

Prüfbericht-Nr.: 50071949 001 Auftrags-Nr.: 114060753 Seite 1 von 46 Page 1 of 46 Test Report No.: Order No.: Kunden-Referenz-Nr.: N/A Auftragsdatum: 25-Jan-2017 Client Reference No .: Order date: Auftraggeber: Intellifi b.v., Keplerlaan 16, 6716 BS Ede, The Netherlands Client: Prüfgegenstand: **Smartspot** Test item: Bezeichnung / Typ-Nr.: Smartspot series Identification / Type No.: **Auftrags-Inhalt:** FCC/IC Test report Order content: Prüfgrundlage: Test specification: FCC 47CFR Part 15: Subpart C Section 15.247 RSS-247 (02-2017) Wareneingangsdatum: 6-Feb-2017 Date of receipt: Prüfmuster-Nr.: A000501832-002 Test sample No.: A000501832-004 Prüfzeitraum: 6-Feb-2017 - 17-Feb-2017 Testing period: Ort der Prüfung: **EMC Laboratory Taipei** Place of testing: Prüflaboratorium: TUV Rheinland Taiwan Ltd. Testing laboratory: Prüfergebnis*: **Pass** Test result*: geprüft von I tested by: kontrolliert von I reviewed by: Ryan W. T. Chen / Project Engineer 2017-03-07 Rene Charton/Senior Project Manager 2017-03-07 Name / Stellung Datum Name / Stellung Unterschrift Datum Unterschrift Signature Date Name / Position Signature Date Name / Position Sonstiges I Other. Zustand des Prüfgegenstandes bei Anlieferung: Prüfmuster vollständig und unbeschädigt Condition of the test item at delivery: Test item complete and undamaged * Legende: 2 = gut 3 = befriedigend 4 = ausreichend 5 = mangelhaft 1 = sehr aut N/T = nicht getestet P(ass) = entspricht o.g. Prüfgrundlage(n) F(ail) = entspricht nicht o.g. Prüfgrundlage(n) N/A = nicht anwendbar Legend: 1 = very good 2 = good3 = satisfactory 4 = sufficient 5 = poor P(ass) = passed a.m. test specification(s) N/T = not tested F(ail) = failed a.m. test specification(s) N/A = not applicable

Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens.

This test report only relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.



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TEST SUMMARY

5.1.1 ANTENNA REQUIREMENT

RESULT: Passed

5.1.2 PEAK OUTPUT POWER

RESULT: Passed

5.1.3 20DB BANDWIDTH

RESULT: Passed

5.1.4 99% BANDWIDTH

RESULT: Passed

5.1.5 CONDUCTED SPURIOUS EMISSIONS AND FREQUENCY BAND EDGE MEASURED IN 100kHz BANDWIDTH

RESULT: Passed

5.1.6 Spurious Emission

RESULT: Passed

5.1.7 FREQUENCY SEPARATION

RESULT: Passed

5.1.8 NUMBER OF HOPPING CHANNELS

RESULT: Passed

5.1.9 TIME OF OCCUPANCY

RESULT: Passed

5.2.1 Mains Conducted Emissions

RESULT: Passed

6.1.1 ELECTROMAGNETIC FIELDS

RESULT: Passed

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1. General Remarks

1.1 Complementary Materials

All attachments are integral parts of this test report. This applies especially to the following appendix:

Appendix P: Photo Documentation

(File Name: 50071949APPENDIX P)

Appendix D: Test Result of Radiated Emissions

(File Name: 50071949APPENDIX D)

Test Specifications

The following standards were applied

Table 1: Applied Standard and Test Levels

Radio

FCC CFR47 Part 15: Subpart C Section 15.247 RSS-247 Issue 2 Feb 2017 RSS-Gen, Issue 4, November 2014 ANSI C63.10:2013



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2. Test Sites

2.1 Test Facilities

TUV Rheinland Taiwan Ltd.

11F. No.758, Sec. 4, Bade Rd., Songshan Dist. Taipei City 105
Taiwan (R.O.C.)

