

FCC LISTED, REGISTRATION  
 NUMBER: 720267

Informe de ensayo n°:  
 Test report No:

IC LISTED REGISTRATION  
 NUMBER IC 4621A-1

**NIE: 47941RRF.001**

## Test report

### USA FCC Part 15.231, 15.209

### CANADA RSS-210, RSS-Gen

Radio Frequency Devices. Periodic operation in the band 40.66-40.70 MHz and above 70 MHz.

Licence-Exempt Radio Apparatus (All Frequency Bands): Category I Equipment.  
 General Requirements and Information for the Certification of Radio Apparatus.

|  |   |
|--|---|
| <b>Identificación del objeto ensayado</b> .....    | TPMS (Tire pressure monitoring system)  |
| Identification of item tested                      |   |
| <b>Marca</b> .....                                 | Continental   |
| Trademark  |   |
| <b>Modelo y/o referencia tipo</b> .....            | TIS-04-ASK  |
| Model and /or type reference                       |   |
| <b>Other identification of the product</b> .....   | FCC ID: KR5TIS-04-ASK<br>IC: 7812D-TIS04ASK   |
| <b>Final HW version</b> .....                      | 01  |
| <b>Final SW version</b> .....                      | SW205   |
| <b>Características</b> .....                       | ASK modulation  |
| Features   |   |
| <b>Fabricante</b> .....                            | Continental Automotive GmbH   |
| Manufacturer                                       | Siemensstr. 12, 93055 Regensburg, Germany   |
| <b>Método de ensayo solicitado, norma</b> .....    | USA FCC Part 15.231 10-1-14 Edition: Periodic operation in the band 40.66-40.70 MHz and above 70 MHz.   |
| Test method requested, standard                    | USA FCC Part 15.209 10-1-14 Edition: Radiated emission limits; general requirements.<br>CANADA RSS-210 Issue 8 (December 2010).<br>CANADA RSS-Gen Issue 4 (November 2014).<br>ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices. |
| <b>Resultado</b> .....                             | IN COMPLIANCE   |
| Summary  |   |
| <b>Aprobado por (nombre / cargo y firma)</b> ..... | A. Llamas / RF Lab. Manager   |
| Approved by (name / position & signature)          |   |
| <b>Fecha de realización</b> .....                  | 2015-12-18  |
| Date of issue                                      |   |
| <b>Formato de informe No.</b> .....                | FDT08_17  |
| Report template No                                 |   |

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## Competences and guarantees

AT4 wireless is a laboratory with a measurement facility in compliance with the requirements of Section 2.948 of the FCC rules and has been added to the list of facilities whose measurements data will be accepted in conjunction with applications for Certification under Parts 15 or 18 of the Commission's Rules. Registration Number: 720267.

AT4 wireless is a laboratory with a measurement site in compliance with the requirements of RSS 212, Issue 1 (Provisional) and has been added to the list of filed sites of the Canadian Certification and Engineering Bureau. Reference File Number: IC 4621A-1.

In order to assure the traceability to other national and international laboratories, AT4 wireless has a calibration and maintenance program for its measurement equipment.

AT4 wireless guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at AT4 wireless at the time of performance of the test.

AT4 wireless is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

The results presented in this Test Report apply only to the particular item under test established in this document.

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## General conditions

1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
3. This document is only valid if complete; no partial reproduction can be made without previous written permission of AT4 wireless.
4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of AT4 wireless and the Accreditation Bodies.

## Uncertainty

Uncertainty (factor  $k=2$ ) was calculated according to the AT4 wireless internal document PODT000.

## Usage of samples

Samples undergoing test have been selected by: **the client**

Sample M/01 is composed of the following elements:

| Control N° | Description  | Model      | Serial N° | Date of reception |
|------------|--|------------|-----------|-------------------|
| 47941/003  | Temperature and pressure monitoring system with integral antenna | TIS-04-ASK | ---       | 2015-11-24        |

1. Sample M/01 has undergone following test(s) in appendix A:  
Subclause (e). Radiated emissions for transmitter and Subclause (c). 20 dB Emission Bandwidth and Occupied Bandwidth.

Sample M/02 is composed of the following elements:

| Control N° | Description                                      | Model      | Serial N° | Date of reception |
|------------|--|------------|-----------|-------------------|
| 47941/006  | Pressure monitoring system with integral antenna | TIS-04-ASK | ---       | 2015-12-02        |

- Sample M/02 has undergone following test(s) in appendix A:  
 Subclause (e). Transmitter deactivation (Periodic transmission).

## Test sample description

Product is dedicated to be mounted on a wheel and send RF messages indicated pressure and temperature inside the tire.

## Identification of the client

Continental Automotive GmbH  
 Siemensstr. 12, 93055 Regensburg, Germany

## Testing period

The performed test started on 2015-11-28 and finished on 2015-12-02.  
 The tests have been performed at AT4 wireless.

