

## TEST REPORT

Test report no.: 1-6614/18-01-03-B



### Testing laboratory

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**Accredited Testing Laboratory:**

The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2005) by the Deutsche Akkreditierungsstelle GmbH (DAkkS)

The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate with the registration number: D-PL-12076-01-03

### Applicant

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### Manufacturer

**Sennheiser electronic GmbH & Co. KG**

Am Labor 1

30900 Wedemark / GERMANY

### Test standard/s

FCC - Title 47 CFR  
Part 15

FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices

RSS - 210 Issue 9

Spectrum Management and Telecommunications Radio Standards Specification - Licence-Exempt Radio Apparatus: Category I Equipment

For further applied test standards please refer to section 3 of this test report.

### Test Item

**Kind of test item:** UHF Wireless Microphones – Bodypack Transmitter

**Model name:** SK 300 G4, SK 500 G4, SK 100 G4

**FCC ID:** DMOSK1574

**IC:** 2099A-SK1574

**Frequency:** 470 MHz to 608 MHz

**Technology tested:** Proprietary

**Antenna:** Integrated antenna

**Power supply:** 2.55 V to 3.45 V DC by 2 x AA batteries

**Temperature range:** -30°C to +50°C



This test report is electronically signed and valid without handwritten signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

### Test report authorized:



Christoph Schneider  
Lab Manager  
Radio Communications & EMC

### Test performed:



Sumit Kumar  
Testing Manager  
Radio Communications & EMC

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## 2 General information

### 2.1 Notes and disclaimer

The test results of this test report relate exclusively to the test item specified in this test report. CTC advanced GmbH does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.

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This test report replaces the test report with the number 1-6614/18-01-03-A and dated 2019-05-28

### 2.2 Application details

|                                    |            |
|------------------------------------|------------|
| Date of receipt of order:          | 2018-06-04 |
| Date of receipt of test item:      | 2019-01-24 |
| Start of test:                     | 2019-01-28 |
| End of test:                       | 2019-01-29 |
| Person(s) present during the test: | -/-        |

### 2.3 Test laboratories sub-contracted

None

### 3 Test standard/s and references

| Test standard              | Date        | Description                                                                                                                                                                               |
|----------------------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| FCC - Title 47 CFR Part 15 |             | FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices                                                                                           |
| RSS - 210 Issue 9          | August 2016 | Spectrum Management and Telecommunications Radio Standards Specification - Licence-Exempt Radio Apparatus: Category I Equipment                                                           |
| ETSI EN 300 422-1 V1.4.2   | 2011-08     | Electromagnetic compatibility and Radio spectrum Matters (ERM); Wireless microphones in the 25 MHz to 3 GHz frequency range; Part 1: Technical characteristics and methods of measurement |

| Guidance         | Version | Description                                                                                                                                                         |
|------------------|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ANSI C63.4-2014  | -/-     | American national standard for methods of measurement of radio-noise emissions from low-voltage electrical and electronic equipment in the range of 9 kHz to 40 GHz |
| ANSI C63.10-2013 | -/-     | American national standard of procedures for compliance testing of unlicensed wireless devices                                                                      |

## 4 Test environment

|                           |   |                                     |                                                                                                                     |
|---------------------------|---|-------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| Temperature               | : | $T_{nom}$<br>$T_{max}$<br>$T_{min}$ | +23 °C during room temperature tests<br>+50 °C during high temperature tests<br>-30 °C during low temperature tests |
| Relative humidity content | : |                                     | 55 %                                                                                                                |
| Barometric pressure       | : |                                     | 1021 hpa                                                                                                            |
| Power supply              | : | $V_{nom}$<br>$V_{max}$<br>$V_{min}$ | 3.00 V DC by 2 x AA batteries<br>3.45 V<br>2.55 V                                                                   |

## 5 Test item

### 5.1 General description

|                            |   |                                                                                                                                                                                                                                                       |
|----------------------------|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Kind of test item          | : | UHF Wireless Microphones – Bodypack Transmitter                                                                                                                                                                                                       |
| Type identification        | : | SK 300 G4, SK 500 G4, SK 100 G4                                                                                                                                                                                                                       |
| HMN                        | : | -/-                                                                                                                                                                                                                                                   |
| PMN                        | : | ewG4                                                                                                                                                                                                                                                  |
| HVIN                       | : | SK 300 G4, SK 500 G4, SK 100 G4                                                                                                                                                                                                                       |
| FVIN                       | : | 1.1.2                                                                                                                                                                                                                                                 |
| S/N serial number          | : | Band Aw+: 1347000011<br>Band Gw1: 1347000011                                                                                                                                                                                                          |
| HW hardware status         | : | 525479_20                                                                                                                                                                                                                                             |
| SW software status         | : | 1.1.0                                                                                                                                                                                                                                                 |
| Frequency band             | : | 470 MHz to 608 MHz<br>Band Aw+: 470 MHz to 558 MHz<br>also available as sub-bands    A1: 470 MHz to 516 MHz<br>A: 516 MHz to 558 MHz<br>AS: 520 MHz to 558 MHz<br>Band Gw1: 558 MHz to 608 MHz<br>also available as sub-band    G: 566 MHz to 608 MHz |
| Type of radio transmission | : | Modulated carrier                                                                                                                                                                                                                                     |
| Use of frequency spectrum  | : |                                                                                                                                                                                                                                                       |
| Type of modulation         | : | Analog FM                                                                                                                                                                                                                                             |
| Number of channels         | : | -/-                                                                                                                                                                                                                                                   |
| Antenna                    | : | Integrated antenna                                                                                                                                                                                                                                    |
| Power supply               | : | 2.55 V to 3.45 V DC by 2 x AA batteries                                                                                                                                                                                                               |
| Temperature range          | : | -30°C to +50°C                                                                                                                                                                                                                                        |

### 5.2 Additional information

The content of the following annexes is defined in the QA. It may be that not all of the listed annexes are necessary for this report, thus some values in between may be missing.

Test setup and EUT photos are included in test report:    1-6614/18-01-03\_AnnexA  
                                                                                          1-6614/18-01-03\_AnnexB  
                                                                                          1-6614/18-01-03\_AnnexC

## 6 Description of the test setup

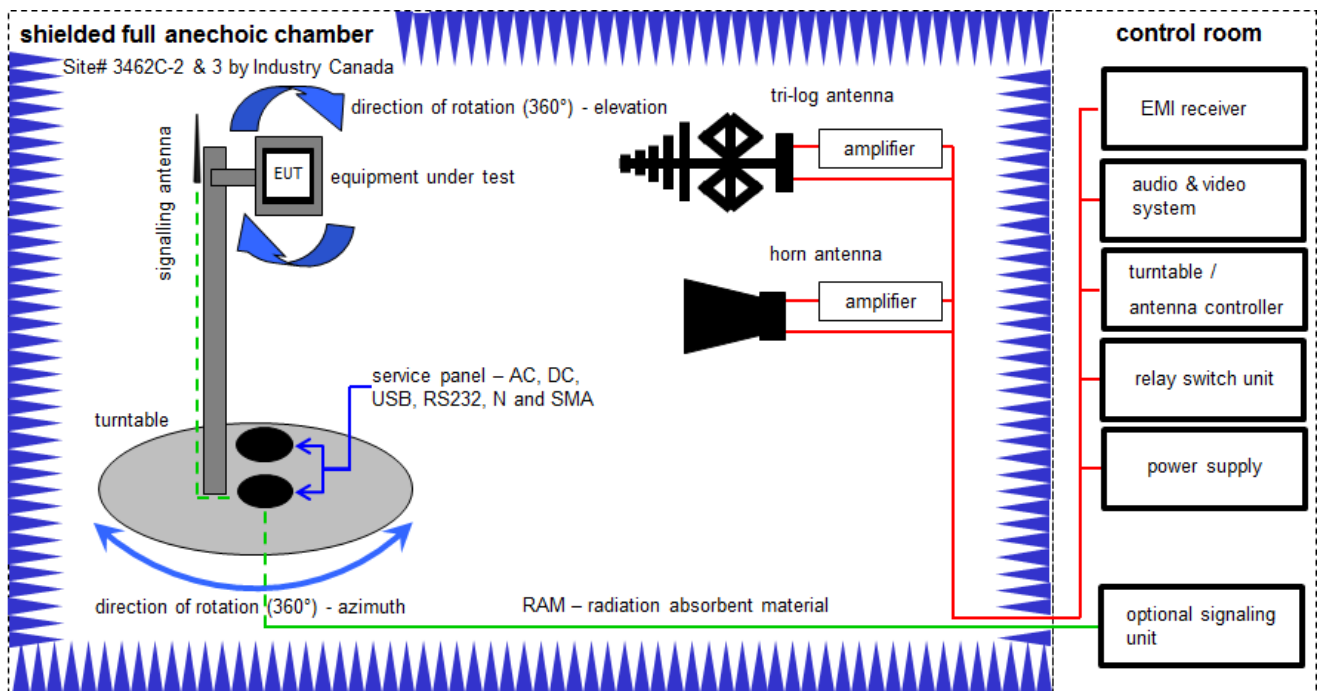
Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements with other calibrated test systems or effective verifications. Weekly chamber inspections and range calibrations are performed. Where possible, RF generating and signaling equipment as well as measuring receivers and analyzers are connected to an external high-precision 10 MHz reference (GPS-based or rubidium frequency standard).

