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|---|--|--------------------------------------|--------------------|---------------------------------------|
| Prüfbericht-Nr.: Test Report No.: | 50223939 001 | Auftrags-Nr.: Order No.: | 114085340 | Seite 1 von 37 Page 1 of 37 |
| Kunden-Referenz-Nr.: Client Reference No.: | N/A | Auftragsdatum: Order date: | 28-Dec-2018 | |
| Auftraggeber: Client: | AAEON Technology Inc. 5F, No. 135, Lane 235, Pao Chiao Rd., Hsin-Tien Dist., New Taipei City 23145, Taiwan, R.O.C | | | |
| Prüfgegenstand: Test item: | LoRa Long Range Node System | | | |
| Bezeichnung / Typ-Nr.: Identification / Type No.: | xAIOT-ILND02x ; (x - Where x may be any combination of alphanumeric characters or "-" or blank for marketing purpose.) | | | |
| Auftrags-Inhalt: Order content: | EN 300 220 Test Report | | | |
| Prüfgrundlage: Test specification: | EN 300 220-1 V3.1.1 EN 300 220-2 V3.1.1 | | | |
| Wareneingangsdatum: Date of receipt: | 04-Jan-2019 | | | |
| Prüfmuster-Nr.: Test sample No.: | A000862828-001, 002 | | | |
| Prüfzeitraum: Testing period: | 29-Jan-2019 - 31-Jan-2019 | | | |
| Ort der Prüfung: Place of testing: | EMC/RF Laboratory Taipei | | | |
| Prüflaboratorium: Testing laboratory: | TUV Rheinland Taiwan Ltd. | | | |
| Prüfergebnis*: Test result*: | Pass | | | |



| | | | | | |
|--|---|----------------------------------|--|---|----------------------------------|
| geprüft von / tested by: <i>Jack Chang</i> | | | kontrolliert von / reviewed by: <i>Ryan Chen</i> | | |
| 11-Feb-2019 Jack Chang / Project Manager | | | 11-Feb-2019 Ryan Chen / Project Manager | | |
| Datum Date | Name / Stellung Name / Position | Unterschrift Signature | Datum Date | Name / Stellung Name / Position | Unterschrift Signature |
| Sonstiges / Other: | | | | | |
| Zustand des Prüfgegenstandes bei Anlieferung: Condition of the test item at delivery: | | | Prüfmuster vollständig und unbeschädigt Test item complete and undamaged | | |
| <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. 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.</p> | | | | | |

TEST SUMMARY

5.1.1 FREQUENCY ERROR*RESULT: Pass***5.1.2 EFFECTIVE RADIATED POWER (CONDUCTED)***RESULT: Passed***5.1.3 OCCUPIED BANDWIDTH***RESULT: Passed***5.1.4 OUT OF BAND EMISSIONS***RESULT: Passed***5.1.5 UNWANTED EMISSIONS IN THE TX SPURIOUS DOMAIN***RESULT: Passed***5.1.6 TRANSIENT POWER***RESULT: Passed***5.1.7 DUTY CYCLE***RESULT: Passed***5.1.8 ADJACENT CHANNEL POWER***RESULT: N/A***5.1.9 ADAPTIVE POWER CONTROL***RESULT: N/A***5.1.10 SHORT TERM BEHAVIOR***RESULT: N/A**Non-applicable. The EUT operation band is out of specified in annex C, table C.1 and NRI.***5.2.1 RX SPURIOUS EMISSIONS***RESULT: Passed***5.2.2 RX SENSITIVITY LEVEL***RESULT: N/A***5.2.3 CLEAR CHANNEL ASSESSMENT THRESHOLD***RESULT: N/A***5.2.4 POLITE SPECTRUM ACCESS TIMING PARAMETERS***RESULT: N/A***5.2.5 ADAPTIVE FREQUENCY AGILITY***RESULT: N/A***5.2.6 BLOCKING***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 1: IUT Photos

(File Name: 50223939 001 AppendixP)

Appendix 2: Test Result of Radiated Emissions

(File Name: 50223939 001 AppendixD)

Table 1: Applied Standard and Test Levels

| Radio |
|----------------------|
| EN 300 220-1 V 3.1.1 |
| EN 300 220-2 V 3.1.1 |

1.2 Decision Rule of conformity

The decision rule of conformity of this test report is following the requirements of the requested standard in the quotation, and agreed among testing laboratory and manufacturer (applicant) to exclude the consideration of Measurement Uncertainty, unless it is required by the specific standard.

2. Test Sites

2.1 Test Laboratory

TUV Rheinland Taiwan Ltd.
Taipei Office

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

2.2 Test Facilities

TUV Rheinland Taiwan Ltd.
Taipei Office

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

2.3 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 | ESR 7 | 101062 | 2018/10/01 | 2019/10/01 |
| Spectrum Analyzer | R&S | FSV 40 | 100921 | 2018/05/02 | 2019/05/02 |
| EXA Signal Analyzer | KEYSIGHT | N9010A | MY52221334 | 2018/02/05 | 2019/02/05 |
| Preamplifier (30MHz -1GHz) | HP | 8447F | 2805A03335 | 2018/08/22 | 2019/08/22 |
| Pre-Amplifier (1GHz~18GHz) | EM Electronics | EM01G18G | 060649 | 2018/08/24 | 2019/08/24 |
| Bilog Antenna | TESEQ | CBL 6111D | 29802 | 2018/08/22 | 2019/08/22 |
| Horn Antenna | ETS-Lindgren | 3117 | 00138160 | 2018/06/01 | 2019/06/01 |
| Horn Antenna (18GHz~40GHz) | COM-POWER | AH-840 | 101031 | 2018/12/22 | 2019/12/22 |
| Loop Antenna | Schwarzbeck | FMZB 1513 | 1513-076 | 2018/06/21 | 2019/06/21 |
| Temp. & Humid. Chamber | Giant Force | GCT-099-40-S | MAF0103-007 | 2017/03/09 | 2019/03/09 |
| LISN (1 phase) | R&S | ENV216 | 101243 | 2018/06/18 | 2019/06/18 |
| LISN | R&S | ENV216 | 101262 | 2018/06/22 | 2019/06/22 |
| Test Software | Agilent | 300328 testsystem | V1.9.1 | N/A | N/A |
| Power sensor | Agilent | U2021XA | MY54020001 | 2018/03/31 | 2019/03/31 |