## Environmental conditions

In the control chamber, the following limits were not exceeded during the test:

|                                      |                              |
|--------------------------------------|------------------------------|
| <b>Temperature</b>                   | Min. = 15 °C<br>Max. = 35 °C |
| <b>Relative humidity</b>             | Min. = 20 %<br>Max. = 75 %   |
| <b>Shielding effectiveness</b>       | > 100 dB                     |
| <b>Electric insulation</b>           | > 10 kΩ                      |
| <b>Reference resistance to earth</b> | < 1 Ω                        |

In the semianechoic chamber, the following limits were not exceeded during the test.

|                                      |   |
|--------------------------------------|---|
| <b>Temperature</b>                   | Min. = 15 °C<br>Max. = 35 °C  |
| <b>Relative humidity</b>             | Min. = 20 %<br>Max. = 75 %  |
| <b>Air pressure</b>                  | Min. = 860 mbar<br>Max. = 1060 mbar   |
| <b>Shielding effectiveness</b>       | > 100 dB  |
| <b>Electric insulation</b>           | > 10 kΩ   |
| <b>Reference resistance to earth</b> | < 1 Ω   |
| <b>Normal site attenuation (NSA)</b> | < ±4 dB at 10 m distance between item under test and receiver antenna, (30 MHz to 1000 MHz) |
| <b>Field homogeneity</b>             | More than 75% of illuminated surface is between 0 and 6 dB (26 MHz to 1000 MHz).            |

In the chamber for conducted measurements, the following limits were not exceeded during the test:

|                                      |                                     |
|--------------------------------------|-------------------------------------|
| <b>Temperature</b>                   | Min. = 15 °C<br>Max. = 35 °C        |
| <b>Relative humidity</b>             | Min. = 20 %<br>Max. = 35 %          |
| <b>Air pressure</b>                  | Min. = 860 mbar<br>Max. = 1060 mbar |
| <b>Shielding effectiveness</b>       | > 100 dB                            |
| <b>Electric insulation</b>           | > 10 kΩ                             |
| <b>Reference resistance to earth</b> | < 1 Ω                               |

## Remarks and comments

1: Used instrumentation:

### Conducted Measurements

|                                     | Last Cal. date | Cal. due date |
|-------------------------------------|----------------|---------------|
| 1. Spectrum Analyzer Agilent E4440A | 2015/10        | 2017/10       |

### Radiated Measurements

|  | Last Cal. date | Cal. due date |
|--|----------------|---------------|
| 1. Semianechoic Absorber Lined Chamber<br>ETS FACT3 200STP             | N.A.           | N.A.          |
| 2. BiconicalLog antenna ETS<br>LINDGREN 3142E                          | 2014/03        | 2017/03       |
| 3. Multi Device Controller EMCO 2090                                   | N.A.           | N.A.          |
| 4. Double-ridge Guide Horn antenna 1-18<br>GHz SCHWARZBECK BBHA 9120 D | 2013/11        | 2016/11       |
| 5. EMI Test Receiver R&S ESU 26  | 2015/11        | 2017/11       |
| 6. EMI Test Receiver R&S ESU 40  | 2014/02        | 2016/02       |
| 7. RF pre-amplifier 10 MHz-6 GHz<br>SCHWARZBECK BBV9743                | 2015/03        | 2016/03       |
| 8. RF pre-amplifier 1-18 GHz BONN<br>ELEKTRONIK BLMA 0118-3A           | 2015/05        | 2016/05       |

## Testing verdicts

|                             |     |
|-----------------------------|-----|
| <b>Not applicable</b> ..... | N/A |
| <b>Pass</b> .....           | P   |
| <b>Fail</b> .....           | F   |
| <b>Not measured</b> .....   | N/M |

| FCC PART 15 PARAGRAPH / RSS-210                         |  | VERDICT |   |   |    |
|---|--|---------|---|---|----|
|   |  | NA      | P | F | NM |
| Section 15.231 Subclause (e) / RSS-210 A1.1.5.          | Transmitter deactivation                                       |         | P |   |    |
| Section 15.231 Subclause (c) / RSS-210 A1.1.3.          | Bandwidth  |         | P |   |    |
| Section 15.231 Subclause (e) / 15.209 / RSS-210 A1.1.5. | Field strength and Emission limitations radiated (Transmitter) |         | P |   |    |

## Appendix A – Test result

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## TEST CONDITIONS

Power supply (V):

$$V_{\text{nominal}} = 3.0 \text{ Vdc}$$

Type of power supply = Battery

Type of antenna = Integral antenna

### TEST FREQUENCIES:

The equipment transmits at the nominal frequency of 315 MHz.

### CONDUCTED MEASUREMENTS

The equipment under test was set up in a shielded room and it is directly connected to the spectrum analyzer.



### RADIATED MEASUREMENTS

The equipment under test was scanned for spurious emissions in the frequency range 30 to 5000 MHz.

