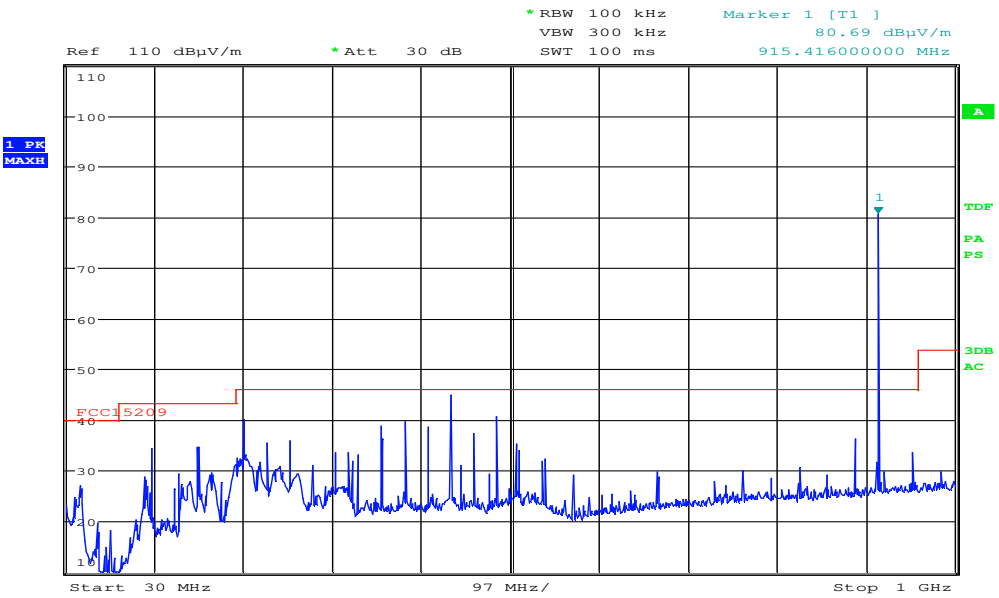
Radiated Emissions, 30-1000 MHz, 915.000 MHz, HP, Internal Antenna



Date: 13.SEP.2019 13:59:30

Radiated Emissions, 30-1000 MHz, 915.000 MHz, VP, External Antenna



Date: 13.SEP.2019 14:02:21

Radiated Emissions, 30-1000 MHz, 915.000 MHz, HP, External Antenna

3.5 Radiated Emissions, 1-10 GHz

FCC Part 15.209(a) / 15.249(a)

ISED Canada RSS-210 issue 9, B.10 (a)(b)

ISED Canada RSS-GEN Issue 5, Clause 7.3 / 8.9

Measurement procedure: ANSI C63.10-2013 Clause 6.6

Test Results: Complies

Measurement Data:

Measuring distance: 3m (1 – 10 GHz)

Spurious Frequency	Carrier Frequency	Antenna	Polarization	Detector	Measured Value (dBµV/m)	Limit (dBµV/m)	Margin
3664 MHz	915 MHz	Internal	HP	Pk	52.7	74	21.3
3664 MHz	915 MHz	Internal	HP	Av	42.5	54	11.5
3664 MHz	915 MHz	Omni	HP	Pk	52.5	74	21.5
3664 MHz	915 MHz	Omni	HP	Av	43.8	54	10.2

No transmitter related emissions exceed the General Emission limit.

The radiated emission at 3664 Mhz is not transmitter related and is the same even with the transmitter off.

Antenna factor, amplifier gain and cable loss are included in spectrum analyzer “Transducer factor”.

See plots.