2.4 Uncertainty of Measurement

According to the requirement of clause 4.4 of EN 300 220-1 V3.1.1, the value of the measurement uncertainty of each parameter is listed as below:

Table 3: Measurement Uncertainty

| Parameter | Uncertainty |
|---|-------------|
| Radio frequency | ±0,5 ppm |
| RF power, conducted | ±1,5 dB |
| Conducted spurious emission of transmitter, valid up to 6 GHz | ±3 dB |
| Conducted emission of receivers | ±3 dB |
| Radiated emission of transmitter, valid up to 6 GHz | ±6 dB |
| Radiated emission of receiver, valid up to 6 GHz | ±6 dB |
| RF level uncertainty for a given BER | ±1,5 dB |
| Radiated emission of receiver, valid up to 26 GHz | ± 6 dB |
| Occupied BandWidth | ±5 % |
| Temperature | ±2,5 °C |
| Humidity | ±2,5 °C |

3. General Product Information

3.1 Product Function and Intended Use

The EUT is suitable for Sub-1GHz IEEE 802.15.4 and ISM applications. It contains a 868MHz compatible module enabling the user to communicate data through a Wireless interface. The Module has RF Shield and an RF output pad. The RF output is routed to external SMA connector in the host board.

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

3.2 Ratings and System Details

Table 4: Technical Specification of EUT

| Technical Specification | Value |
|---------------------------|--|
| Kind of Equipment | LoRa Long Range Node System |
| Operating Frequency | 868.1MHz, 868.3MHz, 868.5MHz |
| Number of Channels | 3 |
| Extreme Temperature Range | 0~60 °C |
| Operation Voltage | 5V |
| Modulation | PSK |
| Antenna Gain | External antenna(RFA-LORA-F17M3-B70-1): 2dBi |

3.3 Independent Operation Modes

Testing basic operation modes are:

- A. Transmitting
- B. Receiving
- C. Standby
- D. Normal
- E. Off

3.4 Noise Generating and Noise Suppressing Parts

Refer to the Circuit Diagram.

4. Test Set-up and Operation Modes

4.1 Principle of Configuration Selection

The equipment under test (EUT) were 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 and special Firmware which makes it possible to control them through a test software installed on a notebook computer.

This software(Performance analyzer) 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: A000862828-001, 002

Radiation(External Antenna RFA-LORA-F17M3-B70-1): A000862828-001

4.3 Special Accessories and Auxiliary Equipment

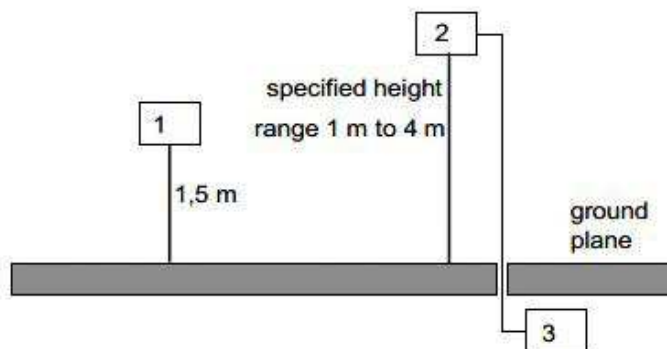
None.

4.4 Countermeasures to Achieve Compliance

The test sample which has been tested contained the noise suppression parts as can be seen in the Photo documentation. No additional measures were employed to achieve compliance.

4.5 Test Setup Diagram

Diagram of Measurement Configuration for Radiation Test



- 1) EUT
- 2) Measurement antenna
- 3) Measurement equipment

Diagram of Measurement Equipment Configuration for Conducted Transmitter Measurement

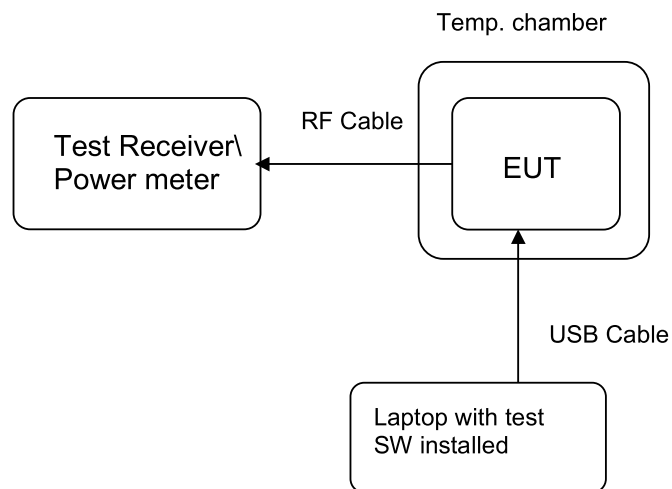
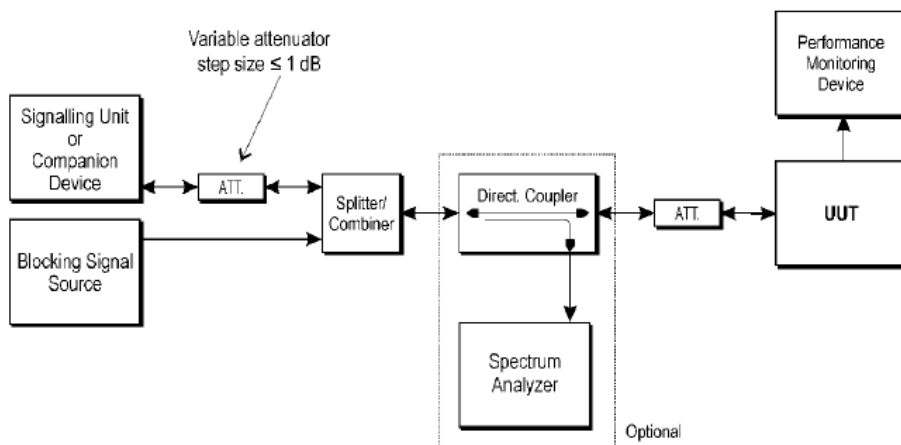