FCC Registration No.: 799772

IC Canada Registration No.: 9465A-1 TAF Accredited NCC Test Lab. No.:0759

TAF ISO17025 Certification effective period: 2016-Jul-1st to 2019-Jun-30th



Testing Laboratory 0759

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2.2 List of Test and Measurement Instruments

Table 2: List of Test and Measurement Equipment

Test Software	Farad	EZ_EMC	Ver. TUV3A1	N/A	N/A
EMI Test Receiver	R&S	ESR7	101062	2016/09/12	2017/09/12
Spectrum Analyzer	R&S	FSV 40	100921	2016/04/21	2017/04/21
Spectrum Analyzer	Agilent	N9010A	MY53470241	2016/04/25	2017/04/24
Preamplifier (30MHz -1GHz)	HP	8447F	2805A03335	2016/07/29	2017/07/29
Preamplifier (18 GHz -40 GHz)	COM- POWER	PAM-840	461257	2016/12/01	2017/12/01
Pre-Amplifier (1GHz~18GHz)	EM Electronics	EM01G18G	060558	2016/11/17	2017/11/17
Bilog Antenna	TESEQ	CBL6111D	29804	2016/06/23	2017/06/23
Horn Antenna	ETS- Lindgren	3117	138160	2016/05/03	2017/05/03
Horn Antenna (18GHz~40GHz)	COM- POWER	AH840	101029	2016/10/11	2017/10/11
Loop Antenna	Schwarzbeck	FMZB 1513	1513-076	2016/05/11	2017/05/11
EMI Test Receiver	R&S	ESCI7	100797	2016/12/30	2017/12/30
Spectrum Analyzer	R&S	FSL3	101943	2015/09/07	2017/09/07
Temp. & Humid. Chamber	Giant Force	GCT-099-40-S	MAF0103- 007	2015/07/13	2017/07/12
LISN (1 phase)	R&S	ENV216	101243	2016/06/02	2017/06/02
LISN	R&S	ENV216	101262	2016/06/16	2017/06/16

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2.3 Traceability

All measurement equipment calibrations are traceable to NML(Taiwan)/NIST(USA) or where calibration is performed outside Taiwan, to equivalent nationally recognized standards organizations.

2.4 Calibration

requiring calibration is calibrated periodically in a suitably accredited Calibration Lab. Additionally all equipment is verified for proper performance on a regular basics using in house standards or comparisons.

2.5 Measurement Uncertainty

The estimated combined standard uncertainty for radiated emissions and conducted emissions measurements:.

Table 3: Emission Measurement Uncertainty

Parameter	Uncertainty
Radio Frequency	± 1 x 10 ⁻⁷
RF power, conducted	± 1.5 dB
RF power density, conducted	± 3 dB
spurious emissions, conducted	± 3 dB
all emissions, radiated	± 6 dB
Temperature	± 1 ºC
Humidity	± 5 %
DC and low frequency voltages	±3 %

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3. General Product Information

3.1 Product Function and Intended Use

The Intellifi Smartspot is a family of RFID readers with antennas. There are several external antennas. The Spot Antenna contains two passive antennae and has two connections to the multiplexer in the main transmitter unit. The Micro Antenna is a single passive antenna with circular polarization. The Shelf Antenna has a single RF connector and an internal multiplexer with a gain below 0 dB.

For details refer to the User Guide, Data Sheet and Circuit Diagram.

3.2 System Details and Ratings

Table 4: Basic Information of EUT

Item	EUT information
Kind of Equipment/Test Item	Smartspot
Type Identification	Smartspot series
FCC ID	2AK2CSMRTSPT
Canada ID	22367-SMRTSPT
Canada HVIN	SMRTSPT170000

Table 5: Technical Specification of EUT

Technical Specification	Value
Operating Frequency	902.75-927.25 MHz
Channel Spacing	500 kHz
Channel number	50
Operation Voltage	12Vdc or 48 Vdc by PoE
Modulation	GFSK
Antenna gain	< 9 dBi



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3.3 Independent Operation Modes

The basic operation modes are:

- A. Transmitting
 - 1. Low channel
 - 2. Middle channel
 - 3. High channel
- B. Receiving



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3.4 Noise Generating and Noise Suppressing Parts

Refer to the Circuit Diagram.

3.5 Submitted Documents

- Circuit Diagram
- Instruction Manual
- Rating Label
- Technical Description



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4. Test Set-up and Operation Modes

4.1 Principle of Configuration Selection

The equipment under test (EUT) was configured to measure its maximum power level. The test modes were adapted accordingly in reference to the instructions for use.

4.2 Test Operation and Test Software

Test operation refers to test setup in chapter 4. All testing were performed according to the procedures in ANSI C63.10: 2013.