In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

### **Agenda:** Kind of Calibration

|      |                                            |     |                                                      |
|------|--------------------------------------------|-----|------------------------------------------------------|
| k    | calibration / calibrated                   | EK  | limited calibration                                  |
| ne   | not required (k, ev, izw, zw not required) | zw  | cyclical maintenance (external cyclical maintenance) |
| ev   | periodic self verification                 | izw | internal cyclical maintenance                        |
| Ve   | long-term stability recognized             | g   | blocked for accredited testing                       |
| vlk! | Attention: extended calibration interval   |     |                                                      |
| NK!  | Attention: not calibrated                  | *)  | next calibration ordered / currently in progress     |

## 6.1 Shielded fully anechoic chamber



Measurement distance: tri-log antenna and horn antenna 3 meter

$$OP = AV + D - G + CA$$

(OP-radiated output power; AV-analyzer value; D-free field attenuation of measurement distance; G-antenna gain+amplifier gain; CA-loss signal path)

### Example calculation:

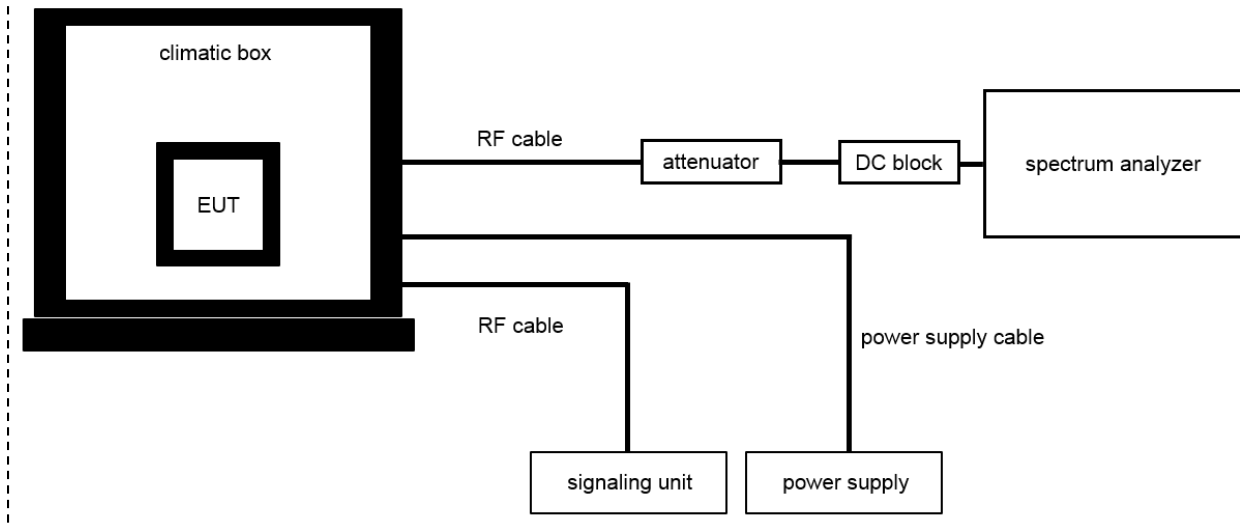
$$OP \text{ [dBm]} = -65.0 \text{ [dBm]} + 50 \text{ [dB]} - 20 \text{ [dBi]} + 5 \text{ [dB]} = -30 \text{ [dBm]} (1 \mu\text{W})$$

### Equipment table:

| No. | Lab / Item | Equipment                                      | Type               | Manufacturer                  | Serial No. | INV. No.  | Kind of Calibration | Last Calibration | Next Calibration |
|-----|------------|------------------------------------------------|--------------------|-------------------------------|------------|-----------|---------------------|------------------|------------------|
| 1   | B          | Double-Ridged Waveguide Horn Antenna 1-18.0GHz | 3115               | EMCO                          | 9107-3697  | 300001605 | k                   | 14.02.2017       | 13.02.2019       |
| 2   | A,B        | Anechoic chamber                               | FAC 3/5m           | MWB / TDK                     | 87400/02   | 300000996 | ev                  | -/-              | -/-              |
| 3   | A,B.       | Highpass Filter                                | WHKX2.9/18G-12SS   | Wainwright                    | 1          | 300003492 | ev                  | -/-              | -/-              |
| 4   | A,B.       | EMI Test Receiver 20Hz- 26,5GHz                | ESU26              | R&S                           | 100037     | 300003555 | k                   | 14.09.2018       | 13.12.2019       |
| 5   | A,B.       | Broadband Amplifier 5-13 GHz                   | CBLU5135235        | CERNEX                        | 22010      | 300004491 | ev                  | -/-              | -/-              |
| 6   | A,B.       | 4U RF Switch Platform                          | L4491A             | Agilent Technologies          | MY50000037 | 300004509 | ne                  | -/-              | -/-              |
| 7   | A,B        | NEXIO EMV-Software                             | BAT EMC V3.16.0.49 | EMCO                          |            | 300004682 | ne                  | -/-              | -/-              |
| 8   | A,B        | PC                                             | ExOne              | F+W                           |            | 300004703 | ne                  | -/-              | -/-              |
| 9   | A          | TRILOG Broadband Test-Antenna 30 MHz - 3 GHz   | VULB9163           | Schwarzbeck Mess - Elektronik | 01029      | 300005379 | vIK!!               | 07.04.2017       | 06.04.2020       |

## 6.2 Conducted measurements normal and extreme conditions

### Conducted measurements normal & extreme conditions



OP = AV + CA  
 (OP-output power; AV-analyzer value; CA-loss signal path)

#### Example calculation:

OP [dBm] = 6.0 [dBm] + 11.7 [dB] = 17.7 [dBm] (58.88 mW)

#### Equipment table:

| No. | Lab / Item | Equipment                     | Type             | Manufacturer             | Serial No.     | INV. No.  | Kind of Calibration | Last Calibration | Next Calibration |
|-----|------------|-------------------------------|------------------|--------------------------|----------------|-----------|---------------------|------------------|------------------|
| 1   | A          | DC Power Supply, 60V, 10A     | 6038A            | HP                       | 3122A11097     | 300001204 | vKI!                | 12.12.2017       | 11.12.2020       |
| 2   | A          | Signal- and Spectrum Analyzer | FSW26            | R&S                      | 101455         | 300004528 | k                   | 19.12.2018       | 18.12.2019       |
| 3   | A          | RF-Cable SRD021 No. 3         | Enviroflex 316 D | Huber & Suhner           |                | 400001313 | ev                  | -/-              | -/-              |
| 4   | A          | RF-Cable SRD021 No. 4         | Enviroflex 316 D | Huber & Suhner           |                | 400001314 | ev                  | -/-              | -/-              |
| 5   | A          | Climatic Box                  | VT 4011          | Voetsch Industrietechnik | 58566230600010 | 300005363 | ev                  | 07.05.2018       | 06.05.2020       |

## 7 Measurement uncertainty

| Measurement uncertainty                                  |                                                    |
|----------------------------------------------------------|----------------------------------------------------|
| Test case                                                | Uncertainty                                        |
| Transmitter output power                                 | $\pm 3$ dB                                         |
| <b>Occupied bandwidth</b>                                | $\pm 3$ kHz to 10 kHz<br>(depends on the used RBW) |
| Transmitter frequency stability                          | $\pm 1$ Hz to 1 kHz<br>(depends on the used RBW)   |
| Transmitter unwanted emissions (radiated or conducted)   | Radiated: $\pm 3$ dB<br>Conducted: $\pm 0.5$ dB    |
| Modulation characteristics                               | -/-                                                |
| Necessary bandwidth (BN) for analogue systems            | $\pm 1$ kHz<br>(depends on the used RBW)           |
| Frequency modulation                                     | $\pm 3$ kHz<br>(depends on the used RBW)           |
| Spurious emissions conducted below 30 MHz (AC conducted) | $\pm 2.6$ dB                                       |

## 8 Summary of measurement results

|                                     |                                                                                                                          |
|-------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> | No deviations from the technical specifications were ascertained                                                         |
| <input type="checkbox"/>            | There were deviations from the technical specifications ascertained                                                      |
| <input type="checkbox"/>            | This test report is only a partial test report.<br>The content and verdict of the performed test cases are listed below. |

| TC Identifier | Description                                          | Verdict    | Date       | Remark |
|---------------|------------------------------------------------------|------------|------------|--------|
| RF-Testing    | FCC Part 15<br>RSS - 210, Issue 9<br>RSS-Gen Issue 5 | See table! | 2019-06-18 | -/-    |

| Test specification clause                                                       | Test case                                              | Temperature conditions | Voltage conditions | C                                   | NC                       | NA                                  | NP                       | Remark                  |
|---------------------------------------------------------------------------------|--------------------------------------------------------|------------------------|--------------------|-------------------------------------|--------------------------|-------------------------------------|--------------------------|-------------------------|
| FCC Part 15.236 (d)(1)<br>FCC Part 2.1046)<br>RSS-210 – G.3.1<br>RSS-Gen – 6.12 | Transmitter output power                               | Nominal                | Nominal            | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/> | -/-                     |
| FCC Part 15.2361 (e)(5)<br>FCC Part 2.1049<br>RSS-210 – G.3.2<br>RSS-Gen – 6.6  | Occupied bandwidth                                     | Nominal                | Nominal            | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/> | -/-                     |
| FCC Part 74.861 (e)(4)<br>FCC Part 2.1055<br>RSS-210 – G.3.3<br>RSS-Gen – 6.11  | Transmitter frequency stability                        | Nominal                | Nominal            | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/> | -/-                     |
|                                                                                 |                                                        | Extreme                | Extreme            | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/> |                         |
| FCC Part 15.236 (g)<br>RSS-210 – G.3.4<br>EN 300 422                            | Transmitter unwanted emissions (radiated or conducted) | Nominal                | Nominal            | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/> | -/-                     |
| FCC Part 2.1047                                                                 | Modulation characteristics                             | Nominal                | Nominal            | -/-                                 |                          |                                     |                          | -/-                     |
| FCC Part 15.236 (g)<br>RSS-210 G.3.4                                            | Necessary bandwidth (BN) for analogue systems          | Nominal                | Nominal            | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/> | -/-                     |
| FCC Part 74.861 (e)(3)<br>RSS-210 – G.3.5.2                                     | Frequency modulation                                   | Nominal                | Nominal            | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/> | -/-                     |
| FCC Part 74.861 (e)(7)                                                          | Receiver spurious emissions                            | Nominal                | Nominal            | <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | No receiver integrated! |
| FCC Part 15.107(a)<br>FCC Part 15.207                                           | Conducted emissions < 30 MHz                           | Nominal                | Nominal            | <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | -/-                     |

**Note:** C = Compliant; NC = Not compliant; NA = Not applicable; NP = Not performed

## 9 Additional comments

Reference documents: None

Special test descriptions: None

Configuration descriptions:

Tested Frequencies:

Band Aw+:

Lowest Channel: 470.100 MHz

Middle Channel: 516.100 MHz

Highest Channel: 557.900 MHz

Band Gw1:

Lowest Channel: 558.100 MHz

Middle Channel: 583.000 MHz

Highest Channel: 607.900 MHz

Test mode:



No test mode available.  
Test signal is applied to the transmitter.