Diagram of Measurement Equipment Configuration for Conducted Receiver blocking Measurement



5. Test Results RADIO

5.1 Transmitter Requirement & Test Suites

5.1.1 Frequency error

RESULT:
Pass

Test procedure: EN 300 220-1 V3.1.1 clause 5.7

Test Setup

Date of testing : 29-Jan-2019
 Input Voltage : DC 5V
 Operation mode : A
 Ambient temperature : 20-24 °C
 Relative humidity : 40-50 %
 Atmospheric pressure : 100-103 kPa

Table 5: Test result of Frequency error

Low Channel

| TEST CONDITION | Channel | Measurement | Freq. Error | Limit |
|----------------|---------|-------------|-------------|-------|
| Temp. | MHz | MHz | ppm | ppm |
| 0 °C | 868.1 | 868.09993 | -0.08 | ±100 |
| 25 °C | 868.1 | 868.10011 | 0.12 | ±100 |
| 60 °C | 868.1 | 868.10039 | 0.45 | ±100 |

High Channel

| TEST CONDITION | Channel | Measurement | Freq. Error | Limit |
|----------------|---------|-------------|-------------|-------|
| Temp. | MHz | MHz | ppm | ppm |
| 0 °C | 868.5 | 868.49996 | -0.05 | ±100 |
| 25 °C | 868.5 | 868.50014 | 0.16 | ±100 |
| 60 °C | 868.5 | 868.50041 | 0.47 | ±100 |

5.1.2 Effective radiated power (Conducted)

RESULT:
Passed

Test procedure: EN 300 220-1 V3.1.1 clause 5.2.2.1

Test Setup

Date of testing : 29-Jan-2019
 Input Voltage : DC 5V
 Operation mode : A
 Ambient temperature : 20-24 °C
 Relative humidity : 40-50 %
 Atmospheric pressure : 100-103 kPa

Table 6: Test result of effective radiated power

| Antenna Assembly Gain (dBi): | | | | 2 |
|------------------------------|------------|-------------------------|-------|----------|
| Cable Loss= | | | | 10.71 |
| TEST CONDITIONS | | TRANSMITTER POWER (dBm) | | |
| | | 0 deg C | 25 | 60 deg C |
| Frequency | | 5V | | |
| 868.1MHz | Read Power | -1.41 | -1.49 | -1.69 |
| | e.r.p* | 9.15 | 9.07 | 8.87 |
| 868.3MHz | Read Power | -1.41 | -1.50 | -1.70 |
| | e.r.p* | 9.15 | 9.06 | 8.86 |
| 868.5MHz | Read Power | -1.41 | -1.50 | -1.70 |
| | e.r.p* | 9.15 | 9.06 | 8.86 |

*ERP= Reading Power+Antenna Gain+Path Loss-2.15

5.1.3 Occupied Bandwidth

RESULT:**Passed**

Test procedure: EN 300 220-1 V3.1.1 clause 5.6.3.4

Test Setup

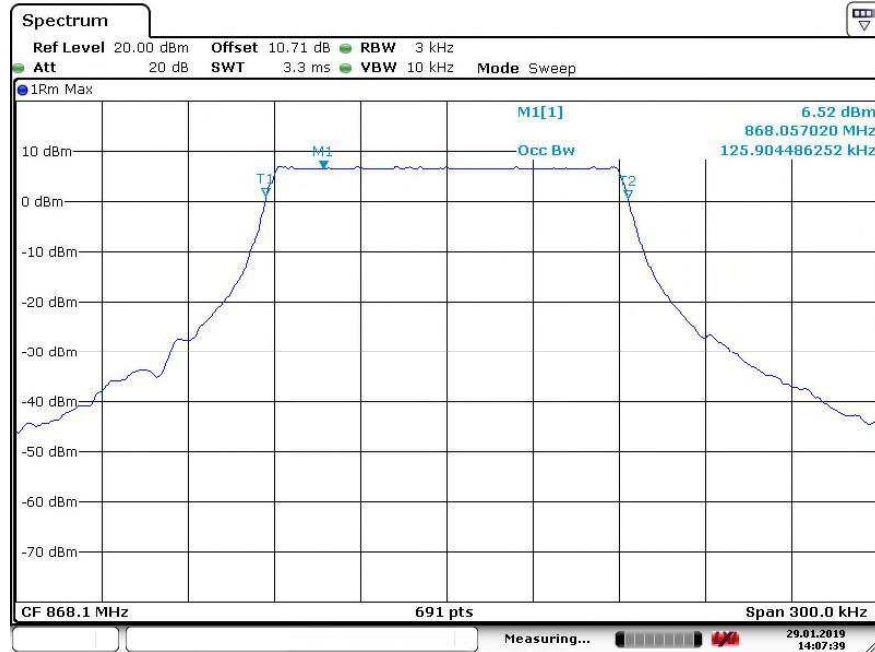
Input Voltage : DC 5V
Operation mode : A
Ambient temperature : 20-24 °C
Relative humidity : 40-50 %
Atmospheric pressure : 100-103 kPa

Table 7: Test result of Occupied Bandwidth

| Modulation | Channel Frequency (MHz) | 99% Bandwidth (KHz) |
|--------------|-------------------------|---------------------|
| Low Channel | 868.1 | 125.9 |
| High Channel | 868.5 | 125.9 |

Test Plot of Occupied Bandwidth, (Normal Temperature)

Low CH



Date: 29.JAN.2019 14:07:38

Test Plot of Occupied Bandwidth, (Normal Temperature)

High CH



Date: 29.JAN.2019 10:54:01

5.1.4 Out Of Band Emissions

RESULT:

Passed

Test procedure: EN 300 220-1 V3.1.1 clause 5.8.3.4

Test Setup

Input Voltage : DC 5V
Operation mode : A
Ambient temperature : 20-24 °C
Relative humidity : 40-50 %
Atmospheric pressure : 100-103 kPa

The test was done in the conducted setup and the defined IUT antenna gain is not included in the test result, due to the result is far from the limit so the technical judgment of the ERP value will still be under the limits.