The samples were used as follows:

Conducted: A000501832-004 Radiation: A000501832-002

Full test was applied on all test modes, but only worst case was shown.

4.3 Special Accessories and Auxiliary Equipment

The product has been tested together with the following additional accessories:

Kind of Equipment	Manufacturer	Model Name	S/N
Laptop	HP	HSTNN-Q78C-3	CNF0339QBM

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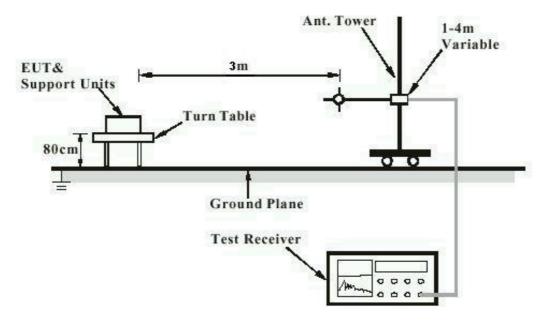
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4.4 Countermeasures to achieve EMC Compliance

The test sample which has been tested containing the noise suppression parts as in the Photo Appendix and the Test Setup Photos. No additional measures were employed to achieve compliance.

4.5 Test Setup Diagram

Diagram of Measurement Configuration for Radiation Test



Note: Measurements above 1 GHz are done with a table height of 1.5m



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Diagram of Measurement Equipment Configuration for Mains Conduction Measurement

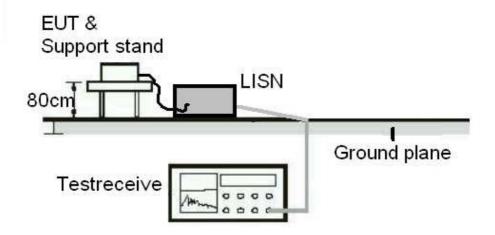
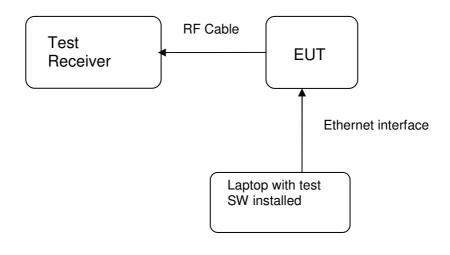


Diagram of Measurement Equipment Configuration for Conducted Transmitter Measurement





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5. Test Results

5.1 Transmitter Requirement & Test Suites

5.1.1 Antenna Requirement

RESULT: Passed

Test standard : LP0002(2011): 2.2, 3.10.1, (3)

FCC Part 15.247(b)(4), Part 15.203 and RSS-

Gen 8.3

Requirement : use of approved antennas only with directional gains that

do not exceed 6 dBi or reduce output power accordingly

The EUT will be marketed with several different antenna configurations. The connections to the antennae are done with SMA connectors. This is acceptable, because the System will always be professionally installed.

The maximum antenna gain including the cables is 9 dBi. Therefore, the maximum allowed conducted output power is 500 mW.

Refer to EUT photos for details.



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5.1.2 Peak Output Power

RESULT: Passed

5.1.2.1 Conducted Measurement for system Single Antenna

Test standard FCC Part 15.247(b)(1),

RSS-247 5.4(2)

LP0002(2011): 3.10.1, (2)

Basic standard ANSI C63.10:2013

LP0002(2011) Appendix II

Kind of test site Shielded room

Test setup

Test Channel Low/ Middle/ High

Operation Mode

Ambient temperature : 22-26 °C Relative humidity : 50-65 % Atmospheric pressure : 100-103 F 100-103 kPa

Table 6: Test result of Peak Output

Channel	Channel Frequency	Peak Outp	Limit	
	(MHz)	(dBm)	(W)	(W)
Low Channel	902.75 MHz	25.737	0.375	0.5
Middle Channel	915MHz	26.005	0.398	0.5
High Channel	927.25 MHz	25.091	0.324	0.5



