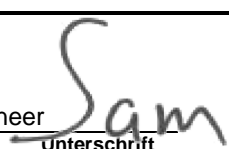
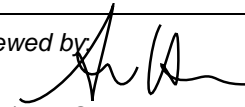


| | | | | |
|--|--|---|-----------------------------|---|
| Prüfbericht-Nr.: <i>Test Report No.:</i> | 50097223 001 | Auftrags-Nr.: <i>Order No.:</i> | 114058583 | Seite 1 von 46 <i>Page 1 of 46</i> |
| Kunden-Referenz-Nr.: <i>Client Reference No.:</i> | N/A | Auftragsdatum: <i>Order date:</i> | 28-Nov-2016 | |
| Auftraggeber: <i>Client:</i> | Liyatech Corporation., 20F.-8, No.7, Sec. 3, New Taipei Blvd., Xinzhuang Dist., New Taipei City 242, Taiwan (R.O.C.) | | | |
| Prüfgegenstand: <i>Test item:</i> | LRM001 | | | |
| Bezeichnung / Typ-Nr.: <i>Identification / Type No.:</i> | LRM001-915 | | | |
| Auftrags-Inhalt: <i>Order content:</i> | FCC Part 15C (DTS) | | | |
| Prüfgrundlage: <i>Test specification:</i> | FCC 47CFR Part 15: Subpart C Section 15.247 | | | |
| Wareneingangsdatum: <i>Date of receipt:</i> | 12-Jan-2017 | | | |
| Prüfmuster-Nr.: <i>Test sample No.:</i> | A000467270-001 | | | |
| Prüfzeitraum: <i>Testing period:</i> | 17-Feb-2017 - 03-Aug-2017 | | | |
| Ort der Prüfung: <i>Place of testing:</i> | EMC Laboratory Taipei | | | |
| Prüflaboratorium: <i>Testing laboratory:</i> | TUV Rheinland Taiwan Ltd. | | | |
| Prüfergebnis*: <i>Test result*:</i> | Pass | | | |
| geprüft von / tested by: | | kontrolliert von / reviewed by: | | |
| 2018-04-09 Sam C.J. Kuo/Engineer | | 2018-04-09 Arvin Ho/Vice General Manager | | |
| Datum <i>Date</i> | Name / Stellung <i>Name / Position</i> | Unterschrift <i>Signature</i> | Datum <i>Date</i> | Name / Stellung <i>Name / Position</i> |
| | |  | |  |
| Sonstiges / Other: | | | | |
| Zustand des Prüfgegenstandes bei Anlieferung: <i>Condition of the test item at delivery:</i> | | Prüfmuster vollständig und unbeschädigt <i>Test item complete and undamaged</i> | | |
| <p>* Legende: 1 = sehr gut 2 = gut 3 = befriedigend 4 = ausreichend 5 = mangelhaft P(ass) = entspricht o.g. Prüfgrundlage(n) F(ail) = entspricht nicht o.g. Prüfgrundlage(n) N/A = nicht anwendbar N/T = nicht getestet</p> <p>Legend: 1 = very good 2 = good 3 = satisfactory 4 = sufficient 5 = poor P(ass) = passed a.m. test specification(s) F(ail) = failed a.m. test specification(s) N/A = not applicable N/T = not tested</p> | | | | |
| <p>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. <i>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.</i></p> | | | | |

TEST SUMMARY

5.1.1 ANTENNA REQUIREMENT

RESULT: *Passed*

5.1.2 PEAK OUTPUT POWER

RESULT: *Passed*

5.1.3 6dB BANDWIDTH AND 99% BANDWIDTH

RESULT: *Passed*

5.1.4 POWER DENSITY

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*

5.2.1 MAINS CONDUCTED EMISSIONS

RESULT: *Passed*

6.1.1 ELECTROMAGNETIC FIELDS

RESULT: *Passed*

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1. General Remarks

1.1 Complementary Materials

The following attachments are integral parts of this test report:

Appendix P: Photo Documentation
(File Name: 50097223APPENDIX P)

Appendix D: Test Result of Radiated Emissions
(File Name: 50097223APPENDIX D)

Test Specifications

The following standards were applied (in bold: product standards, otherwise: basic standards).

Table 1: Applied Standard and Test Levels

| Radio |
|---|
| FCC CFR47 Part 15: Subpart C Section 15.247 |
| ANSI C63.10:2013 |
| KDB558074 D01 DTS Meas Guidance v03r05 |

2. Test Sites

2.1 Test Facilities

TUV Rheinland Taiwan Ltd.
Taipei Office

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

FCC RegistrationNo.: 340738
IC Canada Registration No.: 9465A-1
TAF Accredited NCC Test Lab. No.:0759
TAF ISO17025 Certification effective periods: 2016-Jul-1st to 2019-Jun-30th



Testing Laboratory
0759

2.2 List of Test and Measurement Instruments

Table 2: List of Test and Measurement Equipment

| Kind of Equipment | Manu-facturer | Type | S/N | Last Calibration | Next Calibration |
|-------------------------------|----------------|--------------|-------------|------------------|------------------|
| 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 | 2017/05/02 | 2018/05/01 |
| Spectrum Analyzer | Agilent | N9010A | MY53470241 | 2017/05/23 | 2018/05/22 |
| 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 | 29802 | 2016/8/10 | 2017/8/10 |
| Horn Antenna | ETS-Lindgren | 3117 | 138160 | 2017/5/25 | 2018/5/25 |
| Horn Antenna (18GHz~40GHz) | COM-POWER | AH-840 | 101031 | 2016/11/22 | 2017/11/22 |
| Loop Antenna | Schwarzbeck | FMZB 1513 | 1513-076 | 2017/6/14 | 2018/6/14 |
| 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 | 2017/6/18 | 2018/6/18 |
| LISN | R&S | ENV216 | 101262 | 2016/06/16 | 2017/06/16 |
| Power sensor | Agilent | U2021XA | MY54020001 | 2017/03/08 | 2018/03/07 |

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

Equipment requiring calibration is calibrated periodically by the manufacturer or according to manufacturer's specifications. Additionally all equipment is verified for proper performance on a regular basis using in house standards or comparisons.

2.5 Measurement Uncertainty

The estimated combined standard uncertainty for radiated emissions and conducted emissions measurements are $\pm 3\text{dB}$.

Table 3: Emission Measurement Uncertainty

| Parameter | Uncertainty |
|--|----------------------------------|
| RF power, conducted | $\pm 1.5 \text{ dB}$ |
| Adjacent channel power | $\pm 3 \text{ dB}$ |
| Radiated emission of transmitter, valid up to 26 GHz | $\pm 6 \text{ dB}$ |
| Radiated emission of receiver, valid up to 26 GHz | $\pm 6 \text{ dB}$ |
| Temperature | $\pm 2 \text{ }^{\circ}\text{C}$ |
| Humidity | $\pm 10 \text{ \%}$ |

3. General Product Information

3.1 Product Function and Intended Use

The EUT is a LoRa Module, it contains a 902MHz - 928MHz Wireless compatible module enabling the user to communicate data through a Wireless interface.
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 | LRM001 |
| Type Designation | LRM001-915 |
| FCC ID | 2ALXW-LRM001915010 |

Table 5: Technical Specification of EUT

| Technical Specification | Value |
|-------------------------|---|
| Operating Frequencies | 903 MHz - 914.2MHz 923.3MHz - 927.5 MHz |
| Channel Spacing | 903 MHz - 914.2MHz : 1.6M 923.3MHz - 927.5 MHz: 0.6M |
| Channel number | 903 MHz - 914.2MHz : 8 923.3MHz - 927.5 MHz: 8 |
| Operation Voltage | 5Vdc |
| Modulation | LoRa |
| Antenna gain | 2 dBi |

3.3 Independent Operation Modes

Basic operation modes are:

- A. Transmitting
 - 1. Low channel
 - 2. Middle channel
 - 3. High channel
- B. Receiving
- C. Standby
- D. Off

3.4 Noise Generating and Noise Suppressing Parts

Refer to the Circuit Diagram.

3.5 Submitted Documents

- | | |
|-------------------------|----------------------|
| - Bill of Material | - Circuit Diagram |
| - PCB Layout | - Instruction Manual |
| - Photo Document | - Rating Label |
| - Technical Description | |

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

Setup for testing: Test samples are provided with a USB interface which makes it possible to control them through a test software installed on a notebook computer.

This software was running on the laptop computer connected to the EUT. It was used to enable the operation modes listed in section 3.3 as appropriate.