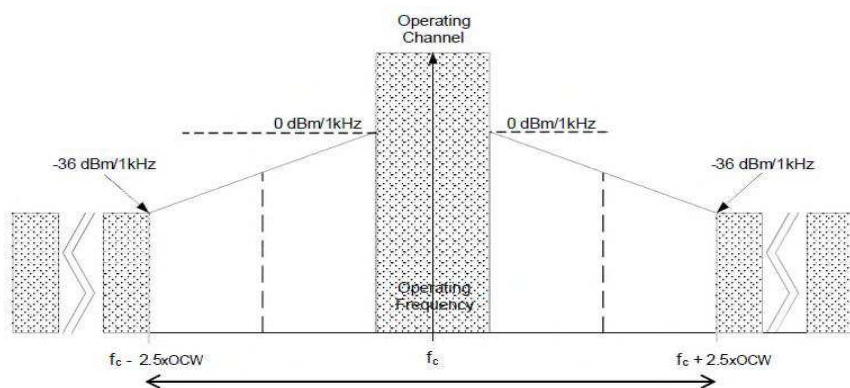


Figure 5: Out Of Band Domain for Operating Channel with reference BW

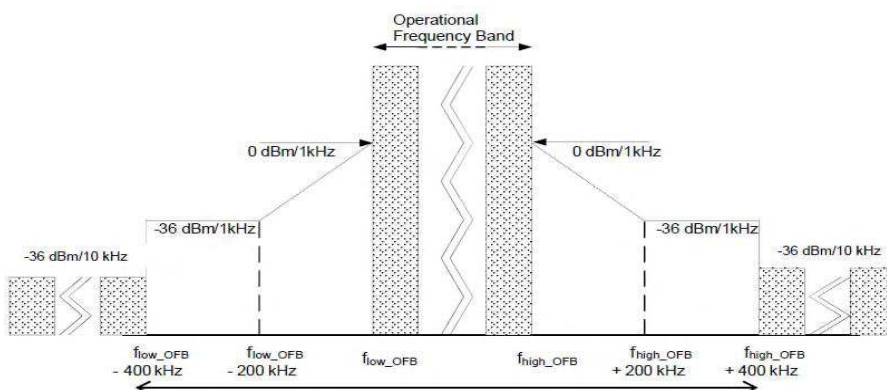
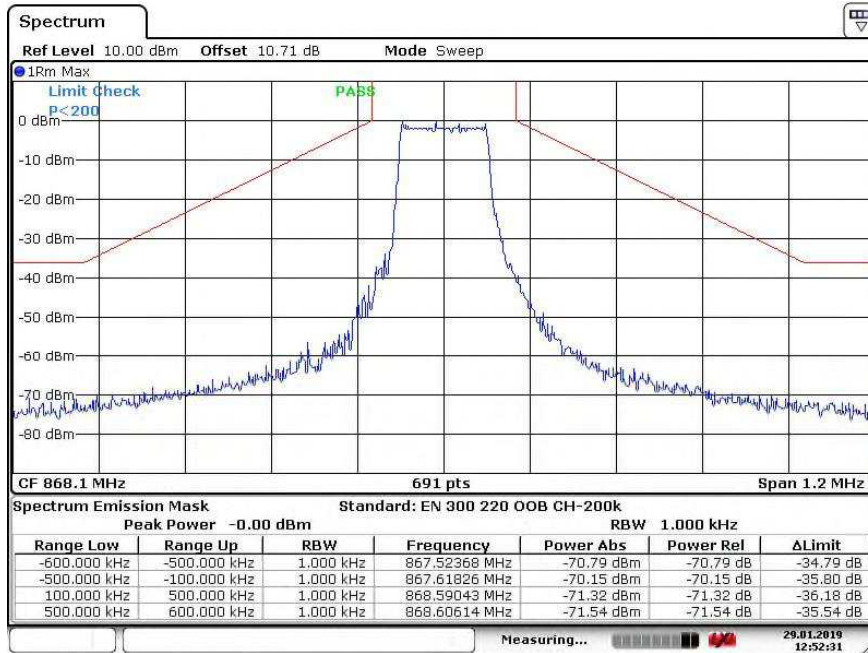