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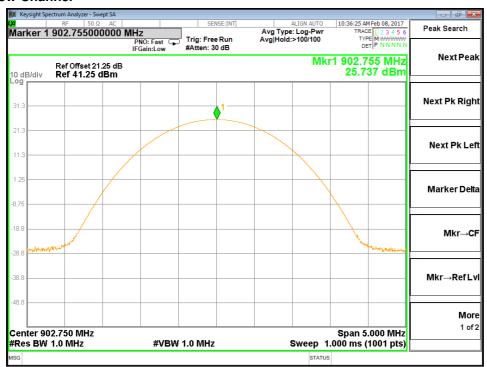
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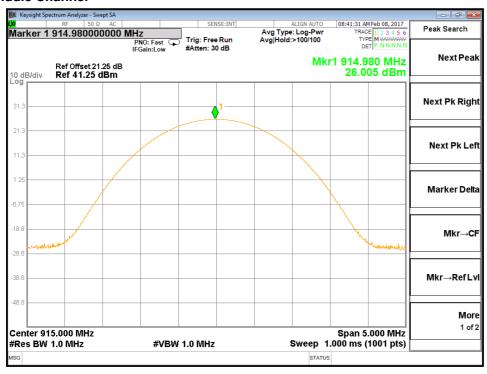
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Test Plot of Peak Output Power,

Low Channel



Middle Channel





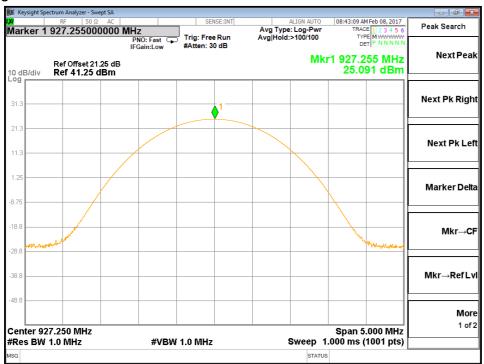
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High Channel

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5.1.2.2 Radiated Measurement for Shelf-Antenna with internal double antenna and multiplexer

FCC Part 15.247(b)(1), Test standard

RSS-247 5.4(2)

Basic standard ANSI C63.10:2013

LP0002(2011) Appendix II

Kind of test site Semi-Anechoic Chamber

Test setup

Test Channel Low/ Middle/ High

Test Channel : Operation Mode :

Ambient temperature : 20-24 °C Relative humidity : 50-65 % Atmospheric pressure : 100-103 kg 100-103 kPa

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Table 7: Test result of Peak Output

Channel	Channel Frequency	Peak Outp	ut Power	Limit
	(MHz)	(dBm)	(W)	(W)
Low Channel	902.75 MHz	20	0.103	0.5
Middle Channel	915MHz	22	0.159	0.5
High Channel	927.25 MHz	21.4	0.139	0.5

Test procedure:

Since the EUT has no connector port available for conducted measurements the test results are obtained by radiated measurement using the setup for radiated emissions. From the measured radiated field strength at a distance of 3m and the antenna gain G (as declared by the applicant) the peak conducted output power value is calculated. This value is calculated using the formula:

E is the measured maximum fundamental field strength in V/m

-> 4.36 dBV/m = 1.65 V/m@ 902.75 MHz -> 6.26 dBV/m = 2.05 V/m-> 5.66 dBV/m = 1.92 V/m@ 915 MHz @ 927.25 MHz

G is the numeric gain of the transmitting antenna with reference to an isotropic radiator.

-> 9 dBi => 7.94

d is the distance in meters from which the field strength was measured.

P is the power in watts:

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

SQ(1.65 *3) / 238 = 0.103 W = 20 dBm SQ(2.05 *3) / 238 = 0.159 W = 22 dBm@ 902.75 MHz @ 915 MHz @ 927.25 MHz SQ(1.92*3) / 238 = 0.139 W = 21.4 dBm

For details refer to Appendix D.



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5.1.3 20dB Bandwidth

RESULT: Passed

Test standard FCC Part 15.247(a)(1),

RSS-247 5.1(1)

LP0002(2011): 3.10.1, (6.1.1)

Basic standard ANSI C63.10:2013

LP0002(2011) Appendix II

Kind of test site Shielded room

Test setup

Test Channel Low/ Middle/ High

Operation Mode

Ambient temperature : Relative humidity : Atmospheric pressure : 22-26°C 50-65% 100-103kPa

Table 8: Test result of 20dB Bandwidth,

Channel	Channel Frequency (MHz)	20dB Bandwidth (kHz)	Limit (kHz)	Result
Low Channel	902.75 MHz	5.85	< 500	Pass
Mid Channel	915MHz	5.85	< 500	Pass
High Channel	927.25 MHz	5.85	< 500	Pass