Special software is used.  
EUT is transmitting pseudo random data by itself

Antennas and transmit  
operating modes:



Operating mode 1 (single antenna)

- Equipment with 1 antenna,
- Equipment with 2 diversity antennas operating in switched diversity mode by which at any moment in time only 1 antenna is used,
- Smart antenna system with 2 or more transmit/receive chains, but operating in a mode where only 1 transmit/receive chain is used)



Operating mode 2 (multiple antennas, no beamforming)

- Equipment operating in this mode contains a smart antenna system using two or more transmit/receive chains simultaneously but without beamforming.



Operating mode 3 (multiple antennas, with beamforming)

- Equipment operating in this mode contains a smart antenna system using two or more transmit/receive chains simultaneously with beamforming.  
In addition to the antenna assembly gain (G), the beamforming gain (Y) may have to be taken into account when performing the measurements.

## 10 Measurement results

### 10.1 Transmitter output power

#### Measurement:

| Measurement parameter    |                                                                                                                                                                                                                                                                   |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Detector:                | Peak (worst case) / Average (RMS)                                                                                                                                                                                                                                 |
| Sweep time:              | Auto / 20s                                                                                                                                                                                                                                                        |
| Resolution bandwidth:    | > emission bandwidth                                                                                                                                                                                                                                              |
| Video bandwidth:         | > resolution bandwidth                                                                                                                                                                                                                                            |
| Span:                    | > 2 times emissions bandwidth                                                                                                                                                                                                                                     |
| Trace mode:              | Max. hold                                                                                                                                                                                                                                                         |
| EUT configuration:       | Peak:<br>Unmodulated carrier<br><br>RMS:<br>Modulate the transmitter with a 2.5 kHz tone at a level 16 dB higher than that required to produce a frequency deviation of $\pm 75$ kHz, or to produce 50% of the manufacturer's rated deviation, whichever is less. |
| Test setup:              | See sub clause 6.1 – A                                                                                                                                                                                                                                            |
| Measurement uncertainty: | See sub clause 8                                                                                                                                                                                                                                                  |

#### Limits:

| FCC                   | IC                     |
|-----------------------|------------------------|
| 470 MHz to 608 MHz    |                        |
| 50 mW / 17 dBm (EIRP) | 250 mW / 24 dBm (EIRP) |

#### Result:

| Channels | Transmitter output power (EIRP) |           |           |           |
|----------|---------------------------------|-----------|-----------|-----------|
|          | Band Aw+*                       |           | Band Gw1* |           |
|          | Peak                            | Average   | Peak      | Average   |
| Lowest   | 14.30 dBm                       | 13.16 dBm | 16.62 dBm | 15.65 dBm |
| Middle   | 16.60 dBm                       | 15.61 dBm | 16.94 dBm | 15.77 dBm |
| Highest  | 15.25 dBm                       | 14.13 dBm | 17.16 dBm | 16.03 dBm |

\*) Output power set to 50 mW.

## 10.2 Occupied bandwidth

### Measurement:

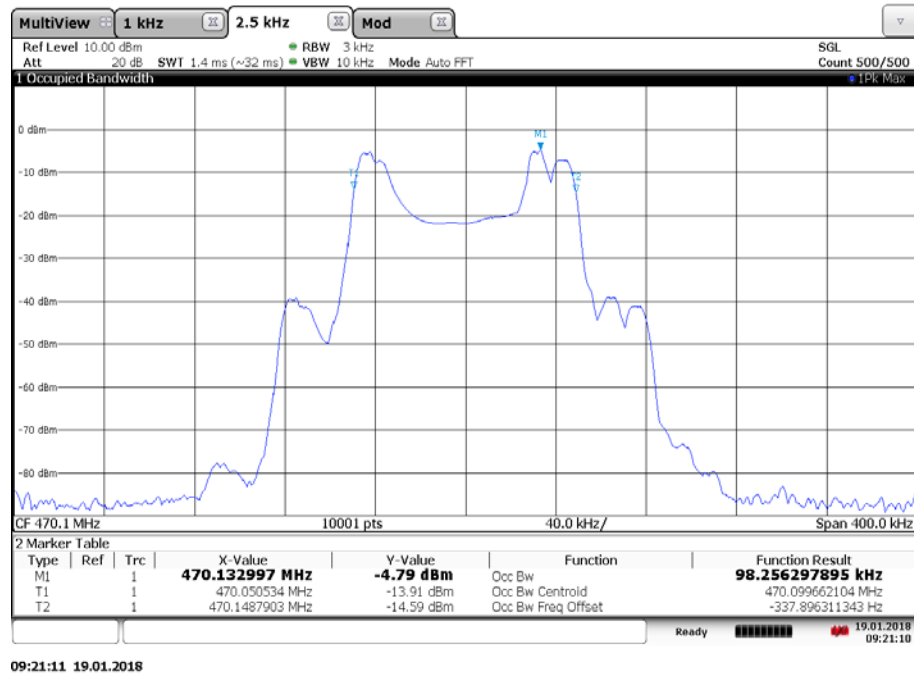
| Measurement parameter    |                                                |
|--------------------------|------------------------------------------------|
| Detector:                | Peak                                           |
| Sweep time:              | Auto                                           |
| Resolution bandwidth:    | 1 % to 5 % of the occupied bandwidth           |
| Video bandwidth:         | 3 x resolution bandwidth                       |
| Span:                    | 2 x emission bandwidth                         |
| Trace mode:              | Max. hold                                      |
| Analyzer function:       | 99% power occupied bandwidth function          |
| EUT:                     | Modulated signal with max. frequency deviation |
| Test setup:              | See sub clause 6.2 - A                         |
| Measurement uncertainty: | See sub clause 8                               |

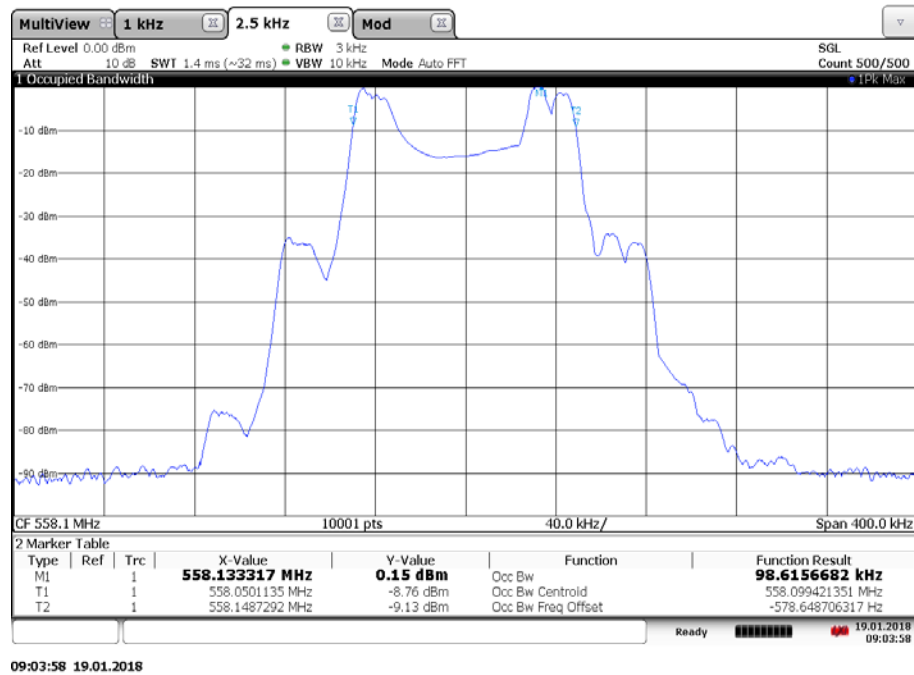
### Limits:

| FCC & IC                                                                                                                                                                                                                                                                                                                    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 470 MHz to 608 MHz    200 kHz                                                                                                                                                                                                                                                                                               |
| Occupied bandwidth 99%. Other than single sideband or independent sideband transmitters - when modulated by a 2500 Hz tone at an input level 16 dB greater than that necessary to produce 50 percent modulation. The input level shall be established at the frequency of maximum response of the audio modulating circuit. |