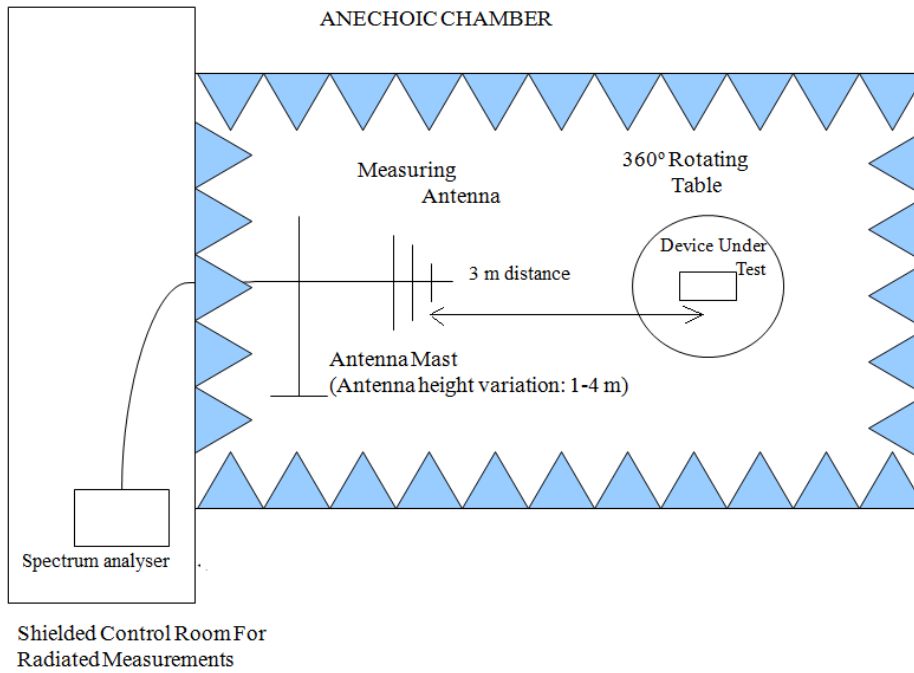
All radiated tests were performed in a semi-anechoic chamber. The measurement antenna is situated at a distance of 3 m for the frequency range 30 MHz-1000 MHz (30 MHz-1000 MHz Bilog antenna) and at a distance of 1m for the frequency range 1 GHz-5 GHz (1 GHz-18 GHz Double ridge horn antenna).

For radiated emissions in the range 1 GHz-5 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance. The sample is prepared so that transmits continuously when the batteries are connected

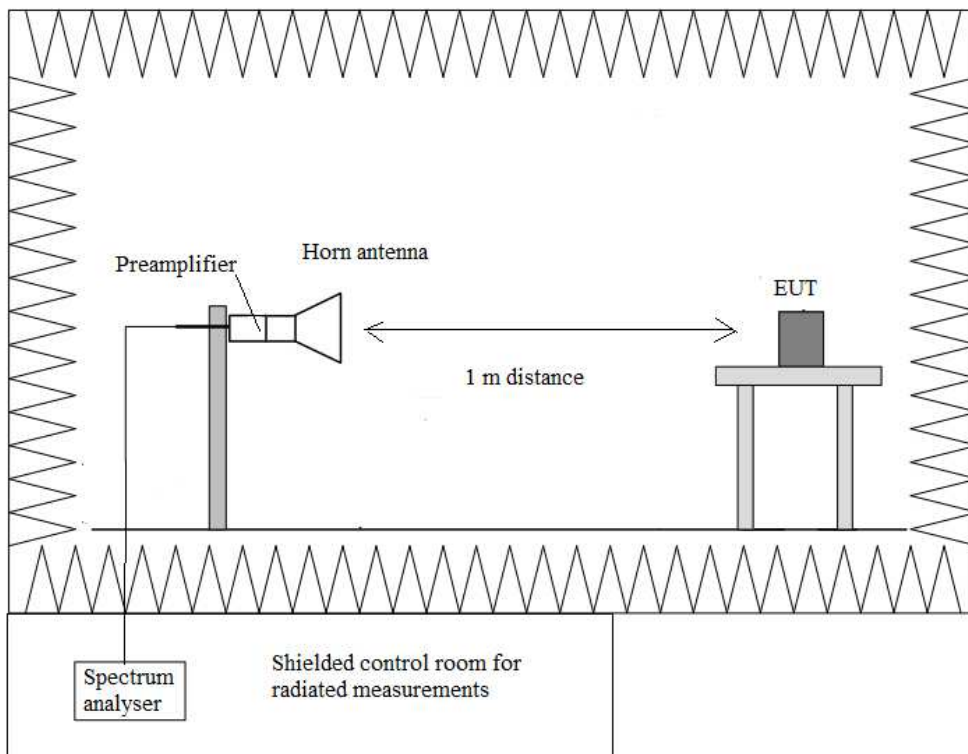
The equipment under test was set up on a non-conductive (wooden) platform one meter above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

Measurements were made in both horizontal and vertical planes of polarization.