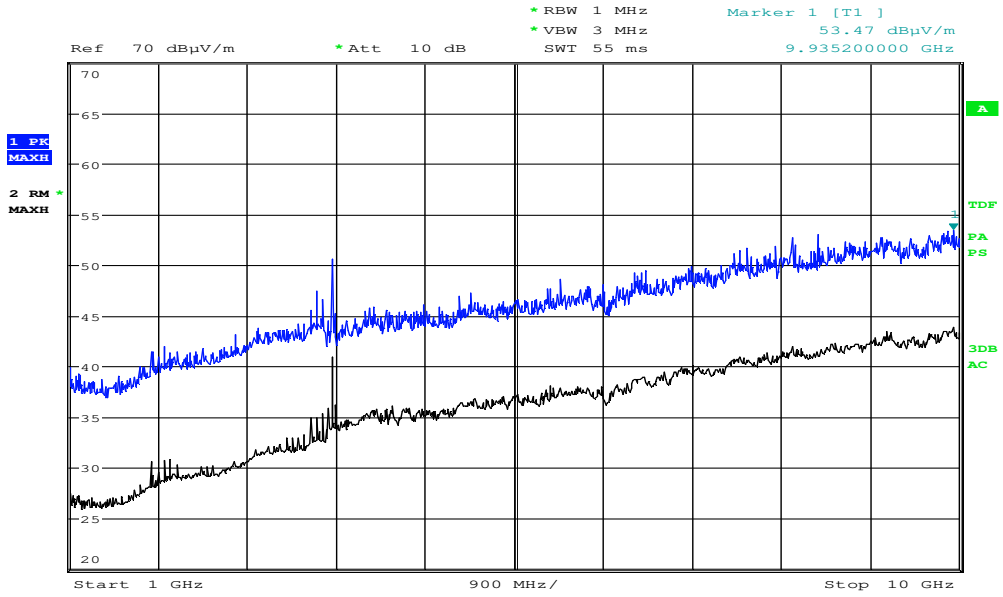
Requirements/Limit

The field strength of harmonic emissions, measured at 3 m, shall not exceed 0.5 mV/m (54 dBµV/m).

The field strength limits shall be measured using an average detector.

Emissions radiated outside of the specified frequency bands, except for harmonic emissions, shall be attenuated by at least 50 dB below the level of the fundamental emissions or to the general field strength limits listed in RSS-Gen or §15.209, whichever is less stringent.

FCC	Part 15.209 @ frequencies defined in §15.205	
ISED Canada	RSS-GEN Issue 5, clause 8.9 @ frequencies defined in clause 8.10	
	Radiated emission limit @3 meters	
Frequency (MHz)	Average Detector (dBµV/m)	Peak Detector (dBµV/m)
1 – 40 GHz	54.0	74.0



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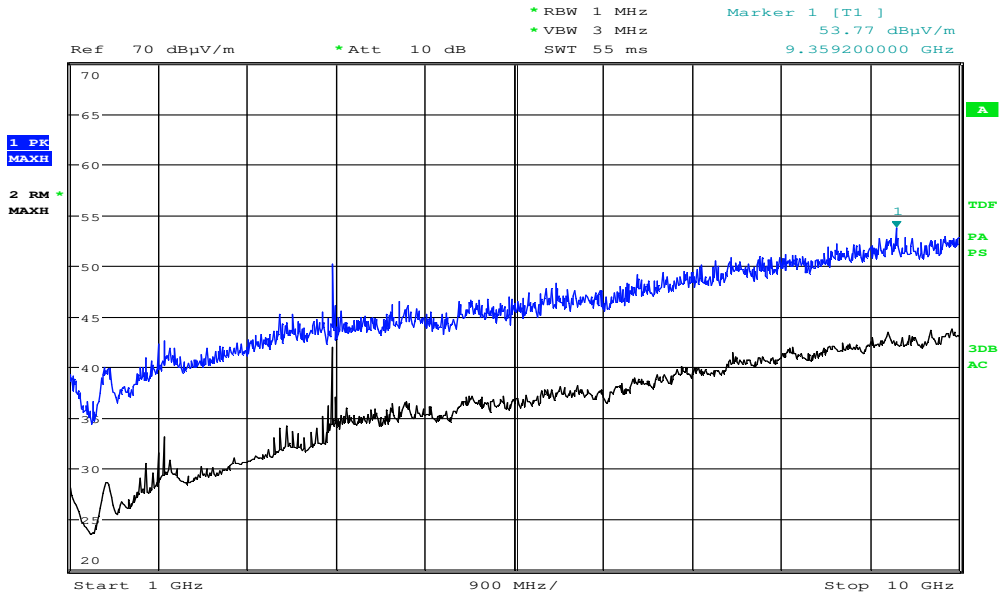
Radiated Emissions, 1000-10000 MHz, 915.000 MHz, VP, Internal Antenna



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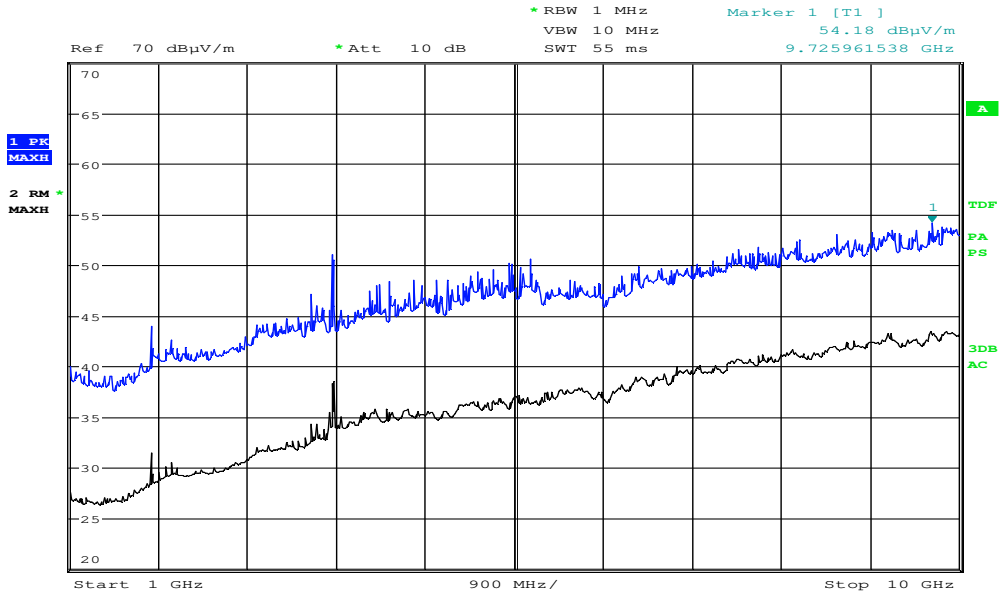
Radiated Emissions, 1000-10000 MHz, 915.000 MHz, HP, Internal Antenna