The samples were used as follows:

Conducted: A000467270 001

Radiation: A000467270 001

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:

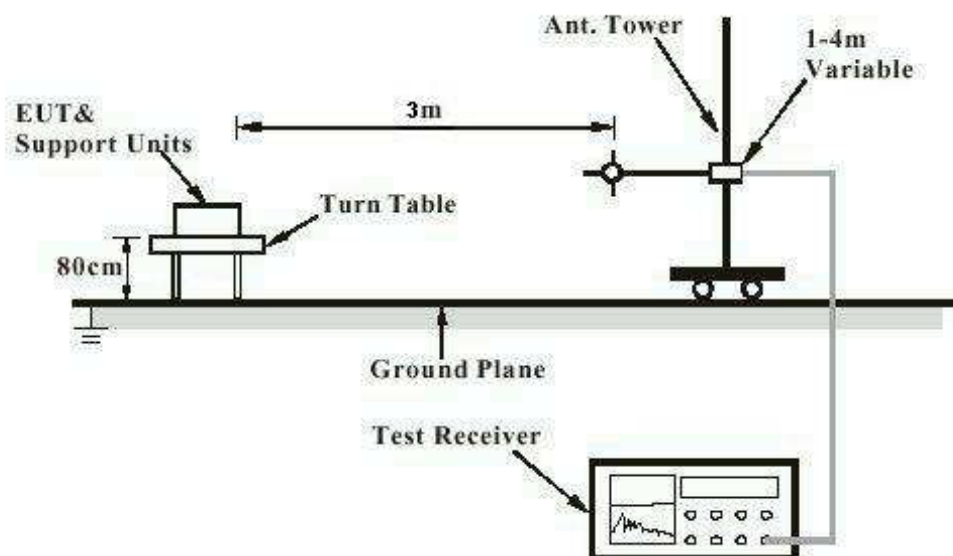
| Description | Manufacturer | Model No. | Serial No. |
|------------------|--------------|-----------|------------|
| Notebook(EMC-06) | Lenovo | TP00048A | PB-0F8B2 |

4.4 Countermeasures to achieve EMC Compliance

The test sample which has been tested contained the noise suppression parts as described in the Constructional Data Form or the Technical Construction File. 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.

Diagram of Measurement Equipment Configuration for Mains Conduction Measurement (if applicable)

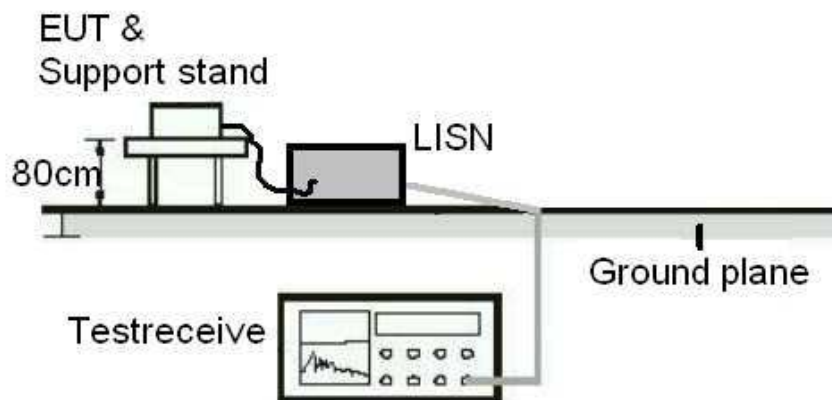
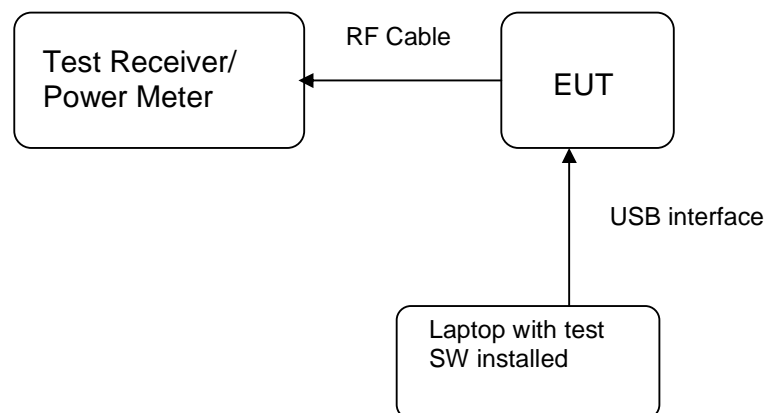


Diagram of Measurement Equipment Configuration for Conducted Transmitter Measurement



5. Test Results

5.1 Transmitter Requirement & Test Suites

5.1.1 Antenna Requirement

RESULT:**Passed**

| | | |
|---------------|---|---|
| Test standard | : | FCC Part 15.247(b)(4), Part 15.203 and RSS-Gen 8.3 |
| Limit | : | the use of antennas with directional gains that do not exceed 6 dBi |

According to the manufacturer declaration, the EUT has an antenna with a directional gain of 2 dBi . The antenna is a dipole antenna with no possibility of replacement with a non-approved antenna by the end-user. Therefore, the EUT is considered to comply with this provision.

Refer to EUT photo for details.

5.1.2 Peak Output Power

RESULT:
Passed

Test standard : FCC Part 15.247(b)(3), RSS-247 5.4(4)
 Basic standard : ANSI C63.10:2009, KDB558074
 Limit : 1 Watt
 Kind of test site : Shielded room

Test setup

Test Channel : Low/ Middle/ High
 Operation Mode : A

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

Table 6: Test result of Peak Output Power (903 MHz - 914.2MHz)

| Channel | Channel Frequency (MHz) | Output Power | | Limit |
|----------------|-------------------------|--------------|---------|-------|
| | | (dBm) | (W) | (W) |
| Low Channel | 903.0 | 7.50 | 0.00562 | 1 |
| Middle Channel | 907.8 | 7.48 | 0.00559 | 1 |
| High Channel | 914.2 | 7.38 | 0.00547 | 1 |

Table 7: Test result of Peak Output Power (923.3MHz - 927.5 MHz)

| Channel | Channel Frequency (MHz) | Output Power | | Limit |
|----------------|-------------------------|--------------|---------|-------|
| | | (dBm) | (W) | (W) |
| Low Channel | 923.3 | 7.20 | 0.00525 | 1 |
| Middle Channel | 925.1 | 7.17 | 0.00521 | 1 |
| High Channel | 927.5 | 7.15 | 0.00519 | 1 |

Max Value: 5.62mw

5.1.3 6dB Bandwidth and 99% Bandwidth**RESULT:****Passed**

Test standard : FCC Part 15.247(a)(2), RSS-247 5.2(1)
Basic standard : ANSI C63.10:2009, KDB558074
Kind of test site : Shielded room

Test setup

Test Channel : Low/ Middle/ High
Operation Mode : A

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

Table 8: Test result of 6dB Bandwidth (903 MHz - 914.2MHz)

| Channel | Channel Frequency (MHz) | 6dB Bandwidth (MHz) | Limit (MHz) | Result |
|--------------|-------------------------|---------------------|-------------|--------|
| Low Channel | 903.0 | 0.7422 | 0.5 | Pass |
| Mid Channel | 907.8 | 0.7631 | 0.5 | Pass |
| High Channel | 914.2 | 0.7536 | 0.5 | Pass |

Table 9: Test result of 6dB Bandwidth (923.3MHz - 927.5 MHz)

| Channel | Channel Frequency (MHz) | 6dB Bandwidth (MHz) | Limit (MHz) | Result |
|--------------|-------------------------|---------------------|-------------|--------|
| Low Channel | 923.3 | 0.7653 | 0.5 | Pass |
| Mid Channel | 925.1 | 0.7624 | 0.5 | Pass |
| High Channel | 927.5 | 0.7617 | 0.5 | Pass |

Table 10: Test result of 99% Bandwidth (903 MHz - 914.2MHz)