Figure 6: Out Of Band Domain for Operational Frequency Band with reference BW

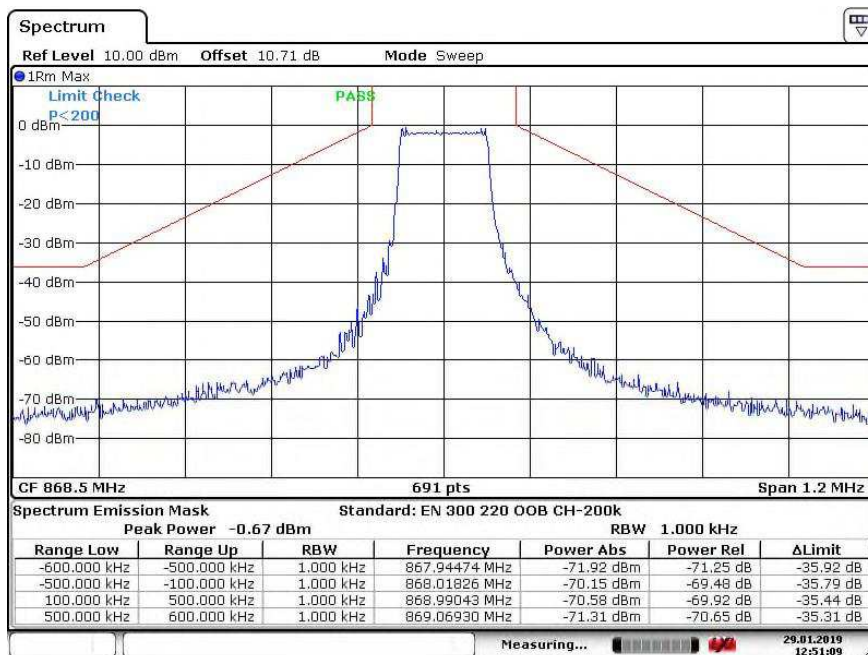
Test Plot of Operating Channel

Low CH



Date: 29. JAN. 2019 12:52:31

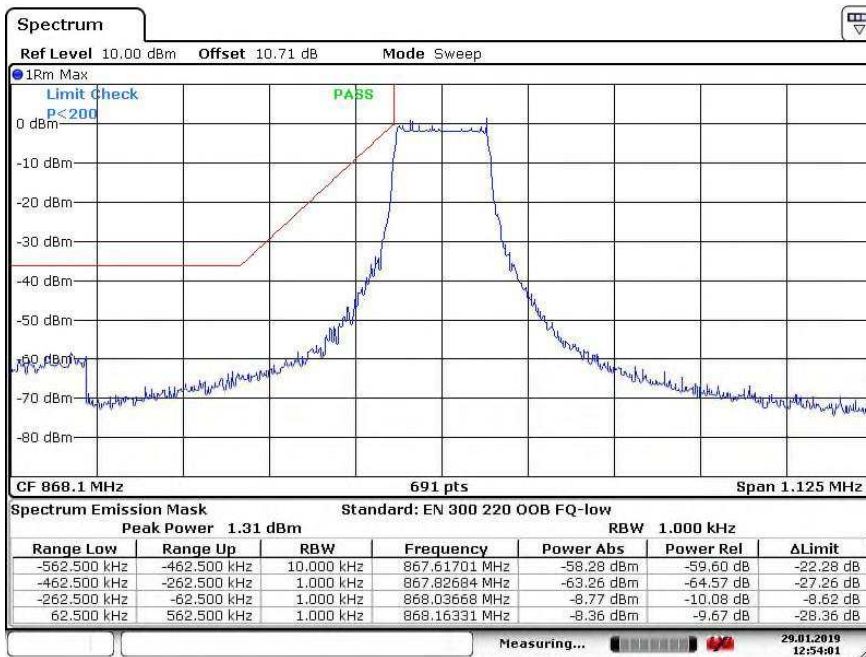
High CH



Date: 29. JAN. 2019 12:51:09

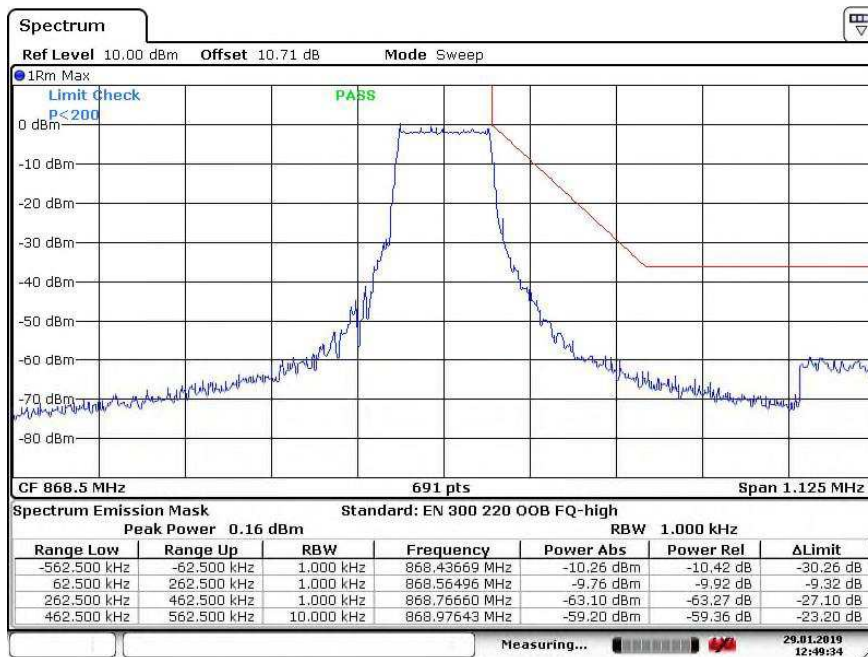
Test Plot of operational frequency band

Low CH



Date: 29. JAN 2019 12:54:01

High CH



Date: 29. JAN 2019 12:49:34

5.1.5 Unwanted emissions in the TX spurious domain

RESULT:**Passed**

Test procedure: EN 300 220-1 V3.1.1 clause 5.9.1.1

Test Setup

| | | |
|----------------------|---|-------------|
| Input Voltage | : | DC 5V |
| Operation mode | : | A |
| Ambient temperature | : | 20-24 °C |
| Relative humidity | : | 40-50 % |
| Atmospheric pressure | : | 100-103 kPa |

Please refer to Appendix D: Test result of Radiated Emissions

5.1.6 Transient power

RESULT:**Passed**

Test procedure: EN 300 220-1 V3.1.1 clause 5.10.3.2

Date of testing : 30-Jan-2019
Input Voltage : DC 5V
Operation mode : A
Ambient temperature : 20-24 °C
Relative humidity : 40-50 %
Atmospheric pressure : 100-103 kPa

Table 8: Test result of Transient power

| Test Freq. (MHz) | Reading dBm | Result dBm/kHz | Limit |
|---------------------|----------------|-------------------|---------|
| 867.997 | -41.72 | -41.72 | 0 dBm |
| 868.203 | -38.96 | -38.96 | 0 dBm |
| 868.3 | -47.5 | -62.7288 | 0 dBm |
| 867.9 | -48.84 | -64.0688 | 0 dBm |
| 867.6 | -55.95 | -75.95 | 0 dBm |
| 868.6 | -56.92 | -76.92 | 0 dBm |
| 866.8 | -46.64 | -71.4112 | -27 dBm |
| 869.4 | -58.51 | -83.2812 | -27 dBm |