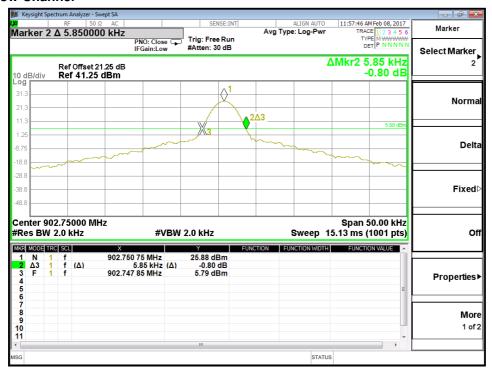
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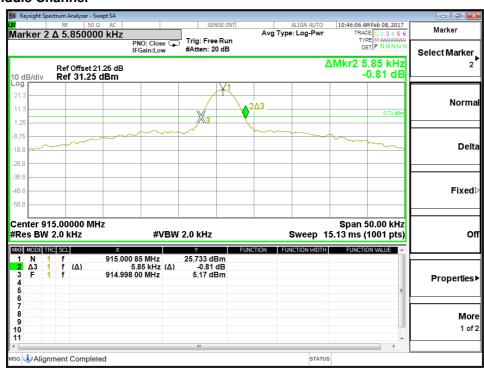
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Test Plot of 20dB Bandwidth

Low Channel



Middle Channel





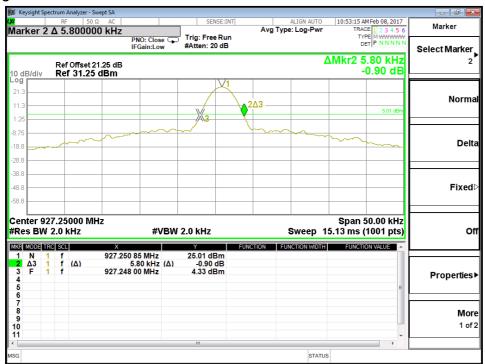
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High Channel





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5.1.4 99% Bandwidth

RESULT: Passed

RSS-Gen, Issue 4, November 2014 Test standard

Basic standard ANSI C63.10:2013 Kind of test site Shielded room

Test setup

Test Channel Low/ Middle/ High

Test Channel : Operation Mode :

Ambient temperature : 22-26°C Relative humidity : 50-65% Atmospheric pressure : 100-103 100-103 kPa

Table 9: Test result of 99% Bandwidth,

Channel	Channel Frequency (MHz)	99% Bandwidth (kHz)
Mid Channel	915	5.77



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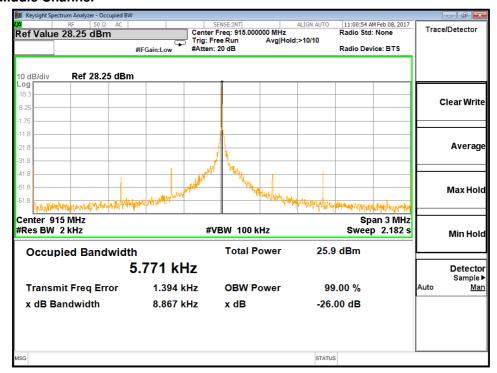
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Test Plot of 99% Bandwidth,

Middle Channel





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5.1.5 Conducted spurious emissions and Frequency Band Edge measured in 100kHz Bandwidth

RESULT: Passed

Test standard FCC part 15.247(d),

RSS-247 5.5

LP0002(2011): 3.10.1, (5)

Basic standard ANSI C63.10:2013 :

LP0002(2011) Appendix II

20dB (below that in the 100kHz bandwidth within the Limit

band that contains the highest level of the desired power)

Kind of test site Shielded room

Test setup

Test Channel Low/ Middle/ High

Operation Mode

Ambient temperature 22-26°C Relative humidity 50-65% Atmospheric pressure 100-103 kPa

All emissions are more than 20dB below fundamental, details refer to following test plot, and compliance is achived as well.

Due to the small size of the product and that there are no inductive components of significant size, 9kHz to 30MHz frequency range is not tested based on technical judgment.