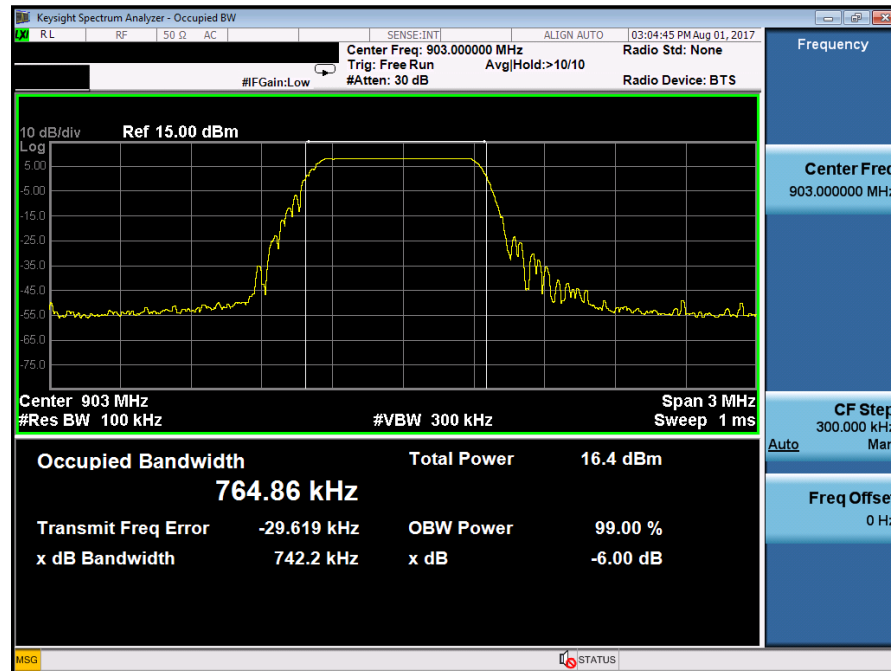
| Channel | Channel Frequency (MHz) | 99% Bandwidth (MHz) |
|--------------|-------------------------|---------------------|
| Low Channel | 903.0 | 0.64090 |
| Mid Channel | 907.8 | 0.63793 |
| High Channel | 914.2 | 0.64160 |

Table 11: Test result of 99% Bandwidth (923.3MHz - 927.5 MHz)

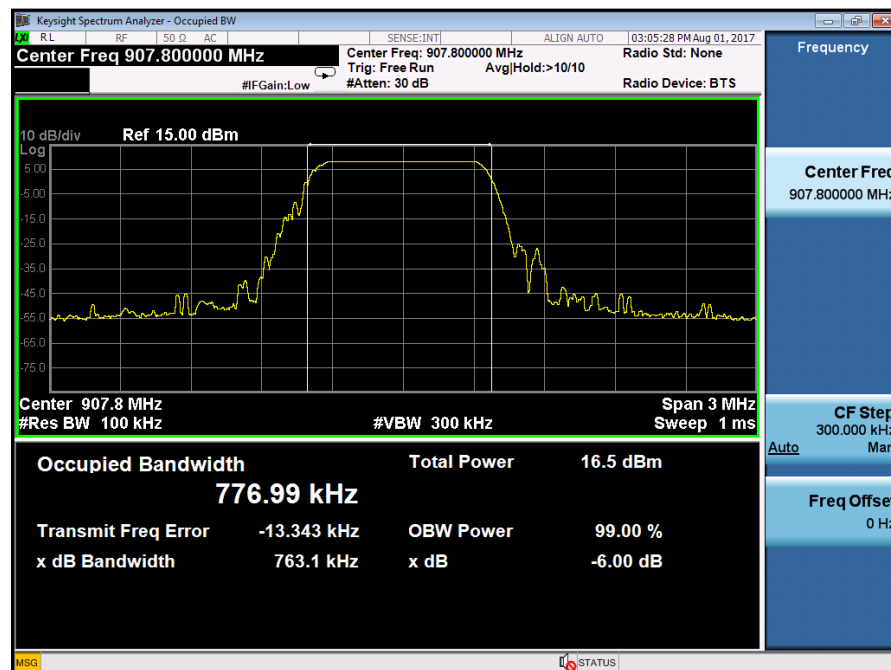
| Channel | Channel Frequency (MHz) | 99% Bandwidth (MHz) |
|--------------|-------------------------|---------------------|
| Low Channel | 923.3 | 0.62684 |
| Mid Channel | 925.1 | 0.61886 |
| High Channel | 927.5 | 0.65338 |

Test Plot of 6dB Bandwidth (903 MHz - 914.2MHz)

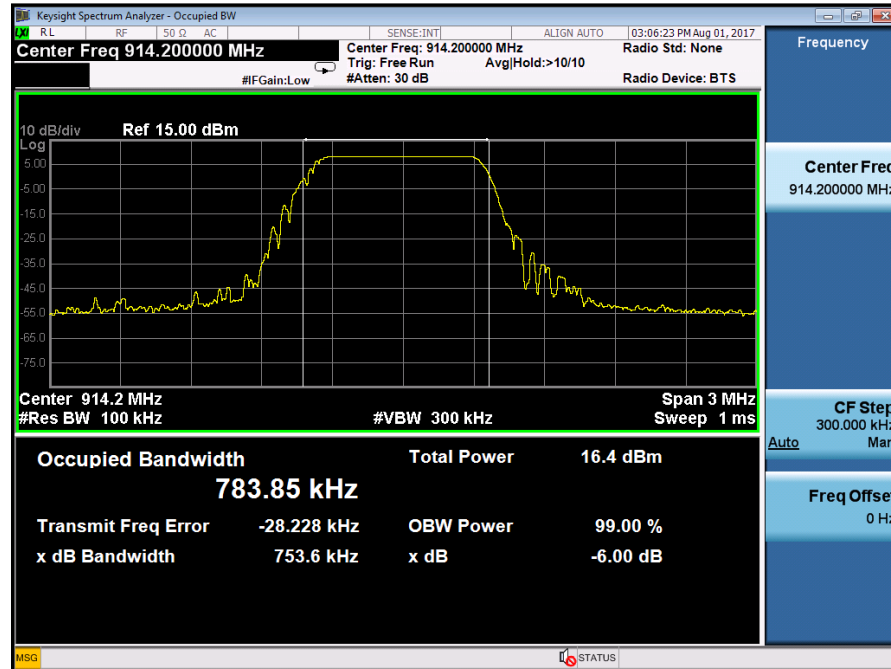
Low Channel



Middle Channel

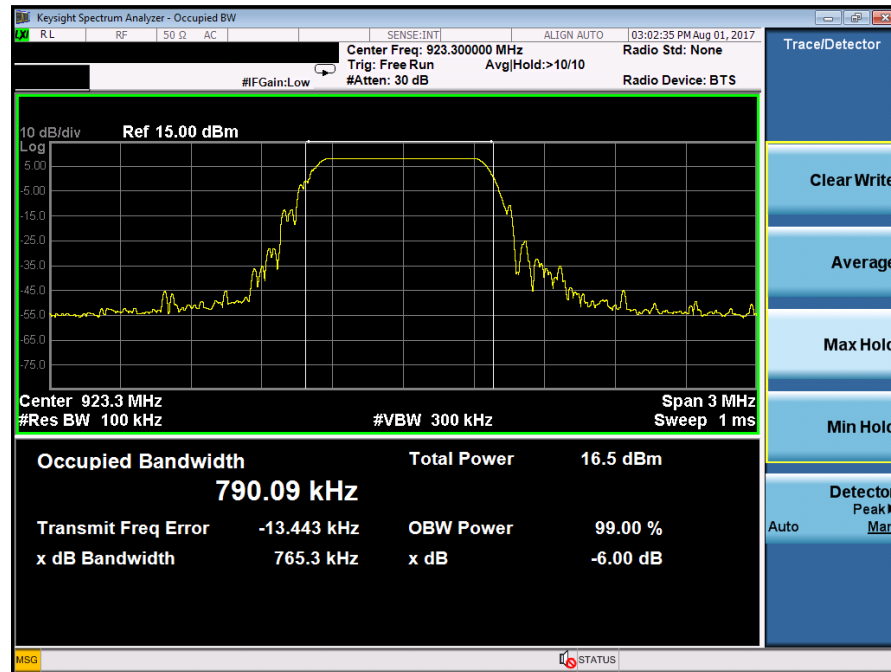


High Channel

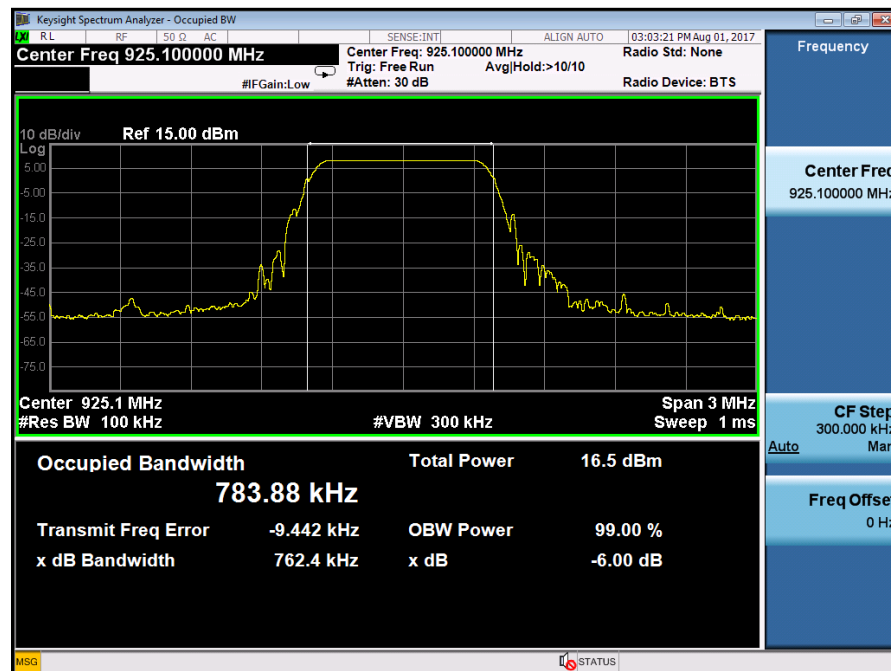


Test Plot of 6dB Bandwidth (923.3MHz - 927.5 MHz)