### Result:

| Occupied bandwidth |          |          |
|--------------------|----------|----------|
| Channels           | Band Aw+ | Band Gw1 |
| Lowest             | 98.3 kHz | 98.6 kHz |
| Middle             | 96.2 kHz | 97.3 kHz |
| Highest            | 95.8 kHz | 97.2 kHz |

**Plots:** Band Aw+**Plot 1:** lowest channel**Plot 2:** middle channel

**Plot 3: highest channel****Plots: Band Gw1****Plot 1: lowest channel**

**Plot 2: middle channel****Plot 3: highest channel**

### 10.3 Transmitter frequency stability

#### Measurement:

| Measurement parameter    |                                                     |
|--------------------------|-----------------------------------------------------|
| Detector:                | Peak                                                |
| Sweep time:              | Auto                                                |
| Resolution bandwidth:    | 1 Hz / 10 Hz / 100 Hz                               |
| Video bandwidth:         | 3 x resolution bandwidth                            |
| Span:                    | wide enough to follow the frequency drift           |
| Trace mode:              | clear/write/view                                    |
| EUT:                     | CW signal or MC with measurement method description |
| Test setup:              | See sub clause 6.2 - B                              |
| Measurement uncertainty: | See sub clause 8                                    |

#### Limits:

| FCC & IC                       |
|--------------------------------|
| 470 MHz to 608 MHz    ± 50 ppm |

#### Results: Band Aw+, lowest channel

| Temperature / Voltage           | Frequency (MHz) | Deviation (kHz) | Deviation (ppm) |
|---------------------------------|-----------------|-----------------|-----------------|
| -30 °C / V <sub>nom</sub>       | 470.098222      | -1.778          | -3.782          |
| -20 °C / V <sub>nom</sub>       | 470.099268      | -0.732          | -1.557          |
| -10 °C / V <sub>nom</sub>       | 470.100543      | 0.543           | 1.155           |
| 0 °C / V <sub>nom</sub>         | 470.101103      | 1.103           | 2.346           |
| +10 °C / V <sub>nom</sub>       | 470.100815      | 0.815           | 1.734           |
| +20 °C / V <sub>nom</sub>       | 470.100210      | 0.210           | 0.447           |
| +30 °C / V <sub>nom</sub>       | 470.099929      | -0.071          | -0.151          |
| +40 °C / V <sub>nom</sub>       | 470.099648      | -0.352          | -0.749          |
| +50 °C / V <sub>nom</sub>       | 470.099573      | -0.427          | -0.908          |
| +20 °C / V <sub>nom</sub> - 15% | 470.100257      | 0.257           | 0.547           |
| +20 °C / V <sub>nom</sub>       | 470.100210      | 0.210           | 0.447           |
| +20 °C / V <sub>nom</sub> + 15% | 470.100236      | 0.236           | 0.502           |

**Results:** Band Aw+, middle channel

| Temperature / Voltage     | Frequency (MHz) | Deviation (kHz) | Deviation (ppm) |
|---------------------------|-----------------|-----------------|-----------------|
| -30 °C / $V_{nom}$        | 516.097013      | 0.013           | 0.025           |
| -20 °C / $V_{nom}$        | 516.099775      | -0.225          | -0.436          |
| -10 °C / $V_{nom}$        | 516.101066      | 1.066           | 2.066           |
| 0 °C / $V_{nom}$          | 516.101061      | 1.061           | 2.056           |
| +10 °C / $V_{nom}$        | 516.100578      | 0.578           | 1.120           |
| +20 °C / $V_{nom}$        | 516.100261      | 0.261           | 0.506           |
| +30 °C / $V_{nom}$        | 516.099903      | -0.097          | -0.188          |
| +40 °C / $V_{nom}$        | 516.099597      | -0.403          | -0.781          |
| +50 °C / $V_{nom}$        | 516.099433      | -0.567          | -1.099          |
| +20 °C / $V_{nom} - 15\%$ | 516.100254      | 0.254           | 0.492           |
| +20 °C / $V_{nom}$        | 516.100261      | 0.261           | 0.506           |
| +20 °C / $V_{nom} + 15\%$ | 516.100240      | 0.240           | 0.465           |

**Results:** Band Aw+, highest channel

| Temperature / Voltage     | Frequency (MHz) | Deviation (kHz) | Deviation (ppm) |
|---------------------------|-----------------|-----------------|-----------------|
| -30 °C / $V_{nom}$        | 557.897382      | -2.618          | -4.693          |
| -20 °C / $V_{nom}$        | 557.900004      | 0.004           | 0.007           |
| -10 °C / $V_{nom}$        | 557.900733      | 0.733           | 1.314           |
| 0 °C / $V_{nom}$          | 557.901126      | 1.126           | 2.018           |
| +10 °C / $V_{nom}$        | 557.900836      | 0.836           | 1.499           |
| +20 °C / $V_{nom}$        | 557.900120      | 0.120           | 0.215           |
| +30 °C / $V_{nom}$        | 557.899792      | -0.209          | -0.375          |
| +40 °C / $V_{nom}$        | 557.899502      | -0.498          | -0.893          |
| +50 °C / $V_{nom}$        | 557.899346      | -0.654          | -1.172          |
| +20 °C / $V_{nom} - 15\%$ | 557.900190      | 0.189           | 0.339           |
| +20 °C / $V_{nom}$        | 557.900120      | 0.120           | 0.215           |
| +20 °C / $V_{nom} + 15\%$ | 557.900221      | 0.221           | 0.396           |

**Results:** Band Gw1, lowest channel

| Temperature / Voltage     | Frequency (MHz) | Deviation (kHz) | Deviation (ppm) |
|---------------------------|-----------------|-----------------|-----------------|
| -30 °C / $V_{nom}$        | 558.094087      | -0.713          | -1.278          |
| -20 °C / $V_{nom}$        | 558.098904      | -1.096          | -1.964          |
| -10 °C / $V_{nom}$        | 558.098904      | -1.096          | -1.964          |
| 0 °C / $V_{nom}$          | 558.100140      | 0.140           | 0.251           |
| +10 °C / $V_{nom}$        | 558.100418      | 0.418           | 0.749           |
| +20 °C / $V_{nom}$        | 558.100268      | 0.268           | 0.480           |
| +30 °C / $V_{nom}$        | 558.100261      | 0.261           | 0.468           |
| +40 °C / $V_{nom}$        | 558.100891      | 0.591           | 1.059           |
| +50 °C / $V_{nom}$        | 558.100701      | 0.701           | 1.256           |
|                           |                 |                 |                 |
| +20 °C / $V_{nom} - 15\%$ | 558.100273      | 0.273           | 0.489           |
| +20 °C / $V_{nom}$        | 558.100268      | 0.268           | 0.480           |
| +20 °C / $V_{nom} + 15\%$ | 558.100245      | 0.245           | 0.439           |

**Results:** Band Gw1, middle channel

| Temperature / Voltage     | Frequency (MHz) | Deviation (kHz) | Deviation (ppm) |
|---------------------------|-----------------|-----------------|-----------------|
| -30 °C / $V_{nom}$        | 582.994101      | -0.999          | -1.714          |
| -20 °C / $V_{nom}$        | 582.997520      | -2.480          | -4.254          |
| -10 °C / $V_{nom}$        | 582.999151      | -0.849          | -1.456          |
| 0 °C / $V_{nom}$          | 583.000215      | 0.215           | 0.369           |
| +10 °C / $V_{nom}$        | 583.000288      | 0.288           | 0.494           |
| +20 °C / $V_{nom}$        | 583.000266      | 0.266           | 0.456           |
| +30 °C / $V_{nom}$        | 583.000305      | 0.305           | 0.523           |
| +40 °C / $V_{nom}$        | 583.000389      | 0.389           | 0.667           |
| +50 °C / $V_{nom}$        | 582.000769      | 0.770           | 1.321           |
|                           |                 |                 |                 |
| +20 °C / $V_{nom} - 15\%$ | 583.000252      | 0.255           | 0.437           |
| +20 °C / $V_{nom}$        | 583.000266      | 0.266           | 0.456           |
| +20 °C / $V_{nom} + 15\%$ | 583.00301       | 0.301           | 0.516           |

**Results:** Band Gw1, highest channel

| Temperature / Voltage     | Frequency (MHz) | Deviation (kHz) | Deviation (ppm) |
|---------------------------|-----------------|-----------------|-----------------|
| -30 °C / $V_{nom}$        | 607.893528      | -0.072          | -0.119          |
| -20 °C / $V_{nom}$        | 607.897623      | -2.377          | -3.910          |
| -10 °C / $V_{nom}$        | 607.899054      | -0.946          | -1.556          |
| 0 °C / $V_{nom}$          | 607.900176      | 0.176           | 0.290           |
| +10 °C / $V_{nom}$        | 607.900303      | 0.303           | 0.499           |
| +20 °C / $V_{nom}$        | 607.900213      | 0.213           | 0.350           |
| +30 °C / $V_{nom}$        | 607.900138      | 0.138           | 0.227           |
| +40 °C / $V_{nom}$        | 607.900359      | 0.359           | 0.591           |
| +50 °C / $V_{nom}$        | 607.900817      | 0.817           | 1.344           |
|                           |                 |                 |                 |
| +20 °C / $V_{nom} - 15\%$ | 607.900186      | 0.186           | 0.306           |
| +20 °C / $V_{nom}$        | 607.900213      | 0.213           | 0.350           |
| +20 °C / $V_{nom} + 15\%$ | 607.900129      | 0.129           | 0.212           |