5.1.7 Duty cycle

RESULT:**Passed**

Test procedure: EN 300 220-1 V3.1.1 clause 5.5.2.2

Test Setup

Date of testing : 30-Jan-2019

Input Voltage : DC 5V

Operation mode : A

Ambient temperature : 20-24 °C

Relative humidity : 40-50 %

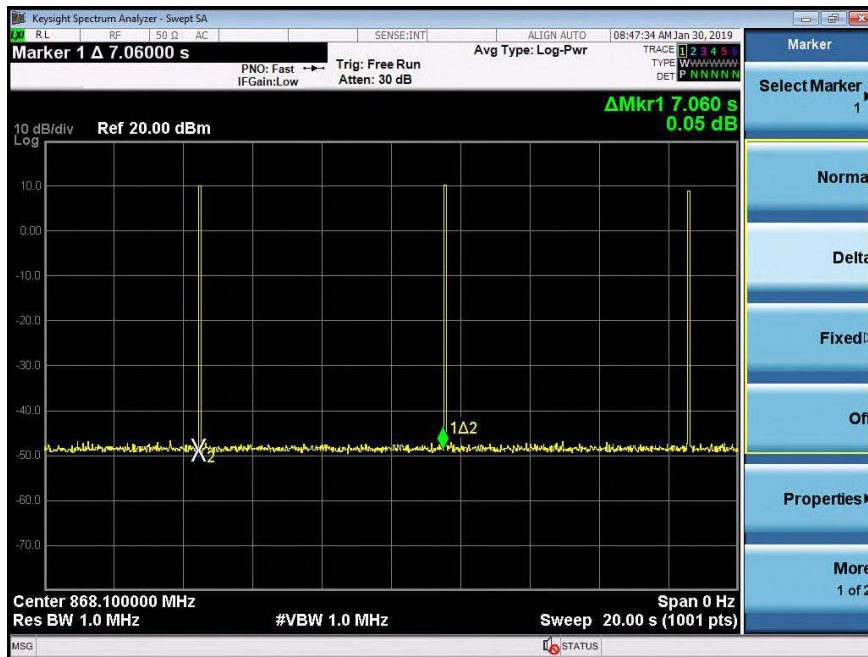
Atmospheric pressure : 100-103 kPa

Table 9: Test result of Duty cycle

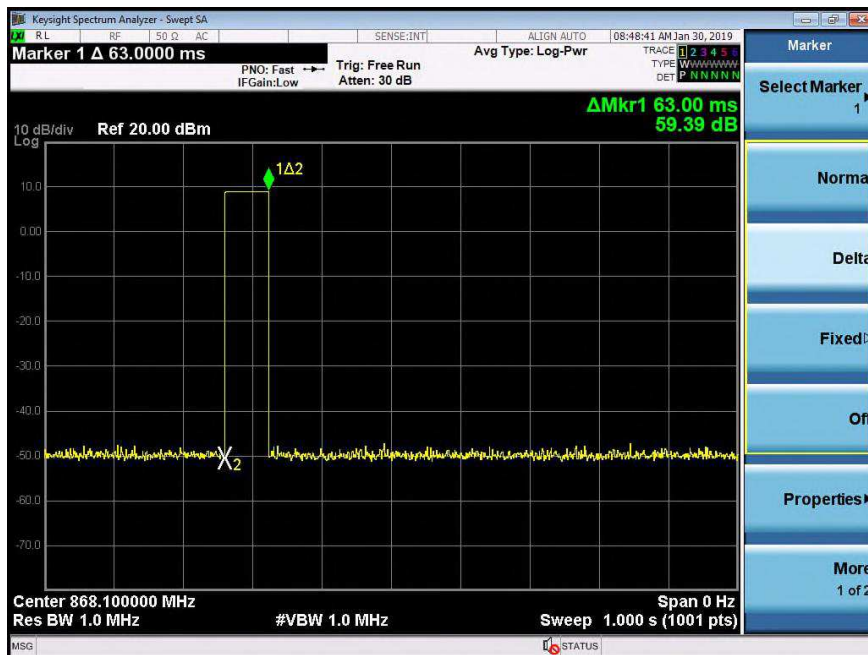
| Frequency (MHz) | Duty cycle | Limit |
|-----------------|------------|-------|
| 868.1 | 0.89% | ≤ 1% |

Test Plot of Duty cycle

On+Off



On



5.1.8 Adjacent channel power

RESULT:

N/A

Test procedure: EN 300 220-1 V3.1.1 clause 4.3.7

This requirement is not applicable because this device OCW > 25 kHz.

5.1.9 Adaptive Power Control**RESULT:****N/A**

Non-applicable. The EUT does not support Adaptive Power Control function.

5.1.10 Short term behavior**RESULT:****N/A**

Non-applicable. The EUT operation band is out of specified in annex C, table C.1 and NRI.

5.2 Receiver Requirement & Test Suites

5.2.1 RX Spurious emissions

RESULT:**Passed**

Please refer to Appendix D: Test result of Radiated Emissions

5.2.2 RX sensitivity level

RESULT:**N/A**

Non-applicable. The EUT does not support polite spectrum access function

5.2.3 Clear channel assessment threshold

RESULT:**N/A**

Non-applicable. The EUT does not support polite spectrum access function

5.2.4 Polite spectrum access timing parameters

RESULT:**N/A**

Non-applicable. The EUT does not support polite spectrum access function

5.2.5 Adaptive Frequency Agility

RESULT:**N/A**

Non-applicable. The EUT does not support adaptive frequency agility function.