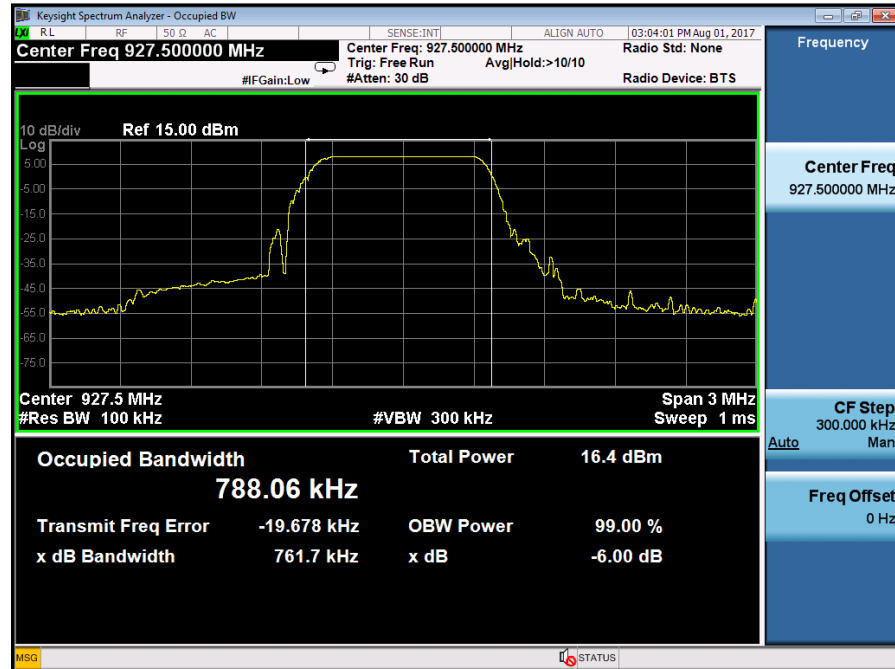
Low Channel



Middle Channel

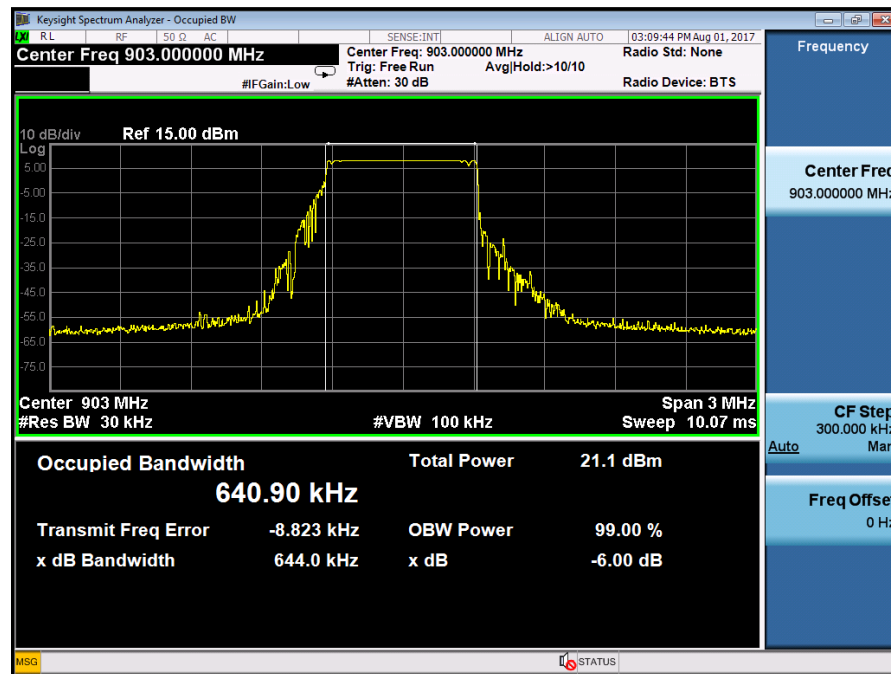


High Channel

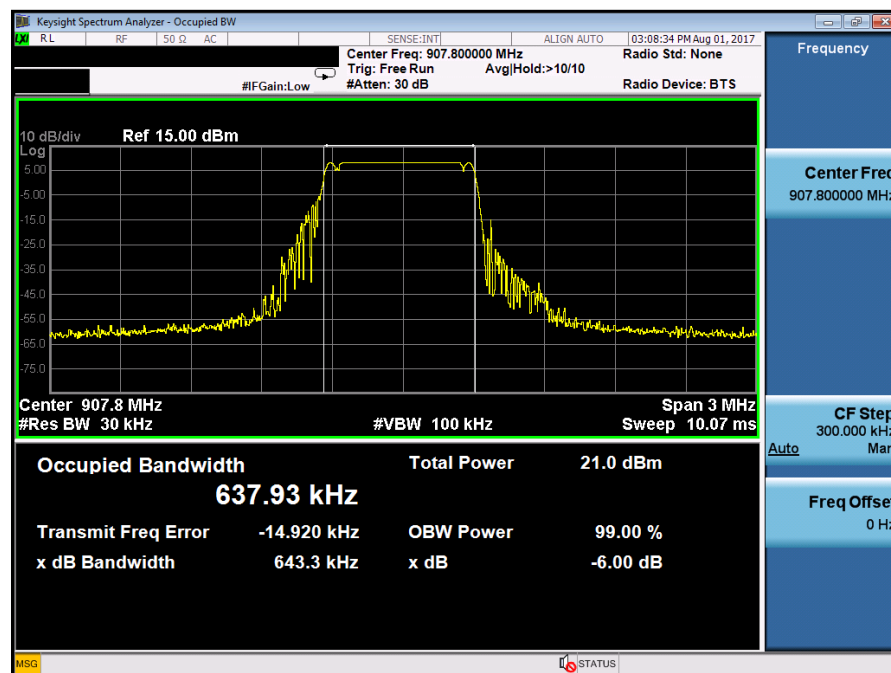


Test Plot of 99% Bandwidth (903 MHz - 914.2MHz)