### Radiated measurements setup $f < 1$ GHz



### Radiated measurements setup $f > 1$ GHz



**Section 15.231 Subclause (e) / RSS-210 A1.1.5. Transmitter deactivation.**

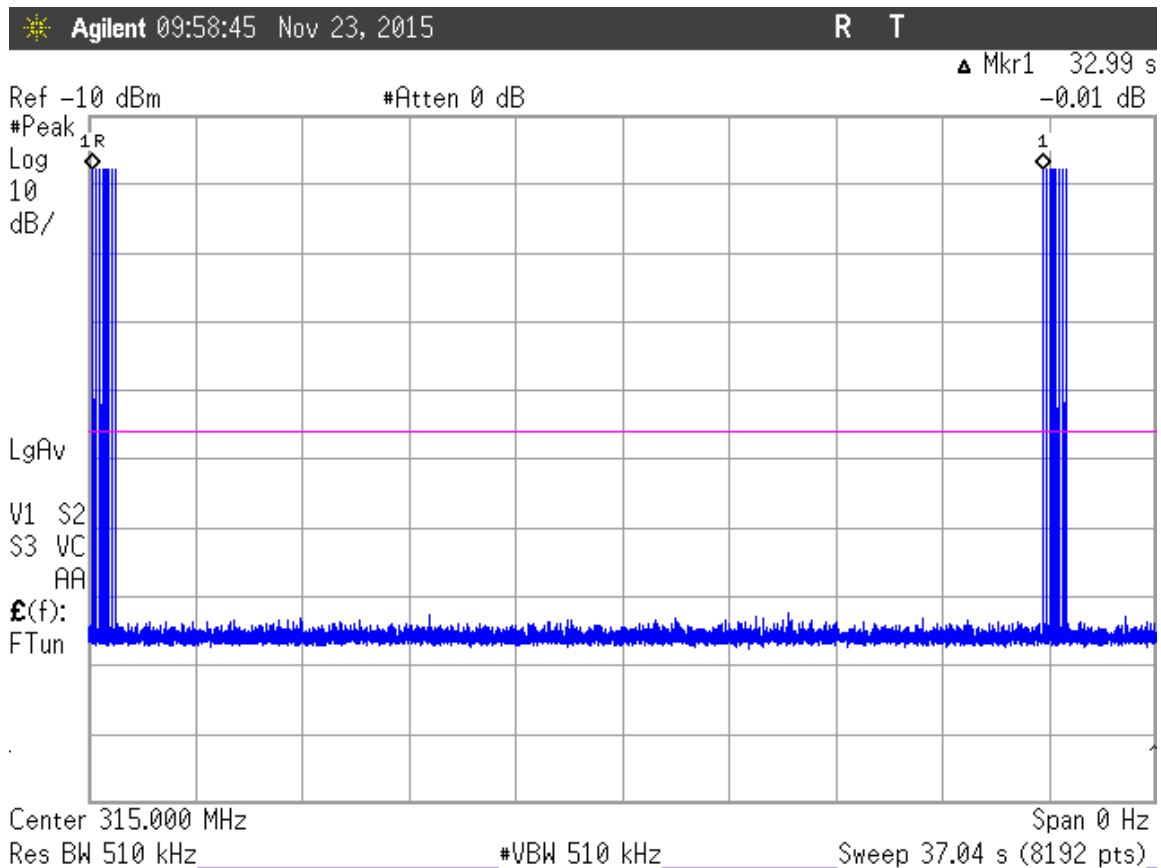
SPECIFICATION

Devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

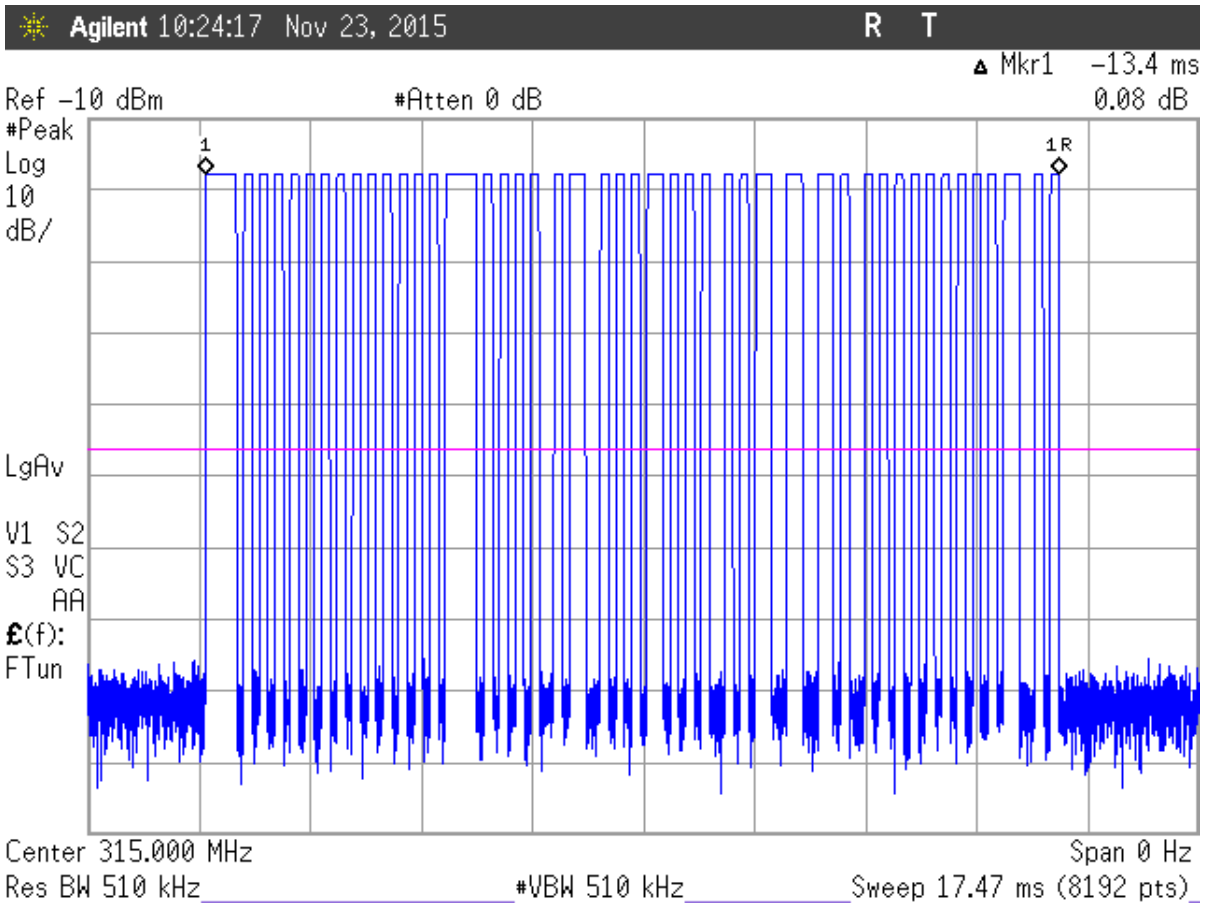
RESULTS

In normal operation the equipment transmits a pulse train periodically (see next plots).

1. Pulse train period = 32.99 s.



2. Pulse train duration = 13.4 ms.



The equipment transmits a pulse train with a total transmission duration of 6.514 ms. 30 times the duration of the transmission is 0.195 seconds.

The silent period between transmissions is 32.97 seconds.