## 10.4 Transmitter unwanted emissions (radiated)

### Measurement:

| Measurement parameter    |                                 |
|--------------------------|---------------------------------|
| Detector:                | Peak (prescan) / RMS            |
| Sweep time:              | Auto                            |
| Resolution bandwidth:    | See table below!                |
| Video bandwidth:         | See table below!                |
| Span:                    | 100 MHz steps!                  |
| Trace-Mode:              | Max. hold                       |
| EUT:                     | MC with max frequency deviation |
| Used equipment:          | See chapter 6.1- A / B          |
| Measurement uncertainty: | See chapter 8                   |

| Frequency being measured | Measuring receiver bandwidth |
|--------------------------|------------------------------|
| 25 MHz to 30 MHz         | 9 kHz to 10 kHz              |
| 30 MHz to 1 000 MHz      | 100 kHz                      |
| > 1 000 MHz              | 1 MHz                        |

### Limits:

| FCC & IC (EN 300 422) |                                                                                     |                                 |                               |
|-----------------------|-------------------------------------------------------------------------------------|---------------------------------|-------------------------------|
| State                 | Max. spurious level                                                                 |                                 |                               |
|                       | 47 MHz to 74 MHz<br>87.5 MHz to 137 MHz<br>174 MHz to 230 MHz<br>470 MHz to 862 MHz | Other frequencies<br>≤ 1000 MHz | All frequencies<br>> 1000 MHz |
| Operating             | 4.0 nW                                                                              | 250 nW                          | 1.00 µW                       |
| Standby               | 2.0 nW                                                                              | 2.0 nW                          | 20.0 nW                       |

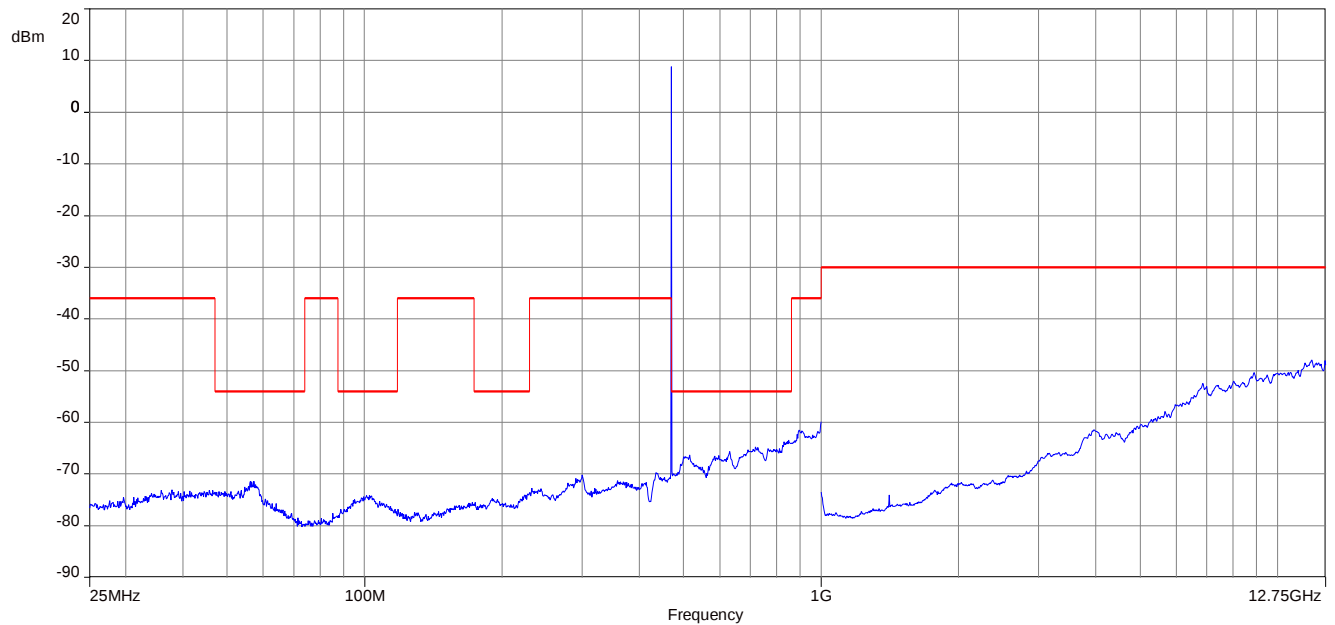
| FCC & IC                                                                                                                                            |                                              |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| The mean power of emissions shall be attenuated below the mean output power of the transmitter in accordance with the following schedule:           |                                              |
| On any frequency removed from the operating frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: at least | 25 dB                                        |
| On any frequency removed from the operating frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth          | 35 dB                                        |
| On any frequency removed from the operating frequency by more than 250 percent of the authorized bandwidth: at least                                | 43 + 10log10 (mean output power in watts) dB |

**Results:**

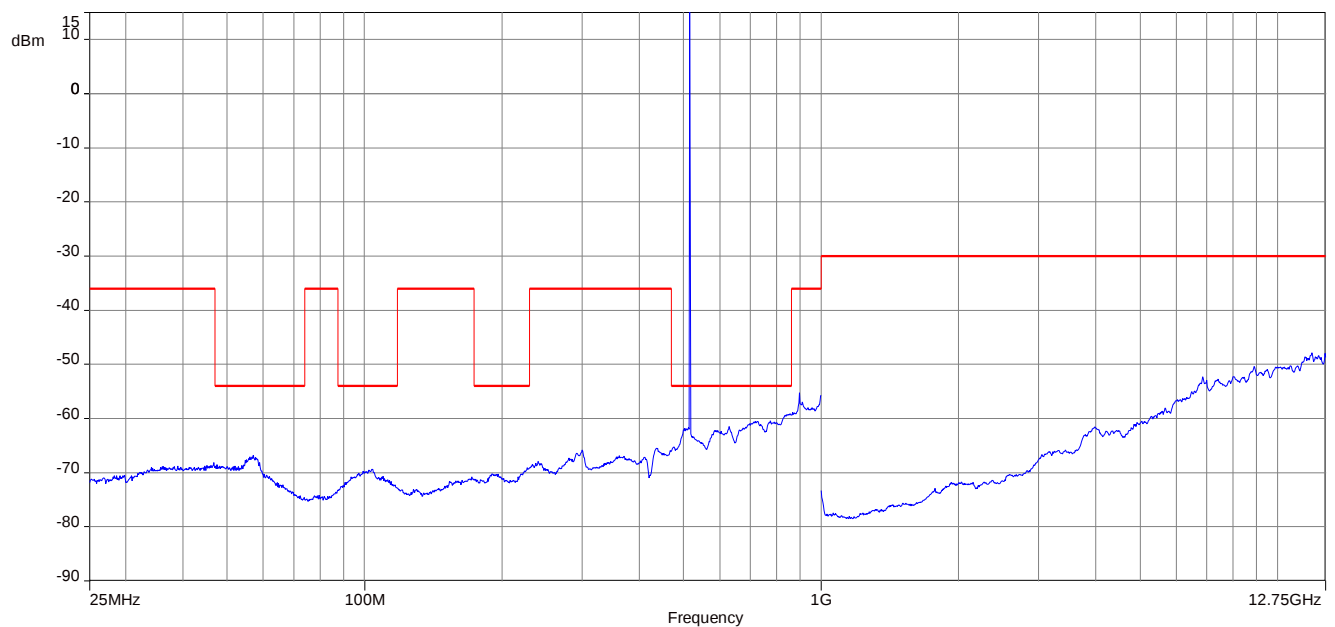
| carrier frequency (MHz)                                     | unwanted emission frequency (MHz) | Limit | level (dB) / (dBm) or remark |
|-------------------------------------------------------------|-----------------------------------|-------|------------------------------|
| All detected emissions are more than 20 dB below the limit. |                                   |       |                              |
|                                                             |                                   |       |                              |
|                                                             |                                   |       |                              |

**Plots:** Band Aw+ (Included Band A1)

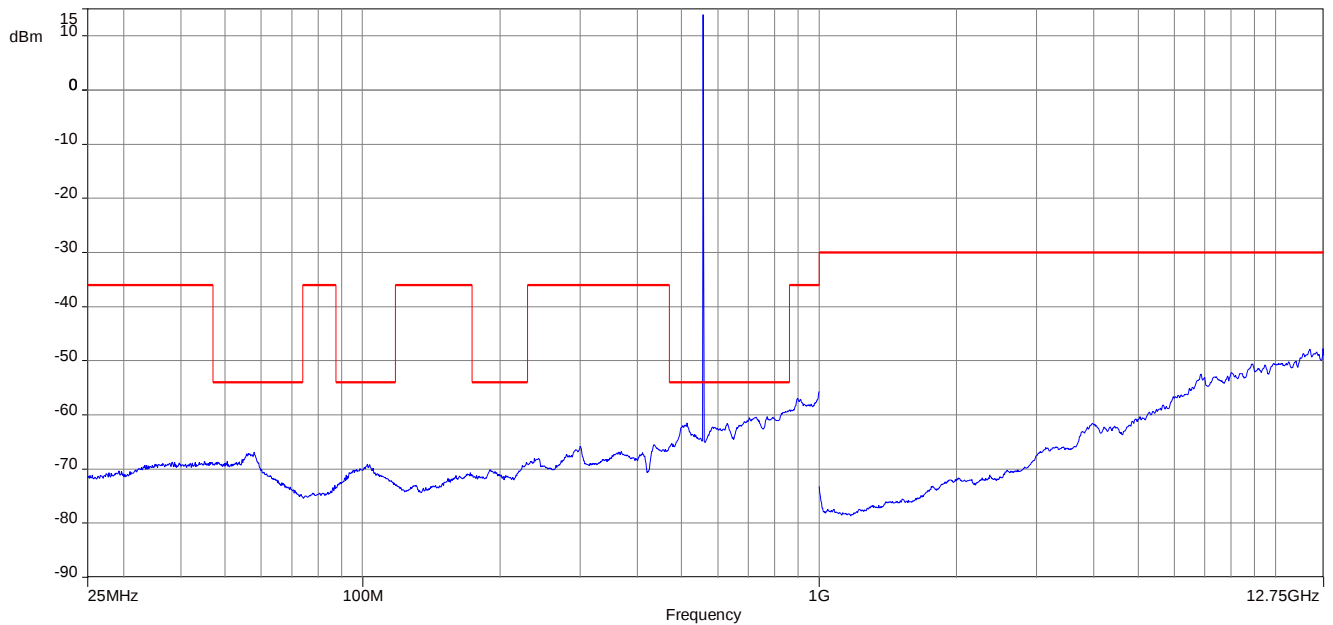
**Plot 1:** lowest channel, spurious emissions, 25 MHz – 12.75 GHz