5.2.6 Blocking

RESULT:
Passed

Test procedure: EN 300 220-1 V3.1.1 clause 5.18.6.4

Test Setup

Date of testing : 30-Jan-2019
 Input Voltage : DC 5V
 Operation mode : D
 Ambient temperature : 20-24 °C
 Relative humidity : 40-50 %
 Atmospheric pressure : 100-103 kPa

This device is Category 2 equipment which is standard performance level of receiver.

| Receiver category 2 | | | | |
|---------------------------|-----------------------|----------------------------|--------|-----------|
| Operating Frequency: | | 868.1 MHz | | |
| Blocking frequency | Blocking Level at EUT | level from Signal source A | Status | Limit |
| Lower OC frequency (MHz): | (dBm) | (dBm) | | |
| 866.00 | -36.19 | -93.03 | Pass | ≥ -69 dBm |
| 858.00 | -26.34 | | Pass | ≥ -44 dBm |
| 824.60 | -22.8 | | Pass | |
| Upper OC frequency (MHz): | (dBm) | (dBm) | | |
| 870.20 | -35.1 | -93.03 | Pass | ≥ -69 dBm |
| 878.20 | -24.02 | | Pass | ≥ -44 dBm |
| 911.61 | -21.33 | | Pass | |

As per Table 32 of EN 300 220-1 V3.1.1
 $Sp = 10 \log RB \text{ kHz} - 117 \text{ dBm}$
 $10 \log(125) - 117 = -96.03 \text{ dBm}$
 Level from signal source A = -93.03 dBm

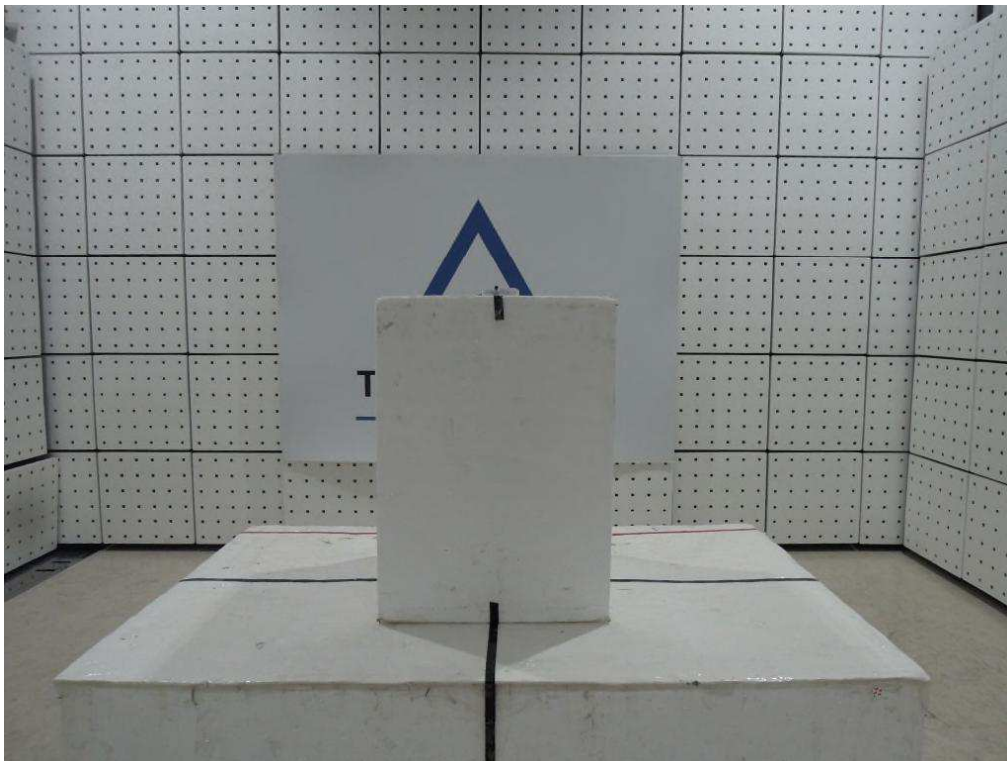
This device is Category 2 equipment which is standard performance level of receiver.

| Receiver category 2 | | | | |
|---------------------------|-----------------------|----------------------------|--------|-----------|
| Operating Frequency: | | 868.5 MHz | | |
| Blocking frequency | Blocking Level at EUT | level from Signal source A | Status | Limit |
| Lower OC frequency (MHz): | (dBm) | (dBm) | | |
| 866.40 | -38.09 | -93.03 | Pass | ≥ -69 dBm |
| 858.40 | -29.27 | | Pass | ≥ -44 dBm |
| 824.98 | -24.63 | | Pass | |
| Upper OC frequency (MHz): | (dBm) | (dBm) | | |
| 870.60 | -39.91 | -93.03 | Pass | ≥ -69 dBm |
| 878.60 | -28.9 | | Pass | ≥ -44 dBm |
| 912.03 | -24.86 | | Pass | |

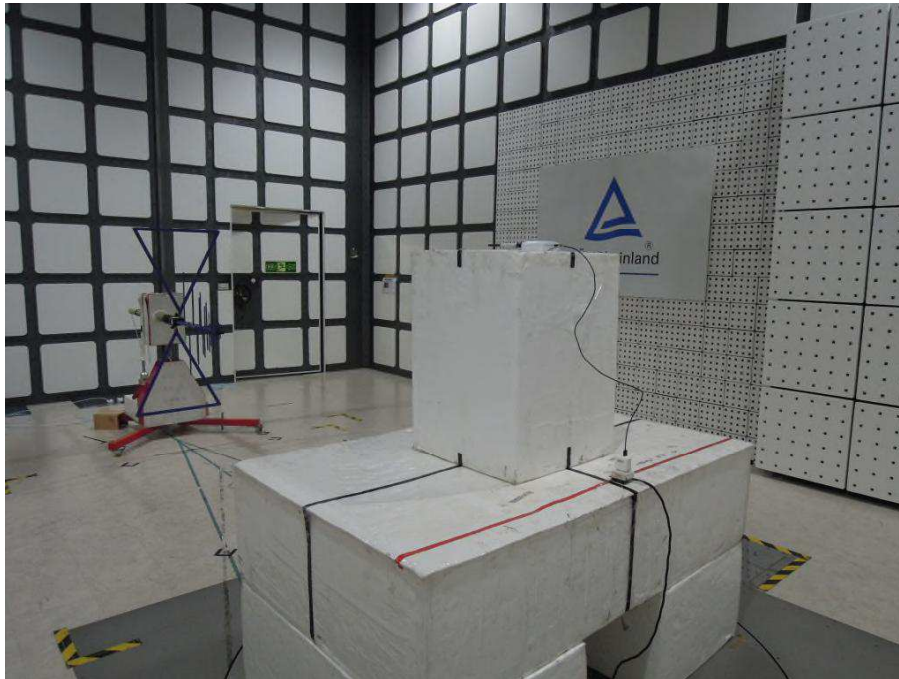
As per Table 32 of EN 300 220-1 V3.1.1
 $Sp = 10 \log RB \text{ kHz} - 117 \text{ dBm}$
 $10 \log(125) - 117 = -96.03 \text{ dBm}$
Level from signal source A = -93.03 dBm