Verdict: Pass

**Section 15.231 Subclause (c) / RSS-210 A1.1.3. Bandwidth**

SPECIFICATION

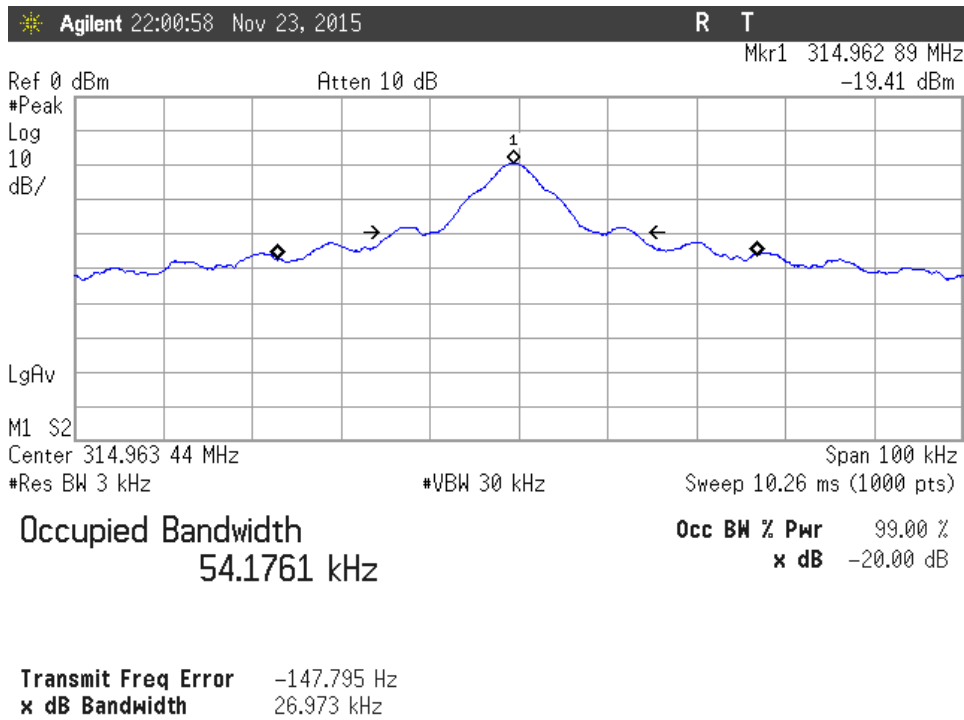
**FCC 15.231:** The bandwidth of the emission shall be no wider than 0.25 % of the centre frequency for devices operating above 70 MHz and below 900 MHz. Bandwidth is determined at the points 20 dB down from the modulated carrier.

RESULTS (see next plot)

Nominal centre frequency = 315 MHz

Limit of spectrum bandwidth = 0.25 % of 315 MHz = 787.5 kHz

|                                |        |
|--------------------------------|--------|
| Measured 20 dB Bandwidth (kHz) | 26.973 |
| Measurement uncertainty (kHz)  | <±1.65 |