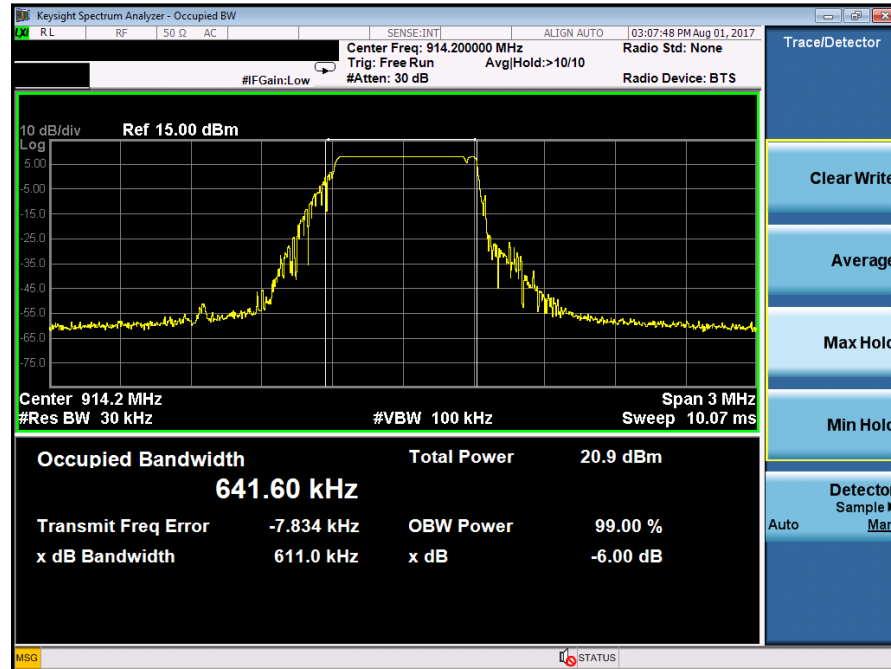
Low Channel



Middle Channel

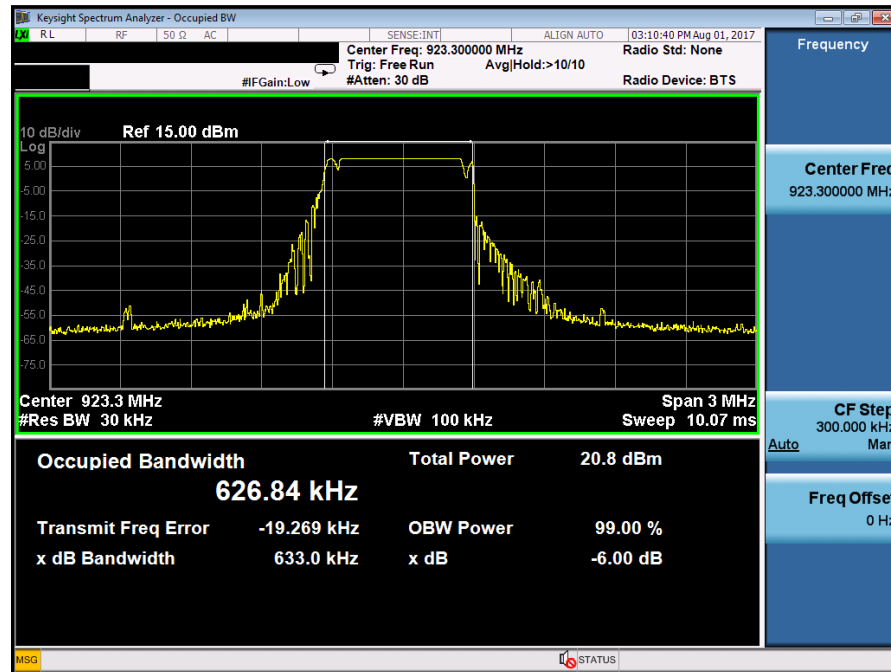


High Channel

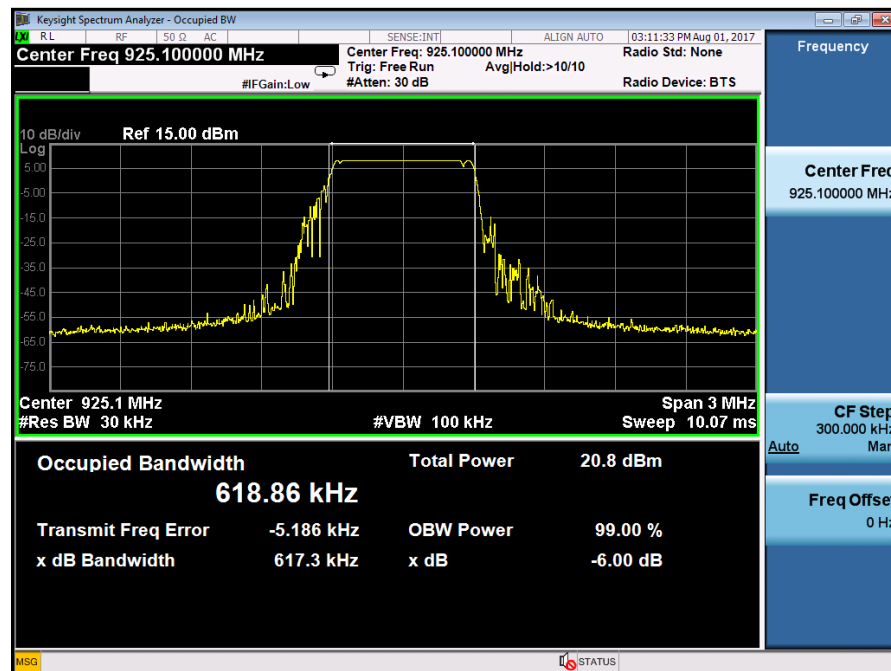


Test Plot of 99% Bandwidth (923.3MHz - 927.5 MHz)

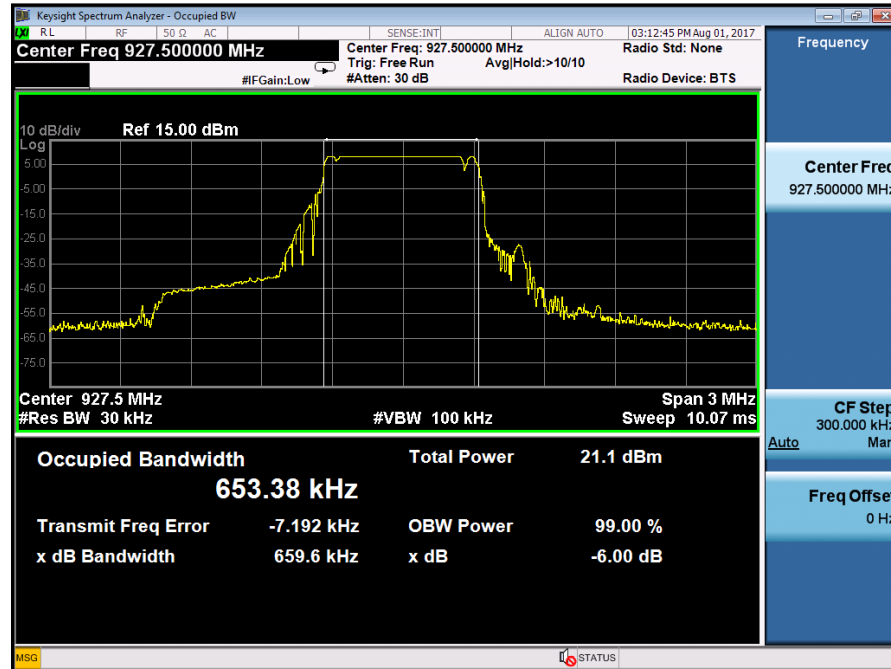
Low Channel



Middle Channel



High Channel



5.1.4 Power Density

RESULT:

Passed

Test standard : FCC Part 15.247(e) , RSS-247 5.2(2)
 Basic standard : ANSI C63.10:2009, KDB558074
 Kind of test site : Shielded room

Test setup

Test Channel : Low/ Middle/ High
 Operation Mode : A
 Ambient temperature : 22-26°C
 Relative humidity : 50-65%
 Atmospheric pressure : 100-103 kPa

Table 12: Test result of Power Density (903 MHz - 914.2MHz)

| Channel | Channel Frequency (MHz) | Power Density | Limit |
|----------------|-------------------------|---------------|-------|
| | | (dBm) | (dBm) |
| Low Channel | 903.0 | 4.244 | 8 |
| Middle Channel | 907.8 | 4.410 | 8 |
| High Channel | 914.2 | 3.650 | 8 |

Table 13: Test result of Power Density (923.3MHz - 927.5 MHz)

| Channel | Channel Frequency (MHz) | Power Density | Limit |
|----------------|-------------------------|---------------|-------|
| | | (dBm) | (dBm) |
| Low Channel | 923.3 | 3.55 | 8 |
| Middle Channel | 925.1 | 3.88 | 8 |
| High Channel | 927.5 | 3.51 | 8 |

Test Plot of Power Density (903 MHz - 914.2MHz)

Low Channel



Middle Channel





Test Plot of Power Density (923.3MHz - 927.5 MHz)

Low Channel



Middle Channel



High Channel



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 |
| Basic standard | : | ANSI C63.10:2009, KDB558074 |
| Limit | : | 20dB (below that in the 100kHz bandwidth within the band that contains the highest level of the desired power) |
| Kind of test site | : | Shielded room |

Test setup

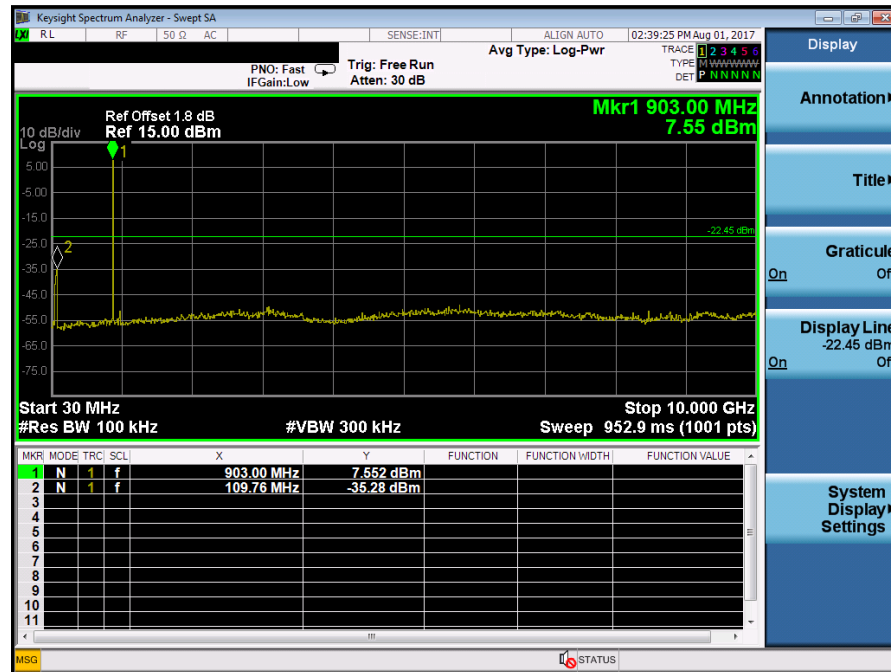
| | | |
|----------------------|---|-------------|
| Test Channel | : | Low/ High |
| Operation mode | : | A |
| Ambient temperature | : | 22-26°C |
| Relative humidity | : | 50-65% |
| Atmospheric pressure | : | 100-103 kPa |

All emissions are more than 30dB below fundamental, details refer to following test plot, and compliance is achieved as well.