6. Photographs of the Test Set-Up

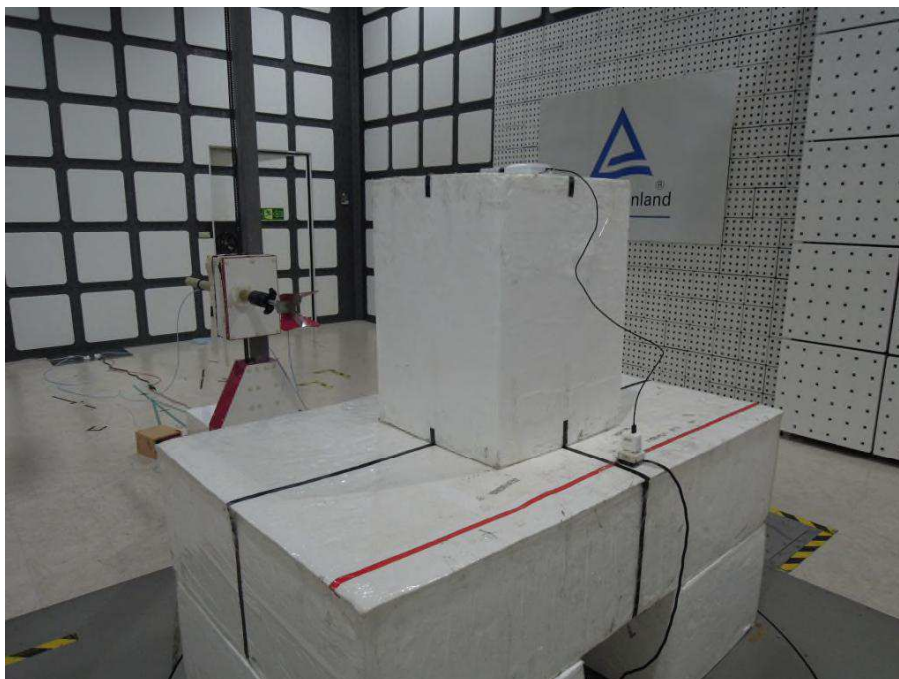
Photograph 1: Setup for Radiated Emission (Front)



Photograph 2: Set-up for Radiated Emission (Rear View 1)



Photograph 3: Set-up for Radiated Emission (Rear View 2)



Photograph 4: Set-up for Radiated Emission (Rear View 3)



Photograph 5: Set-up for Conducted Testing



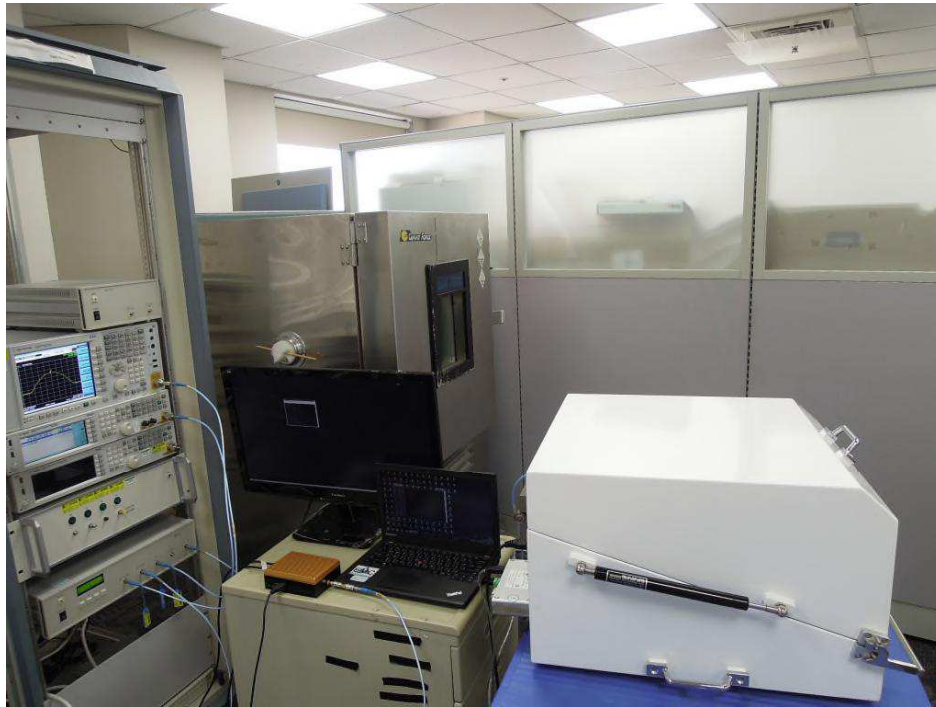
Photograph 6: Set-up for Conducted Testing



Photograph 7: Set-up for Conducted Testing



Photograph 8: Set-up for Conducted Blocking Testing



Photograph 9: Set-up for Conducted Blocking Testing



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