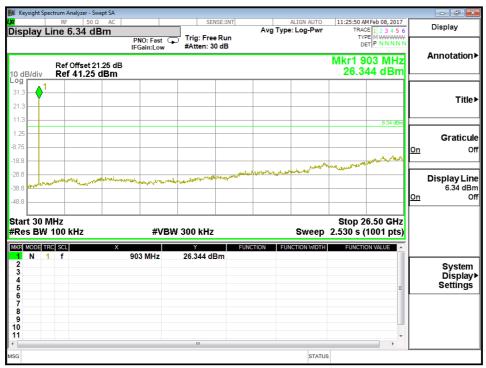
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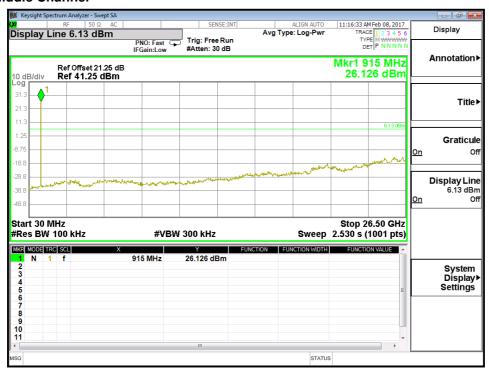
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Test Plot of 100kHz Conducted Emissions,

Low Channel



Middle Channel





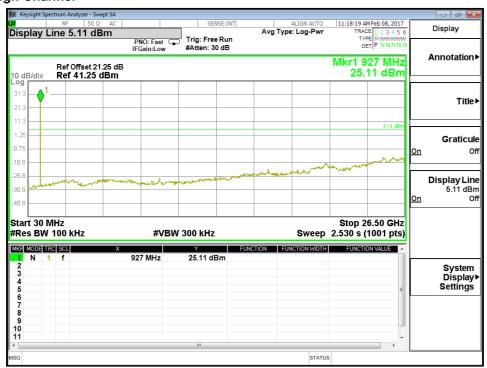
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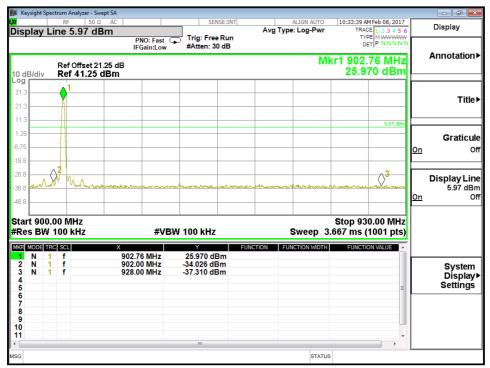
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Test Plot of 100kHz Bandwidth of Frequency Band Edge

Low Channel

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High Channel





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Hopping On





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5.1.6 Spurious Emission

RESULT: Passed

Test standard FCC part 15.247(d), FCC 15.205, FCC 15.209,

RSS-247 5.5 and RSS-Gen 8.9

LP0002(2011): 3.10.1, (5)

Basic standard ANSI C63.10: 2013

Radiated emissions which fall in the restricted bands, Limits

> as defined in FCC 15.205(a) and RSS-Gen i4, 8.9 (Table 6), must comply with the radiated emission limits specified in FCC 15.209(a) and RSS-Gen i4,

8.9 (Table 4 and 5).

Emission radiated outside the specified frequency bands must comply with the -20dBc emission limits

specified in FCC 15.247 and RSS-247 5.5

Kind of test site 3m Semi-Anechoic Chamber

Test setup

Test Channel Low/ Middle/ High

Operation Mode

Remark: Testing was carried out within frequency range 30MHz to the tenth harmonic. For details refer to Appendix D. The Radiated Emissions testing was performed in the X, Y and Z axis orientation. The worst-case Axis orientation is recorded in this test report.



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5.1.7 Frequency Separation

RESULT: Passed

Test standard FCC part 15.247(a)(1)

RSS-210 A8.1(b)

LP0002(2011): 3.10.1, (6.1.1)

Basic standard ANSI C63.10:2013

LP0002(2011) Appendix II

Limit

Test setup

Test Channel Low/ Middle/ High

Operation Mode Ambient temperature **24**℃ Relative humidity 53%

Table 10: Test result of Frequency Separation

Channel	Channel Frequency (MHz)	Measured Channel Separation (MHz)	Limit (kHz)	Result
Record Channel	914.500			
Record Channel adj 1	915.000	0.5	≥115 kHz	Pass
Record Channel adj 2	915.500			