**Plot 2:** middle channel, spurious emissions, 25 MHz – 12.75 GHz

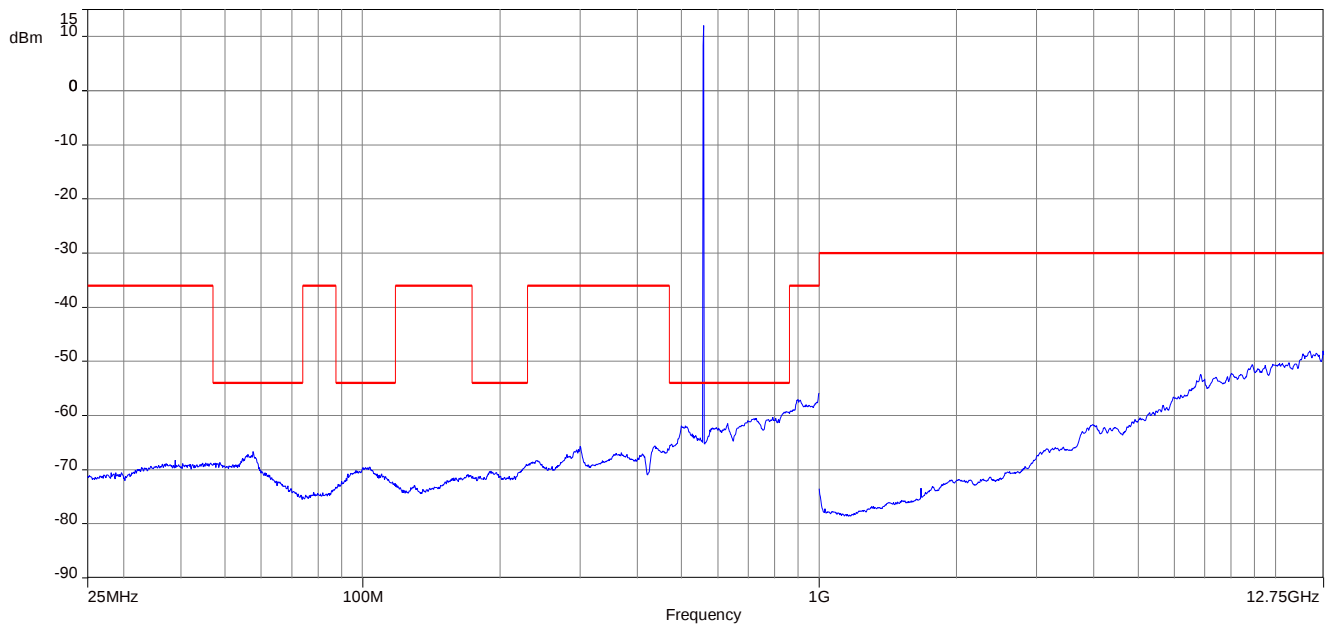


**Plot 3:** highest channel, spurious emissions, 25 MHz – 12.75 GHz

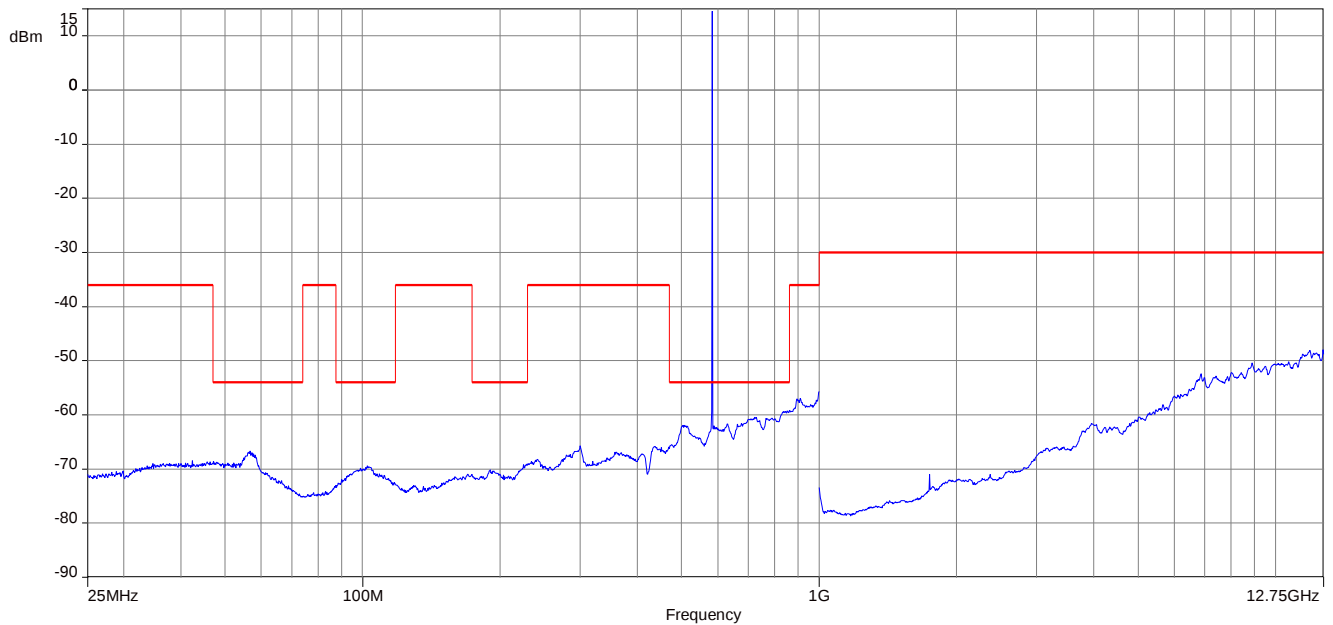


**Plots:** Band Gw1

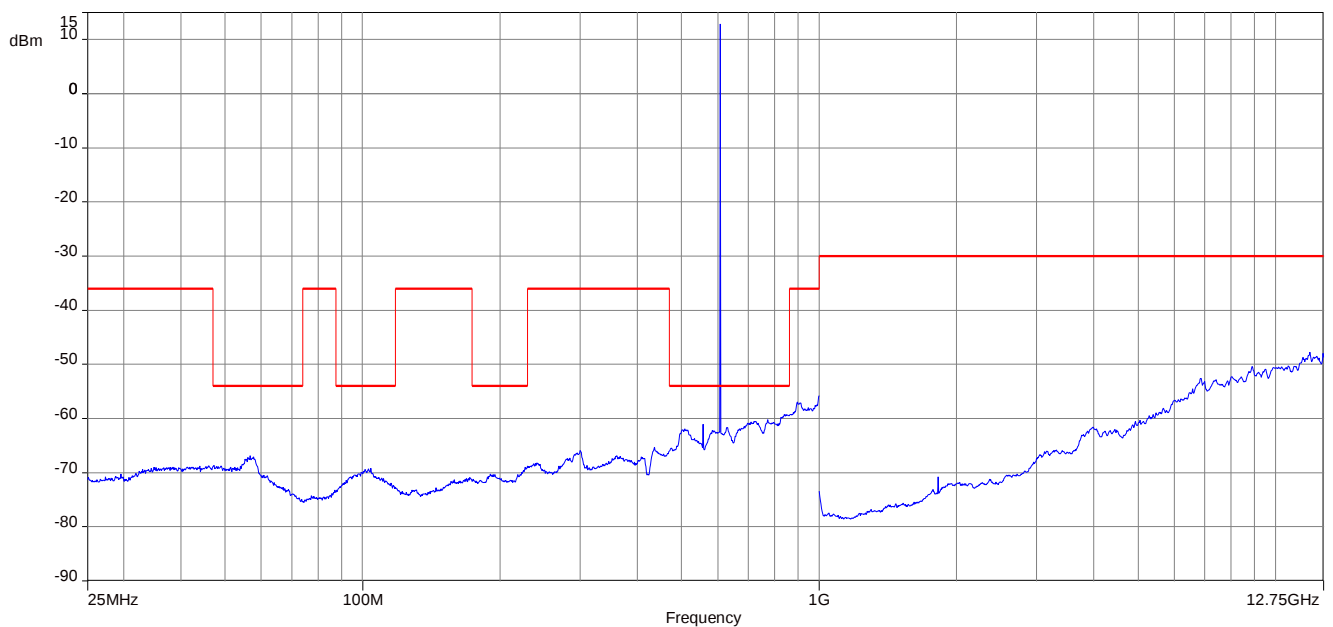
**Plot 1:** lowest channel, spurious emissions, 25 MHz – 12.75 GHz