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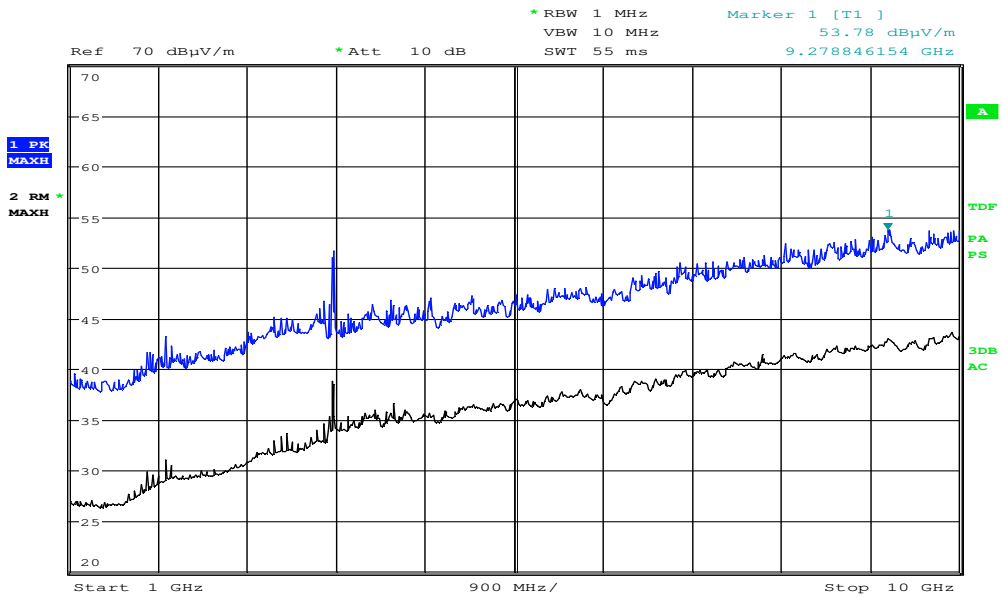
Radiated Emissions, 1000-10000 MHz, 915.000 MHz, VP, External Antenna



Date: 13.SEP.2019 14:31:26

Radiated Emissions, 1000-10000 MHz, 915.000 MHz, HP, External Antenna

4 Measurement Uncertainty

Measurement Uncertainty Values		
Test Item		**Uncertainty**
Spurious Emissions, Radiated	**< 1 GHz**	±2.5 dB
	> 1 GHz	±2.2 dB
Emission Bandwidth		±4 %
Power Line Conducted Emissions		+2.9 / -4.1 dB
Temperature Uncertainty		±1 °C

All uncertainty values are expanded standard uncertainty to give a confidence level of 95%, based on coverage factor k=2

5 LIST OF TEST EQUIPMENT

To facilitate inclusion on each page of the test equipment used for related tests, each item of test equipment and ancillaries are identified (numbered) by the Test Laboratory.