Verdict: PASS

### Occupied Bandwidth

**SPECIFICATION**

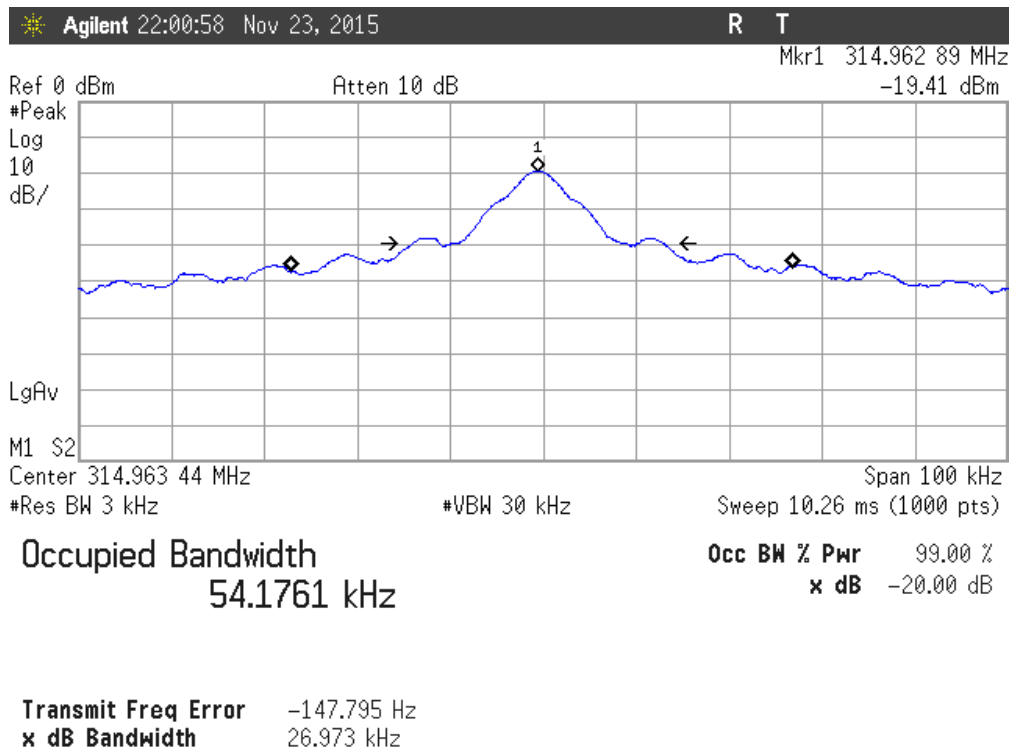
RSS-210. A.1.1.3.: the 99% bandwidth shall be no wider than 0.25% of the centre frequency for devices operating between 70 MHz and 900 MHz.

**RESULTS** (see next plot).

Nominal centre frequency = 315 MHz

Limit of spectrum bandwidth = 0.25 % of 315 MHz = 787.5 kHz

|                               |         |
|-------------------------------|---------|
| 99% bandwidth (kHz)           | 54.1761 |
| Measurement uncertainty (kHz) | <±1.5   |



Verdict: PASS

**Section 15.231 Subclause (e)/15.209 / RSS-210 A1.1.5. Field strength and Emission limitations radiated (Transmitter)**

SPECIFICATION

Intentional radiators may operate at a periodic rate exceeding that specified in paragraph (a) of this section and may be employed for any type of operation, including operation prohibited in paragraph (a) of this section, provided the intentional radiator complies with the provisions of paragraphs (b) through (d) of this section, except the field strength table in paragraph (b) of this section is replaced by the following:

| Fundamental frequency (MHz) | Field strength of fundamental ( $\mu\text{V/m}$ ) | Field strength of spurious emissions ( $\mu\text{V/m}$ ) |
|-----------------------------|---|--|
| 40.66 – 40.70               | 1,000   | 100  |
| 70 – 130                    | 500   | 50   |
| 130 - 174                   | 500 to 1,500 **                                   | 50 to 150 **   |
| 174 - 260                   | 1,500   | 150  |
| 260 - 470                   | 1,500 to 5,000 **                                 | 150 to 500 **  |
| Above 470                   | 5,000   | 500  |

\*\* : Linear Interpolations. The maximum permitted unwanted emission level is 20dB below the maximum permitted fundamental level.

Spurious emissions shall be attenuated to the limits shown in the above table or to the general limits shown in Section 15.209/RSS-Gen, whichever limit permits a higher field strength.

For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table is specified when measuring with peak detector function.