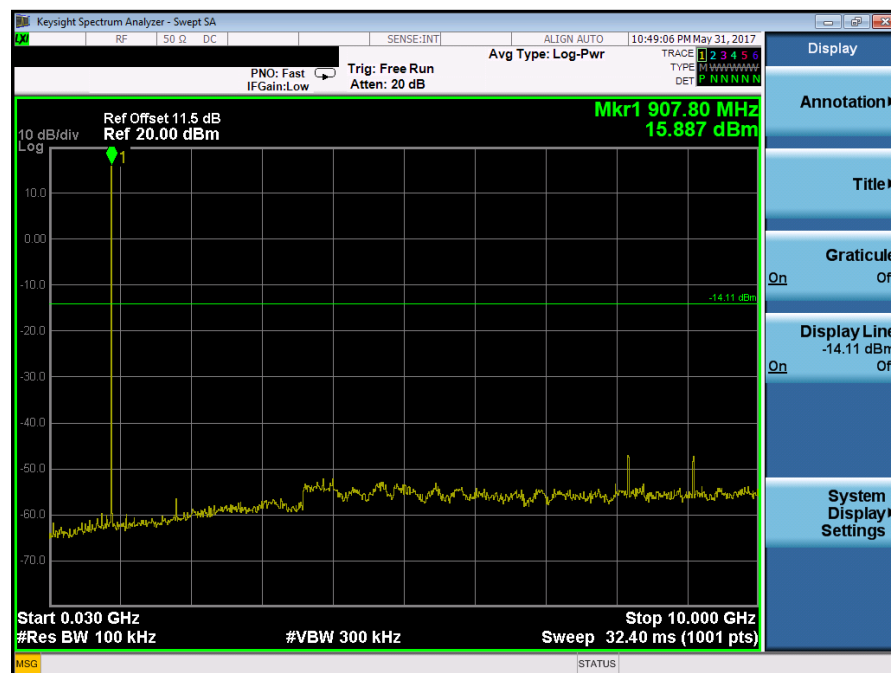
Due to the small size of the product and that there are no inductive components of significant size, 9kHz to 30MHz frequency range is not tested based on technical judgment.

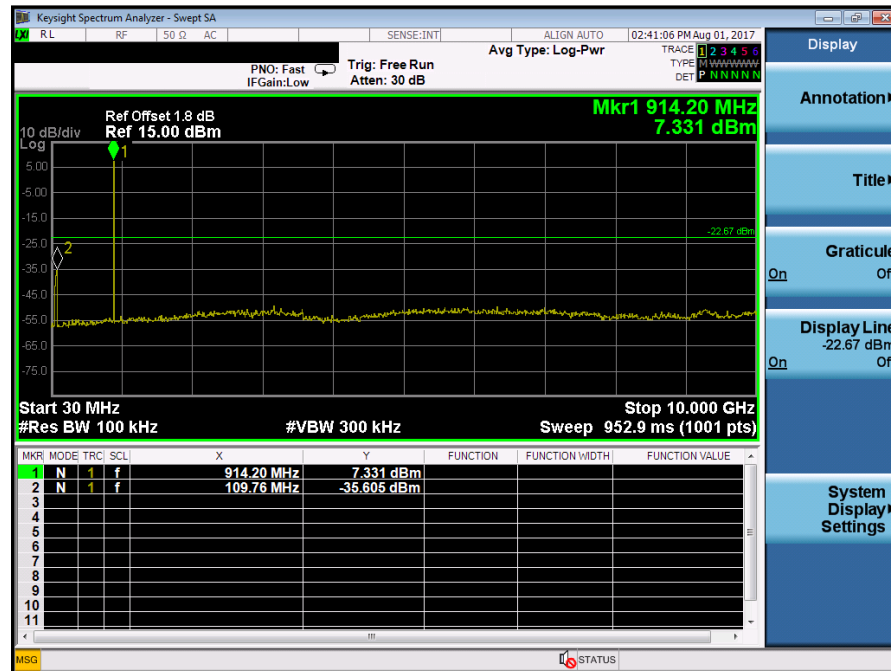
Test Plot 100kHz Conducted Emissions (903 MHz - 914.2MHz)