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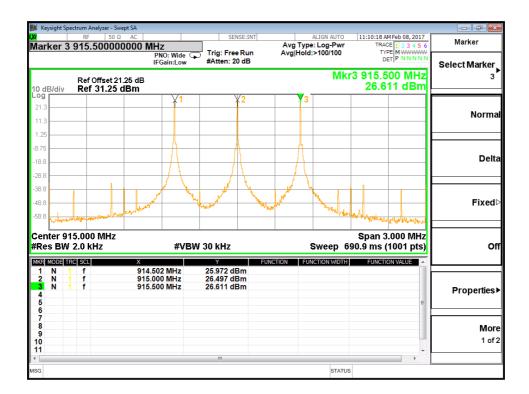
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Test Plot of Frequency Separation





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5.1.8 Number of Hopping Channels

RESULT: Passed

Test standard FCC part 15.247(a)(1)(iii)

RSS-247 5.1(5)

LP0002(2011): 3.10.1, (6.1.2)

Basic standard ANSI C63.10:2013

LP0002(2011) Appendix II

Test setup

Test Channel Hopping On

Operation Mode

Ambient temperature : 22-26°C Relative humidity : Atmospheric pressure : 50-65% 100-103 kPa

Table 11: Test result of Number of hopping frequency

Frequency Range	Measured Number of Hopping Channel	Limit	Result
902 to 928 MHz	50	≥50	Pass



Products

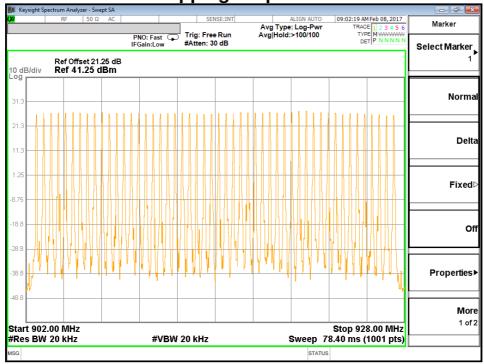
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Test Plot of Number of hopping frequencies





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5.1.9 Time of Occupancy

RESULT: Passed

Test standard FCC part 15.247(a)(1)(iii) :

RSS-247 5.1(5)

LP0002(2011): 3.10.1, (6.1.2)

Basic standard ANSI C63.10:2013

LP0002(2011) Appendix II

Limits 0.4s

Kind of test site Shield room

Test setup

Test Channel Low/ Middle/ High

Operation Mode

Ambient temperature : 22-26°C Relative humidity 50-65% Atmospheric pressure : 100-103 kPa

Table 12: Test result of Time of Occupancy

Data Mode	Captured Burst (s)	Dwell time (s)	On+Off time (s)	Limit (s)	Result
	0.120	0.120	23	0.4	Pass

Dwell time = Pulse width x (Hopping rate / Number of channels) x Period

Period = 0.4 (seconds/ channel) x 50 (channel) = 20 seconds.



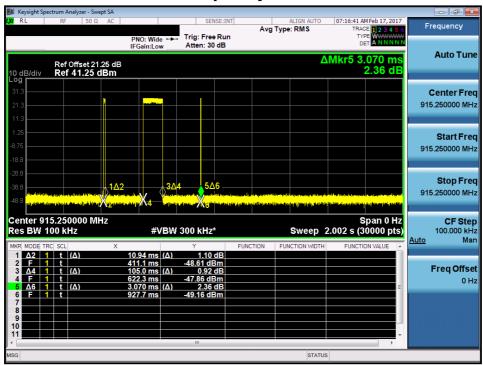
Products

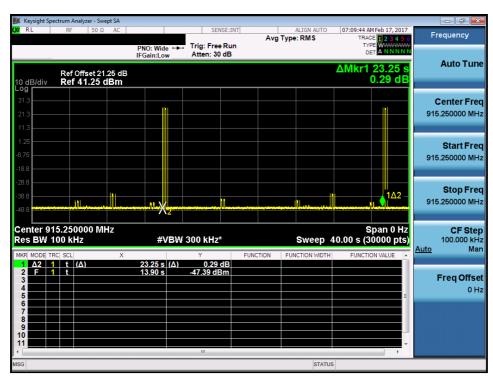
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Test Plot of Time of Occupancy







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5.2 Mains Emissions

5.2.1 Mains Conducted Emissions

RESULT: Passed

Test standard FCC Part 15.207

> FCC Part 15.107 RSS-Gen 7.2.4 LP0002: 8.8

Limits Mains Conducted emissions as defined in

above test standards must comply with the mains conducted emission limits specified

Kind of test site Shielded Room

Test setup

Middle **Test Channel** Operation mode Α

Remark: For details refer to Appendix D.