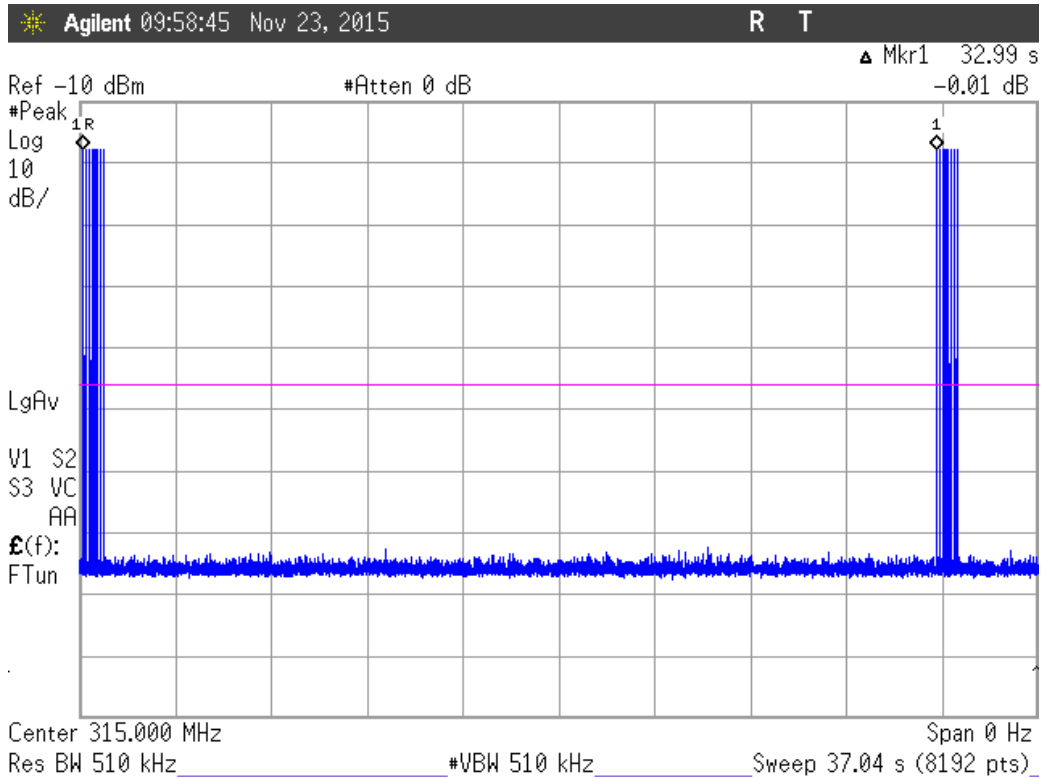
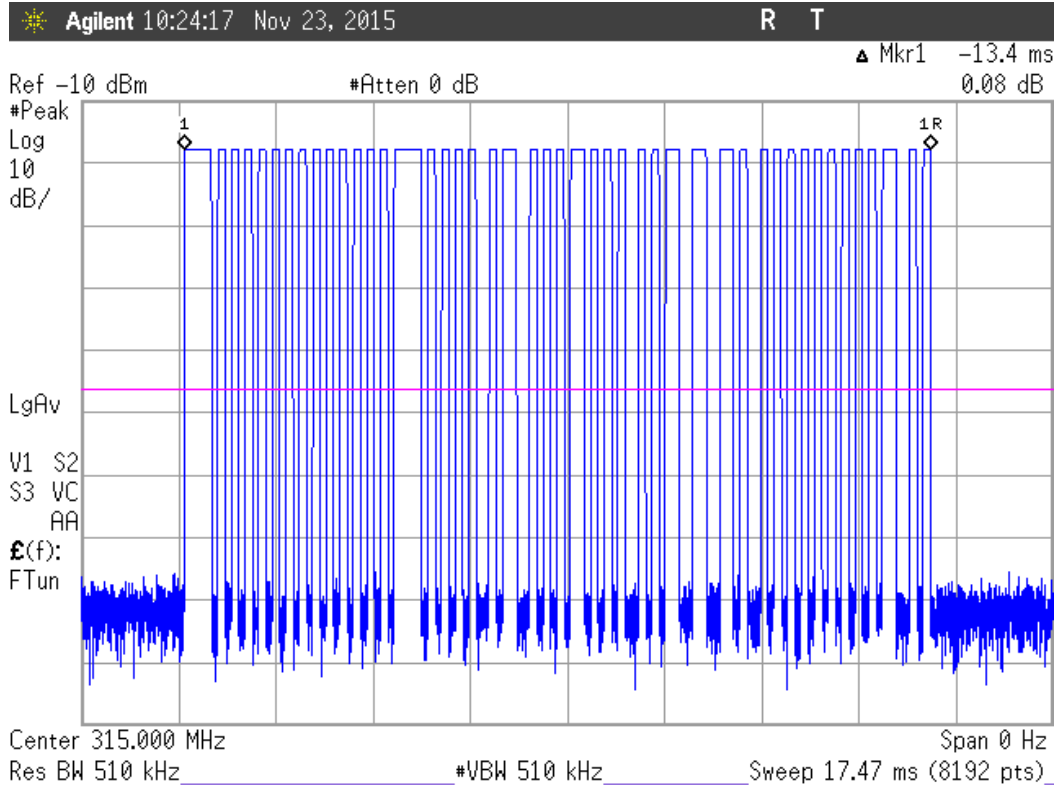
RESULTS:

The field strength is calculated by adding correction factor to the measured level from the spectrum analyser. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

The EUT is set in continuous unmodulated transmission for peak level measurement.

The normal operation transmission is pulsed so the average values of transmitter fundamental and spurious emissions are calculated from the measured peak values using the duty cycle correction factor  $\delta$  as indicated in standard ANSI C63.10-2013.

**Computation of duty-cycle correction factor.**





Pulse train period: 32.99 s  
Number of pulses within 100 ms: 1 pulse train  
Pulse train duration: 6.514 ms

Duty-cycle correction factor calculation.

| Pulse train | Number of pulses in the pulse train | Total duration (ms) | Pulse train "On Time" (ms) |
|-------------|-------------------------------------|---------------------|----------------------------|
| 1           | 46                                  | 6.514               | 6.514                      |
|             |                                     | TOTAL ON TIME:      | 6.514                      |

Duty cycle correction factor  $\delta = 6.514 / 100 = 0.06514$

$\delta = 20 \log (0.06514) = -23.72 \text{ dB}$

**Frequency range 30 MHz-1000 MHz (see next plots)**

| Frequency (MHz)           | Polarization | Detector | Emission Level                      | Limits<br>15.231 (e) / 15.209                   |
|---------------------------|--------------|----------|-------------------------------------|---|
| 314.9626<br>(Fundamental) | V            | Peak     | 3,515.60 (µV/m) / 70.92<br>(dBµV/m) | 24,145.66 (µV/m) / ---<br>87.66 (dBµV/m) / ---  |
| 944.90400                 | H            | Peak     | 35.32 (µV/m) / 30.96<br>(dBµV/m)    | 2,414.566 / 2,000 (µV/m)<br>67.66 / 66 (dBµV/m) |

Calculation for average level

| Spurious frequency (MHz)  | Emission Level (dBµV/m) Peak | Duty-cycle correction factor δ (dB) | Corrected Emission Level (dBµV/m) Average | Limits<br>15.231 (e) / 15.209               |
|---------------------------|------------------------------|-------------------------------------|---|---|
| 314.9626<br>(Fundamental) | 70.92                        | -23.72                              | 47.20                                     | 2,414.566 (µV/m) (67.66 dBµV/m) / ---       |
| 944.90400                 | 30.96                        | -23.72                              | 7.24                                      | 241.456 / 200 (µV/m)<br>47.66 / 46 (dBµV/m) |

Measurement uncertainty (dB): ±3.88 dB.