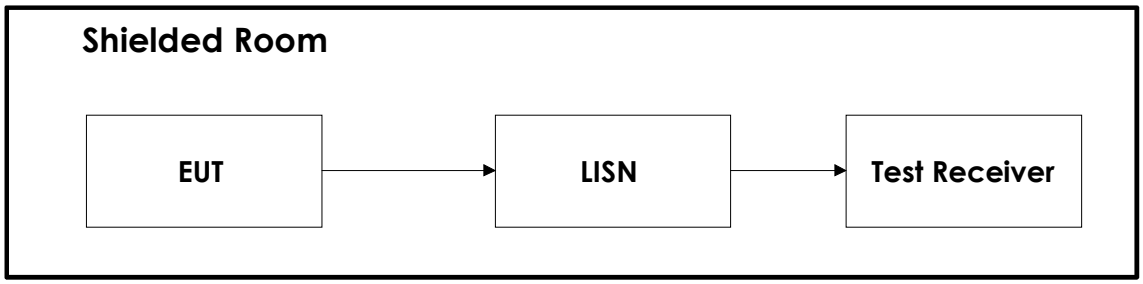
No.	Model number	Description	Manufacturer	Ref. no.	Cal. date	Cal. Due
1	ESU40	Measuring Receiver	Rohde & Schwarz	LR 1639	2019.01	2020.01
2	FSW43	Spectrum Analyzer	Rohde & Schwarz	LR 1690	2019.01	2020.01
2	6810.17B	Attenuator	Suhner	LR 1669	2019.07	2020.07
3	JB3	BiLog Antenna	Sunol Sciences	N-4525	2017.11	2020.11
4	317	Preamplifier	Sonoma Instruments	LR 1687	2019-07	2020-07
5	3115	Horn Antenna	EMCO	LR 1330	2016-10	2021-10
6	8449A	Pre-amplifier	Hewlett Packard	LR 1322	2019-07	2020-07
7	6HC1500/18000-3-KK	High Pass Filter	Trilithic	LR 1612	2019-07	2020-07
8	FS108P	PoE Switch	Netgear	Serial No.: 2HK11B3W00AB8	N/A	

The software listed below has been used for one or more tests.

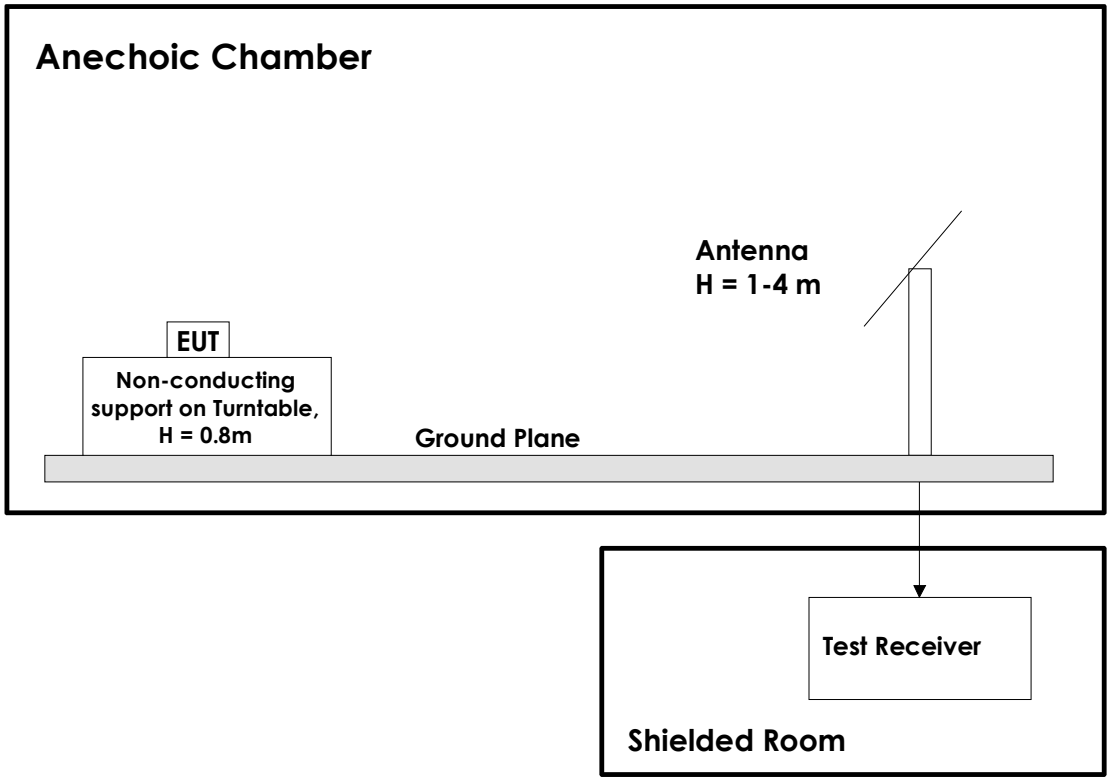
No.	Manufacturer	Name	Version	Comment
1	Rohde & Schwarz	EMC32	10.50.10	Radiated Emission test software
2	Rohde & Schwarz	GPIBShot	2.7	Screenshots from R&S Spectrum Analyzers
4				

6 BLOCK DIAGRAM

6.1 Power Line Conducted Emission



6.2 Test Site Radiated Emission



This test setup is used for all radiated emissions tests. Measuring distance is 3m. Emissions above 1 GHz are measured with a Spectrum Analyzer and Horn Antenna. All measurements at 1GHz and above were performed with turntable height 1.5m and with the ground plane covered by absorbers. A pre-amplifier was used for all measurements, and a high-pass filter was used for all harmonics.