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6. Safety Human exposure

6.1 Radio Frequency Exposure Compliance

6.1.1 Electromagnetic Fields

RESULT: Passed

Test standard : FCC KDB Publication 447498 D01 v05

RSS-102 issue 5, Table 4

The Equipment will maintain a 23 cm distance to all persons in the US and 35cm distance in Canada. The Equipment will be installed professionally.

Maximum Exposure FCC:

Power to Antenna (mW)	398 mW
Power to Antenna (dBm)	26.0 dBm
Antenna Gain	10 dBi
Power+Ant Gain	3980.0 mW
Distance	23 cm
S=	0.599 mW/cm^2

Limit FCC: 0.61 mW/cm²

FCC:

0.3-1.34 MHz (100) mW/cm² 1.34-30 MHz (180/f²) mW/cm² 30-300 MHz 0.2 mW/cm² 300-1500 MHz f/1500 mW/cm² 1500-100,000 MHz 1.0 mW/cm²



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Maximum Exposure Canada:

Power to Antenna (mW)	398 mW
Power to Antenna (dBm)	26.0 dBm
Antenna Gain	10 dBi
Power+Ant Gain	3980.0 mW
Distance	35 cm
S=	0.259 mW/cm^2

Limit Canada: 0.274 mW/cm²

Canada:

 Canada:

 10-20 MHz
 0.2 mW/cm²

 20-48 MHz
 (0.8944/f^{0.5}) mW/cm²

 48-300 MHz
 0.129 mW/cm²

 300-6000 MHz
 (0.002619*f^{0.6834}) mW/cm²

 6000-15000MHz
 1.0 mW/cm²



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7. Photographs of the Test Set-Up

Photograph 1: Set-up for Spurious Emissions (Front View)





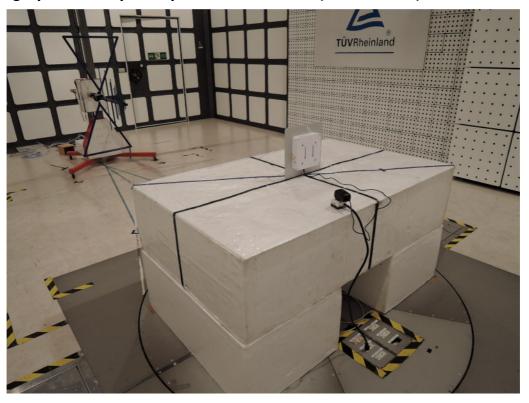


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Photograph 2: Set-up for Spurious Emissions (Back View 1)

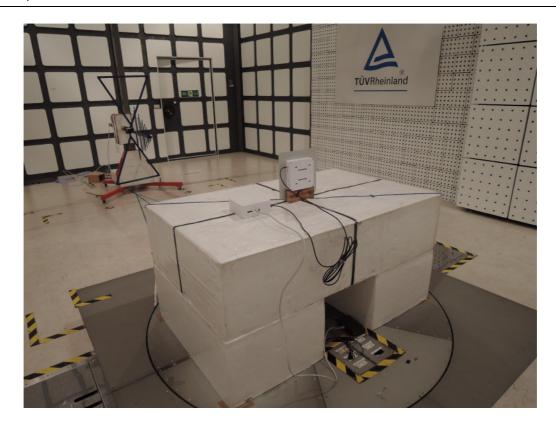




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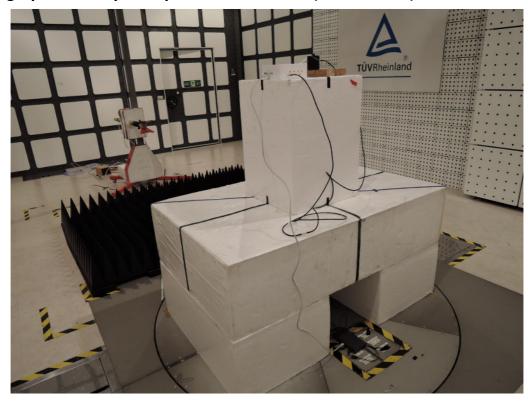




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Photograph 3: Set-up for Spurious Emissions (Back View 2)



Photograph 4: Set-up for Conducted testing





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Photograph 5: Set-up for for Mains Conducted testing Back



Photograph 6: Set-up for for Mains Conducted testing Front





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