**Plot 2:** middle channel, spurious emissions, 25 MHz – 12.75 GHz



**Plot 3:** highest channel, spurious emissions, 25 MHz – 12.75 GHz



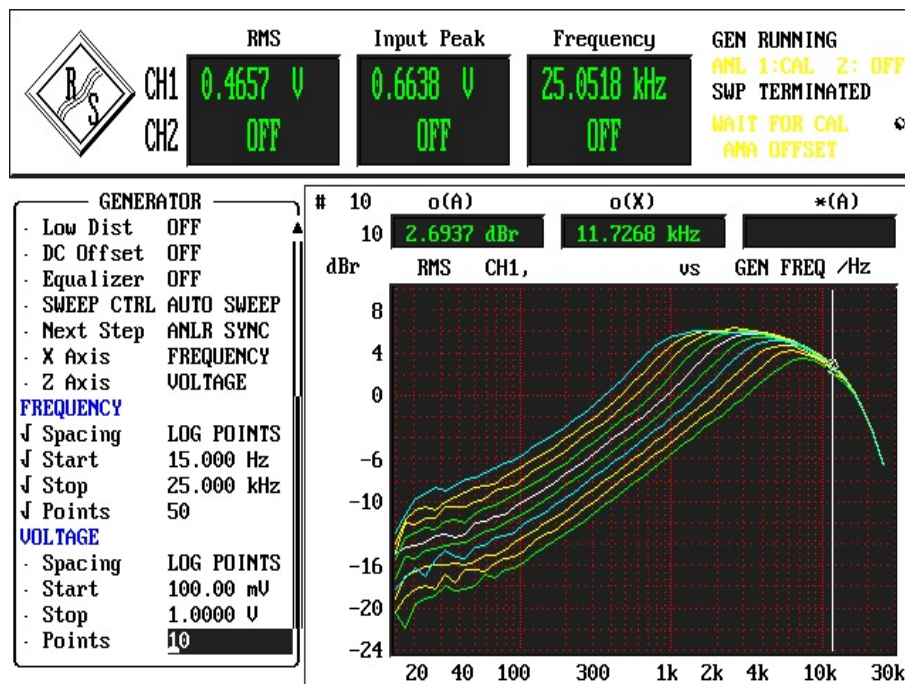
## 10.5 Modulation characteristics

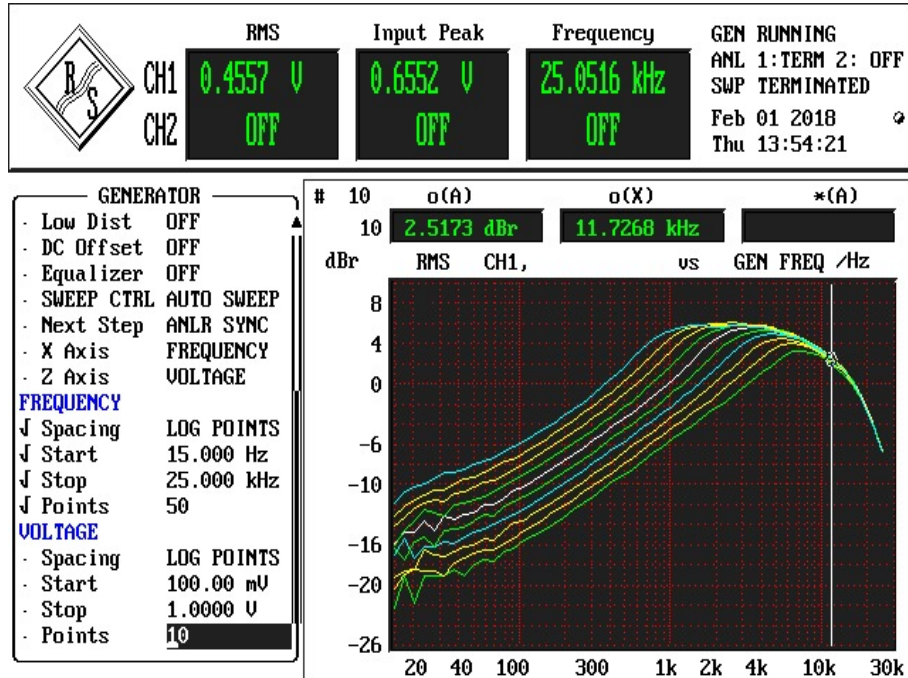
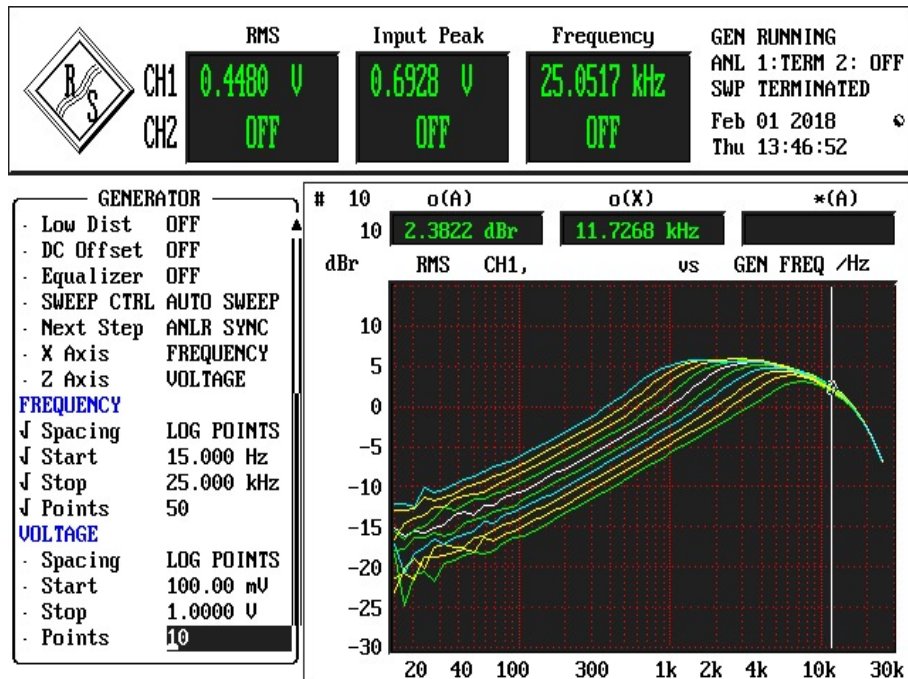
### Method of measurement:

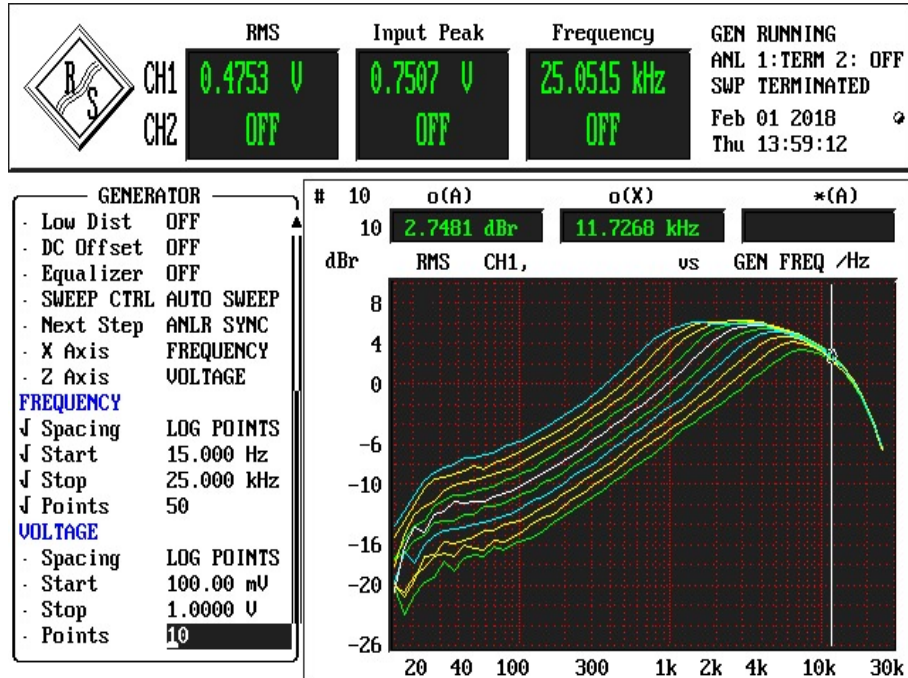
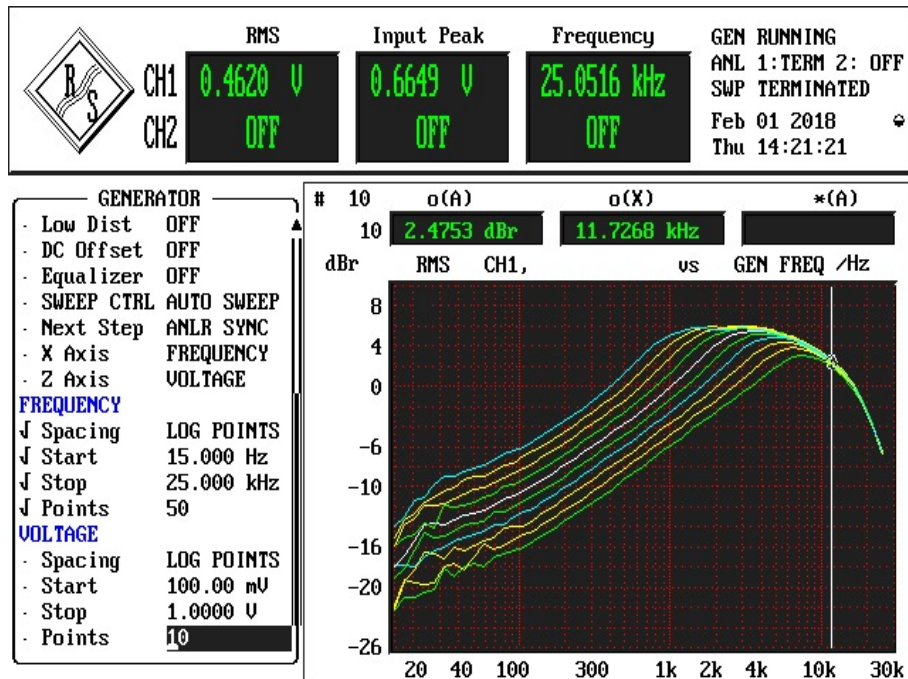
The audio frequency response was measured in accordance with EIA/TIA 603. The plots shows 10 curves with different modulation levels, the test frequency is varied from 15 Hz to 20 kHz.