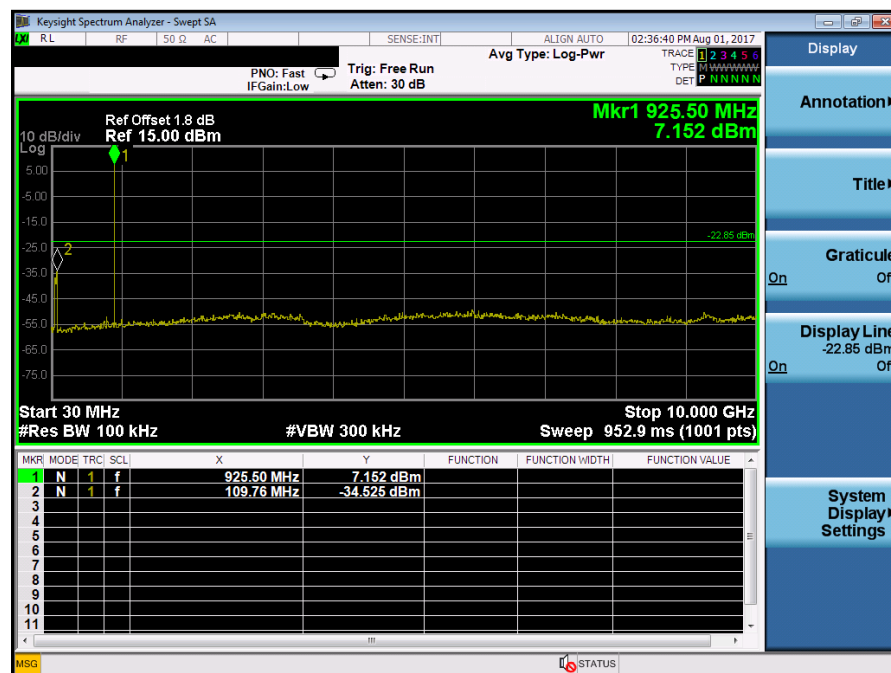
Low Channel

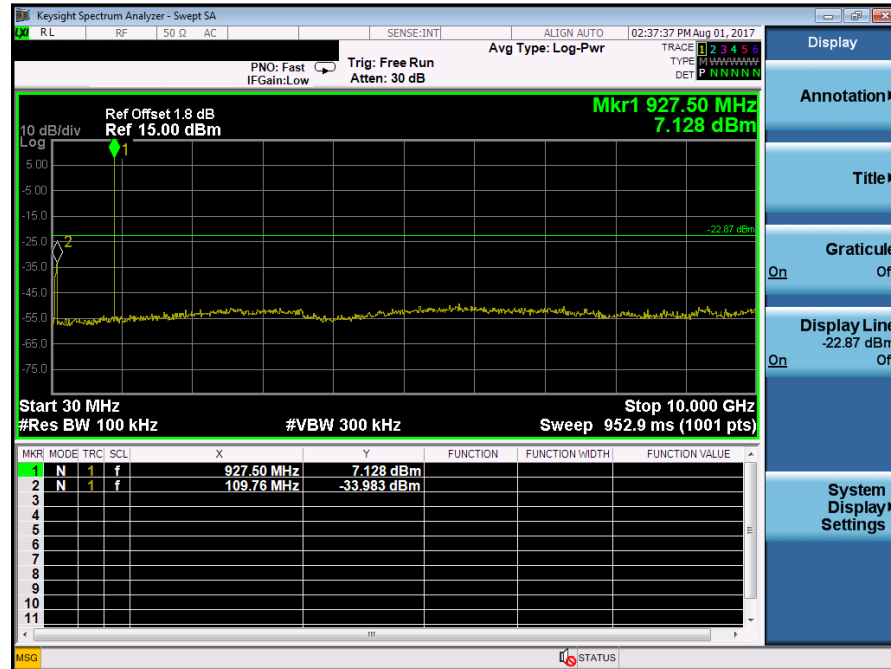


Middle Channel



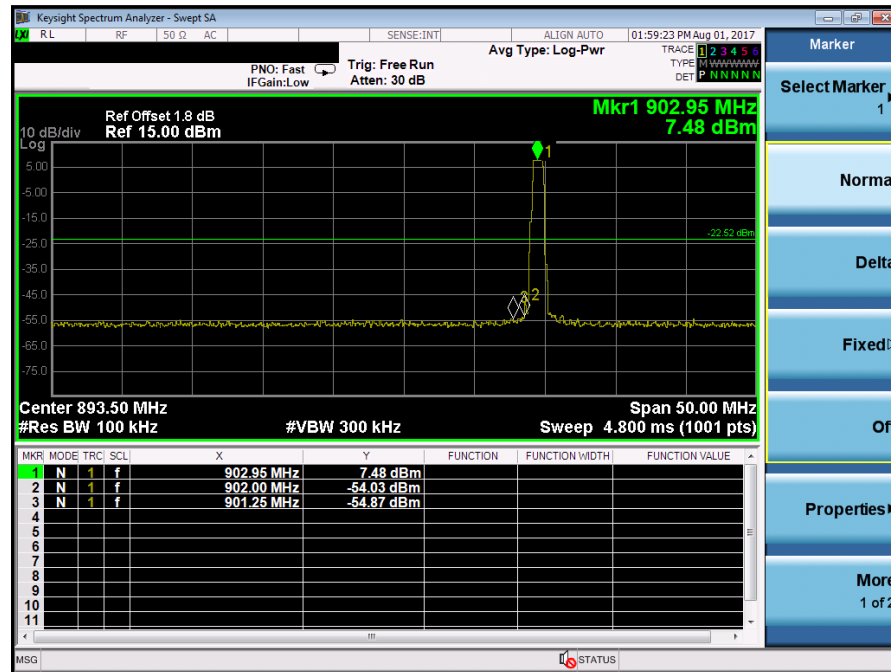




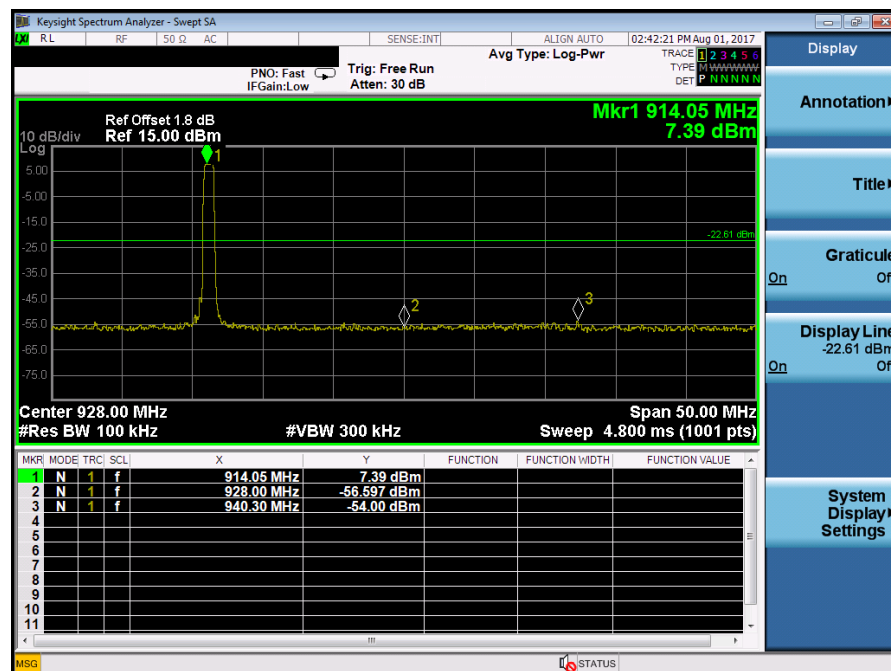


Test Plot 100kHz RBW of Band Edge (903 MHz - 914.2MHz)

Low Channel

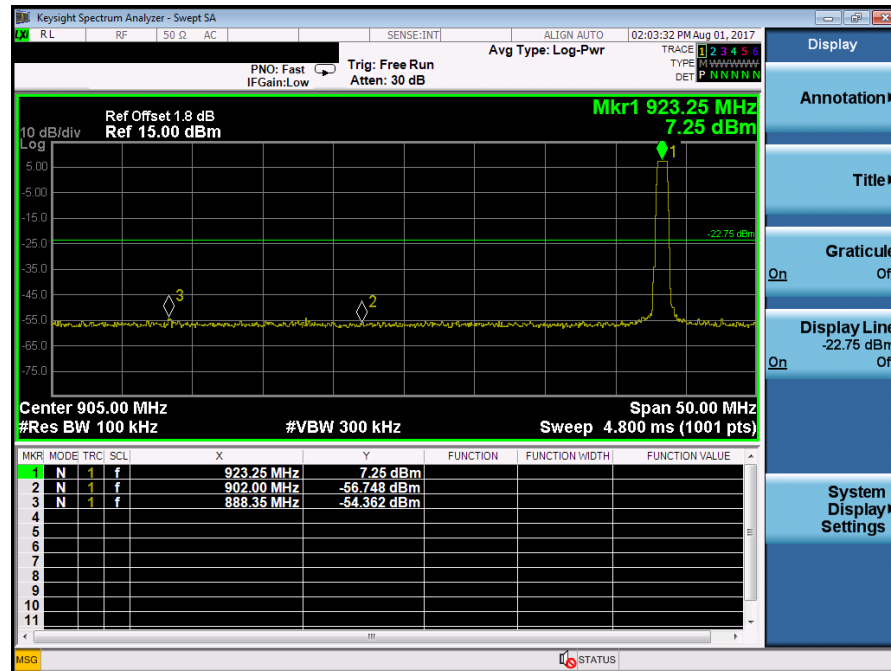


High Channel

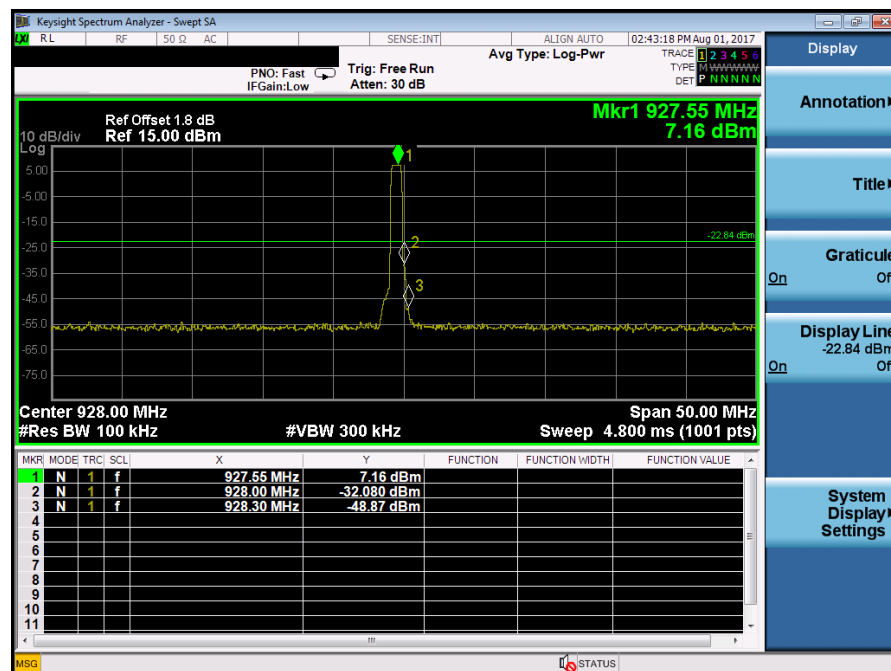


Test Plot 100kHz RBW of Band Edge (923.3MHz - 927.5 MHz)

Low Channel



High Channel



5.1.6 Spurious Emission

RESULT:**Passed**

| | | |
|-------------------|---|--|
| Test standard | : | FCC part 15.247(d), FCC 15.205, FCC 15.209, RSS-210 2.2, RSS-247 5.5 and RSS-Gen 8.9 |
| Basic standard | : | ANSI C63.10: 2009 |
| Limits | : | Radiated emissions which fall in the restricted bands, 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). Radiated emissions which fall in the restricted bands, as defined in LP0002(2016): 2.7 , must comply with the radiated emission limits specified in LP0002(2016): 2.8 Emission radiated outside the specified frequency bands must comply with the radiated emission limits specified in FCC 15.209(a) and FCC 15.249(a), RSS-Gen i4, 8.9 (Table 4 and 5) and RSS-210 A2.9(a). Emission radiated outside the specified frequency bands must comply with the radiated emission limits specified in LP0002(2016): 2.8 |
| Kind of test site | : | 3m Semi-Anechoic Chamber |

Test setup

| | | |
|----------------|---|-------------------|
| Test Channel | : | Low/ Middle/ High |
| Operation mode | : | A, B |

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 X Axis orientation is the worst-case and recorded in this test report. 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.