Verdict: PASS

**Frequency range 1 GHz-5 GHz (see next plots)**

All peaks are more than 20 dB below the limit.

Highest spurious levels.

| Frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Limits (dBµV/m)<br>15.231 (e) / 15.209 |
|-----------------|--------------|----------|-------------------------|--|
| 2.52000         | V            | Peak     | 36.94                   | 67.66 / 74                             |
| 2.83520         | V            | Peak     | 36.60                   | 67.66 / 74                             |
| 3.78000         | V            | Peak     | 35.93                   | 67.66 / 74                             |

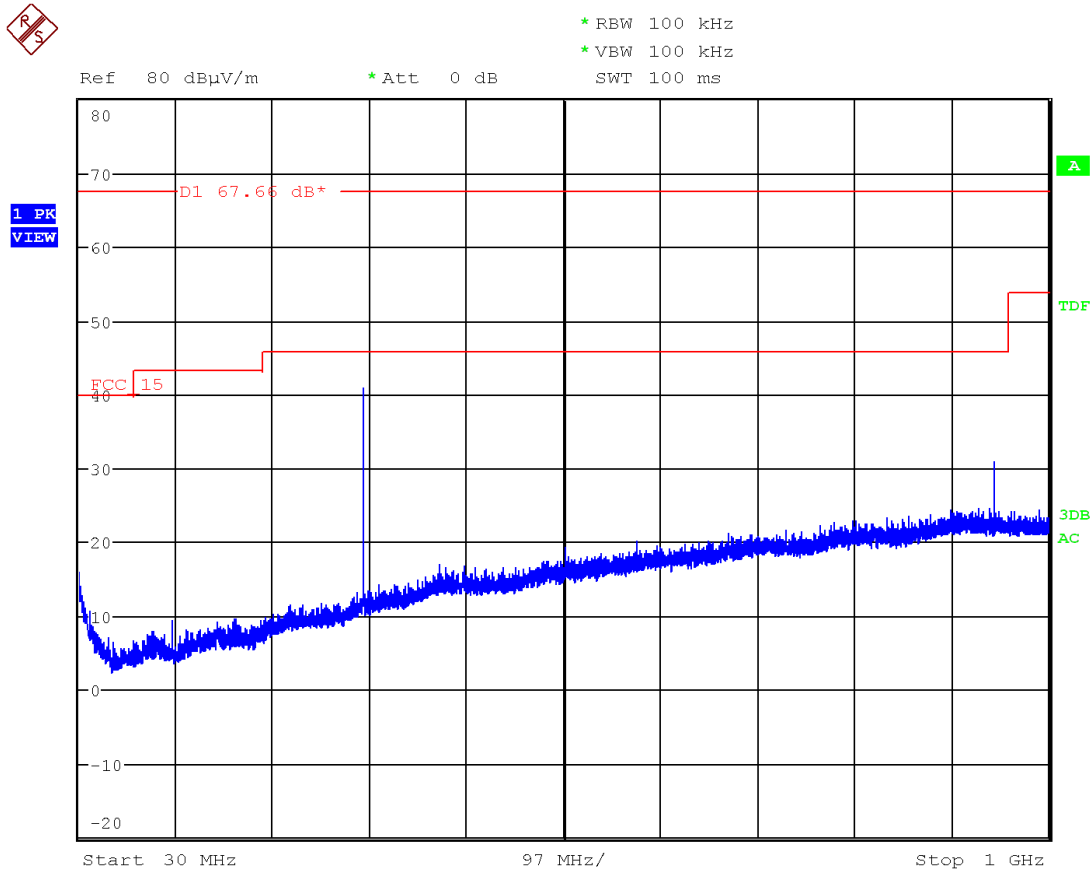
Calculation for average level

| Spurious frequency (MHz) | Emission Level (dBµV/m) Peak | Duty-cycle correction factor $\delta$ (dB) | Corrected Emission Level (dBµV/m) Average | Limits (dBµV/m)<br>15.231 (b) / 15.209 |
|--------------------------|------------------------------|--|---|--|
| 2.52000                  | 36.94                        | -23.72                                     | 13.22                                     | 47.66 / 54                             |
| 2.83520                  | 36.60                        | -23.72                                     | 12.88                                     | 47.66 / 54                             |
| 3.78000                  | 35.93                        | -23.72                                     | 12.21                                     | 47.66 / 54                             |

Measurement uncertainty (dB):  $\pm 4.69$  dB.

Verdict: PASS.

FREQUENCY RANGE 30 MHz-1000 MHz



Note: The carrier frequency (fundamental) was attenuated using a notch filter.

FREQUENCY RANGE 1 GHz to 5 GHz