5.2 Mains Emissions

5.2.1 Mains Conducted Emissions

RESULT:**Passed**

| | | |
|-------------------|---|--|
| Test standard | : | FCC Part 15.207 FCC Part 15.107 RSS-Gen 8.8 |
| Limits | : | Mains Conducted emissions as defined in above standards |
| Kind of test site | : | Shielded Room |

Test setup

| | | |
|----------------|---|--------|
| Test Channel | : | Middle |
| Operation mode | : | A |

Remark: For details refer to Appendix D.

6. Safety Human exposure

6.1 Radio Frequency Exposure Compliance

6.1.1 Electromagnetic Fields

RESULT:**Passed**

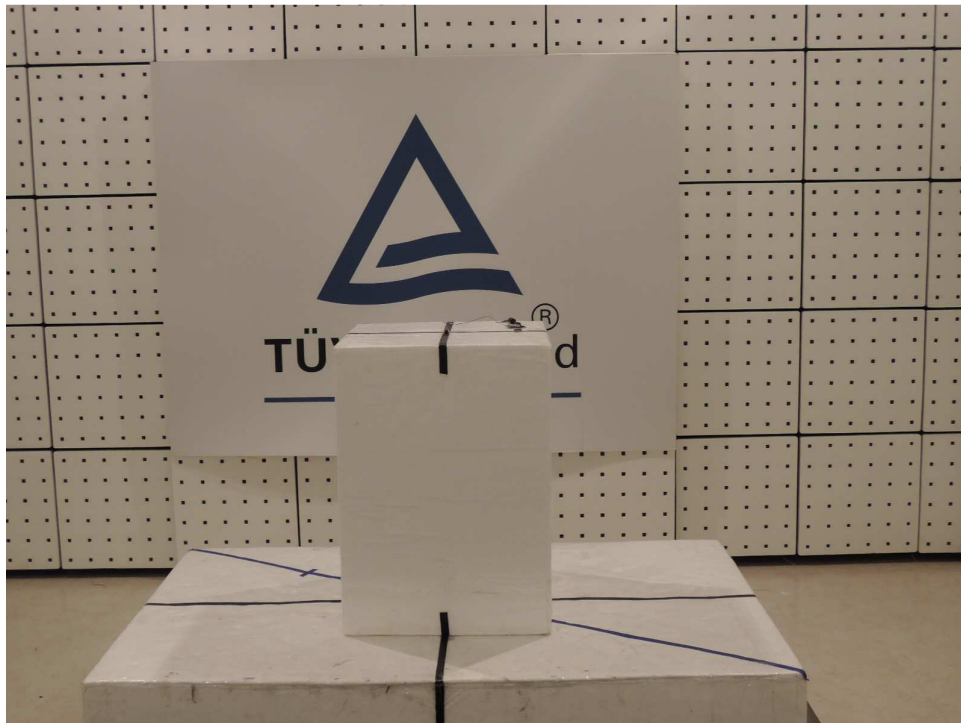
Test standard : FCC KDB Publication 447498 D01 v06
RSS--102

FCC:

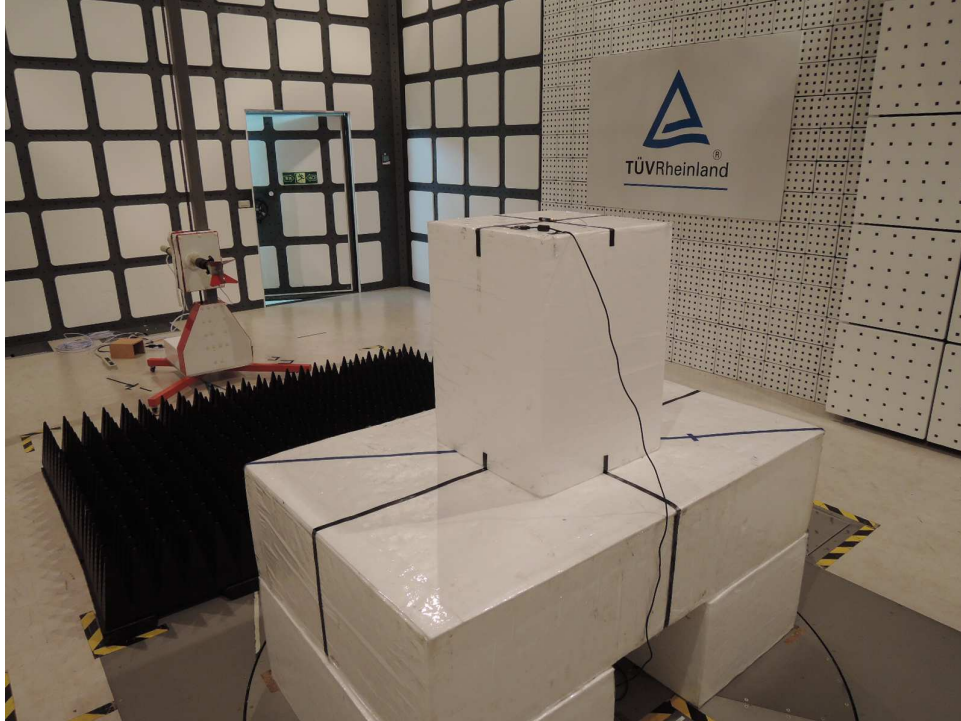
Since maximum peak output power of the transmitter is 5.62 mW < 10mW, hence the EUT is excluded from SAR evaluation according to FCC KDB publication 447498 D01 v05: Mobile Portable RF Exposure

Photographs of the Test Set-Up

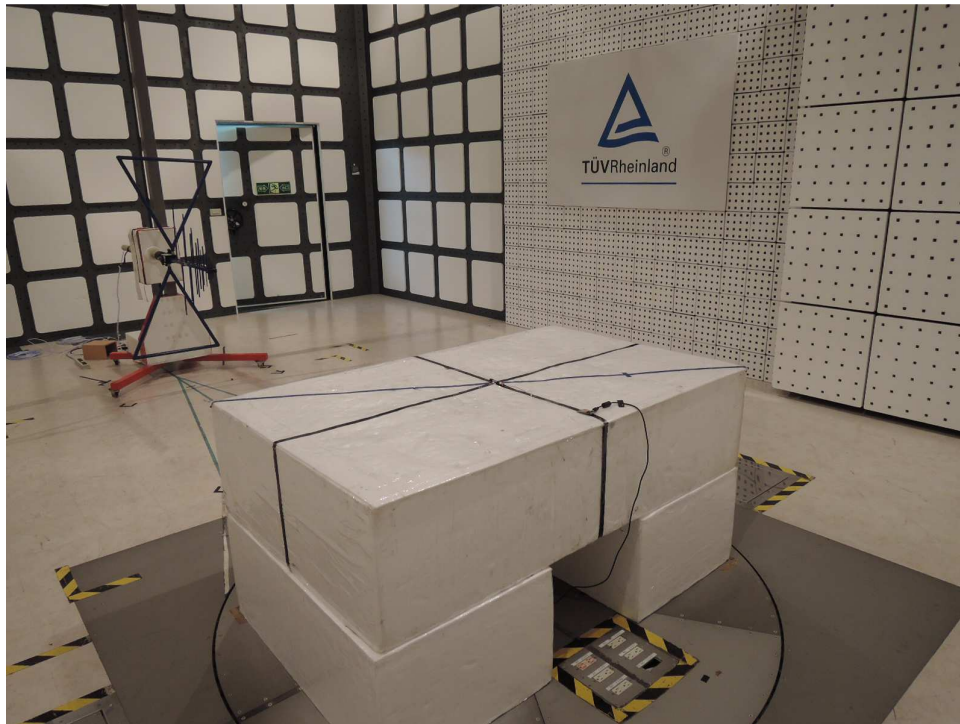
Photograph 1: Set-up for Spurious Emissions (Front View)



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



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



Photograph 4: Set-up for Conducted testing



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



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



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