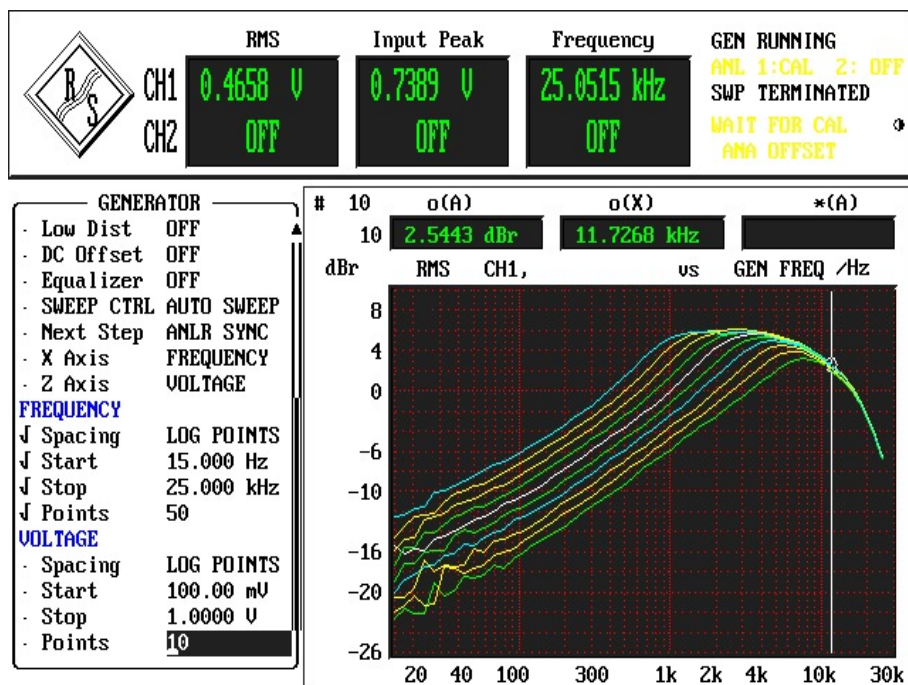
**Plots:** Band Aw+

**Plot 1:** lowest channel, 10 curves with voltage and frequency variation



**Plot 2:** middle channel, 10 curves with voltage and frequency variation**Plot 3:** highest channel, 10 curves with voltage and frequency variation

**Plots:** Band Gw1**Plot 1:** lowest channel, 10 curves with voltage and frequency variation**Plot 2:** middle channel, 10 curves with voltage and frequency variation

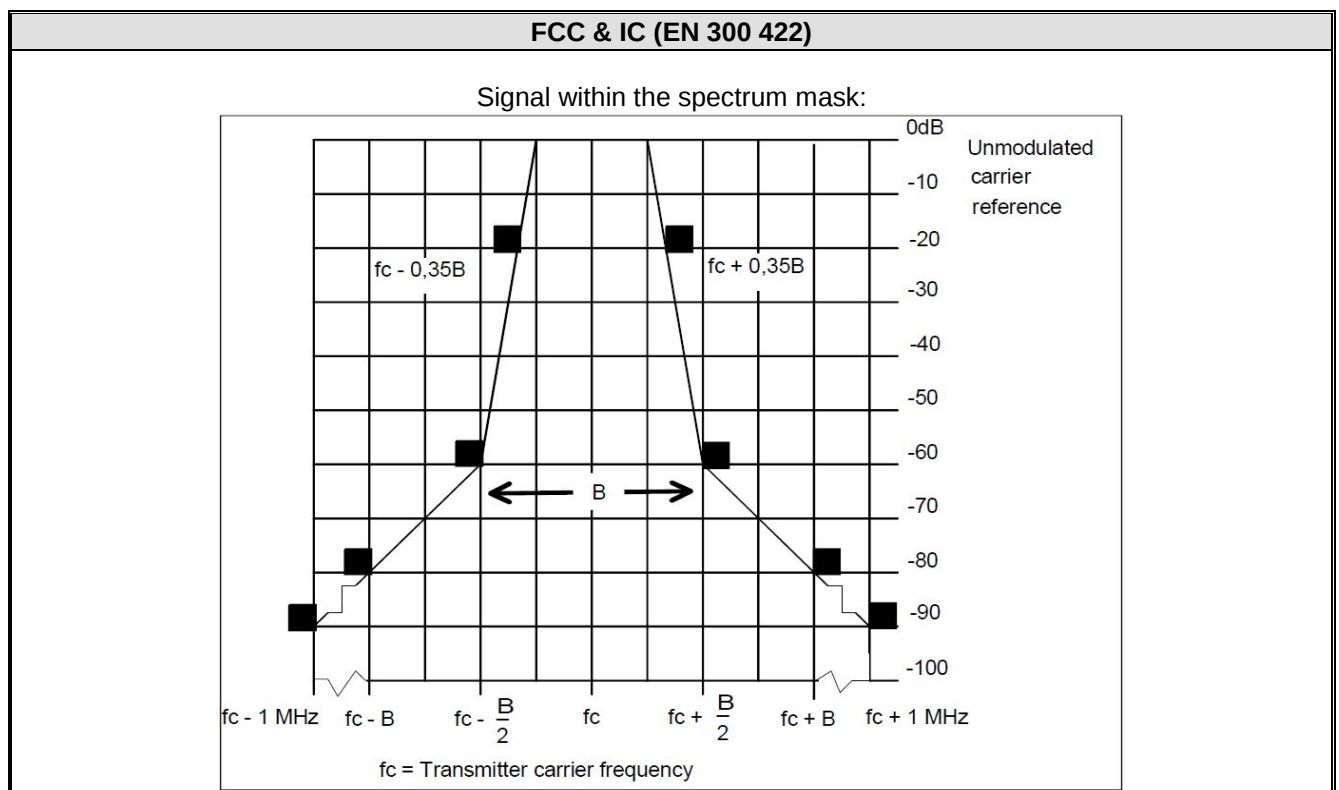
**Plot 3:** highest channel, 10 curves with voltage and frequency variation

## 10.6 Necessary bandwidth (BN) for analogue systems

### Measurement:

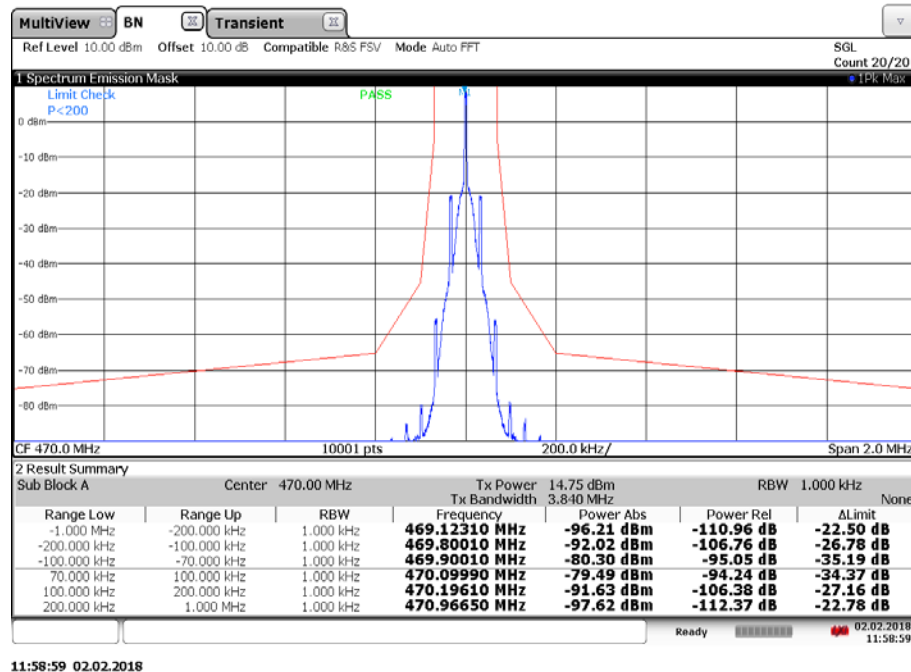
| Measurement parameter    |                                                        |
|--------------------------|--------------------------------------------------------|
| Detector:                | Peak / Average (-90 dBc point only)                    |
| Sweep time:              | Auto                                                   |
| Resolution bandwidth:    | 1 kHz                                                  |
| Video bandwidth:         | 1 kHz                                                  |
| Span:                    | $f_c - 1 \text{ MHz}$ to $f_c + 1 \text{ MHz}$ (2 MHz) |
| Trace mode:              | Max hold/view                                          |
| EUT:                     | CW and MC                                              |
| Test setup:              | See sub clause 6.2 - D                                 |
| Measurement uncertainty: | See sub clause 8                                       |

### Limits:

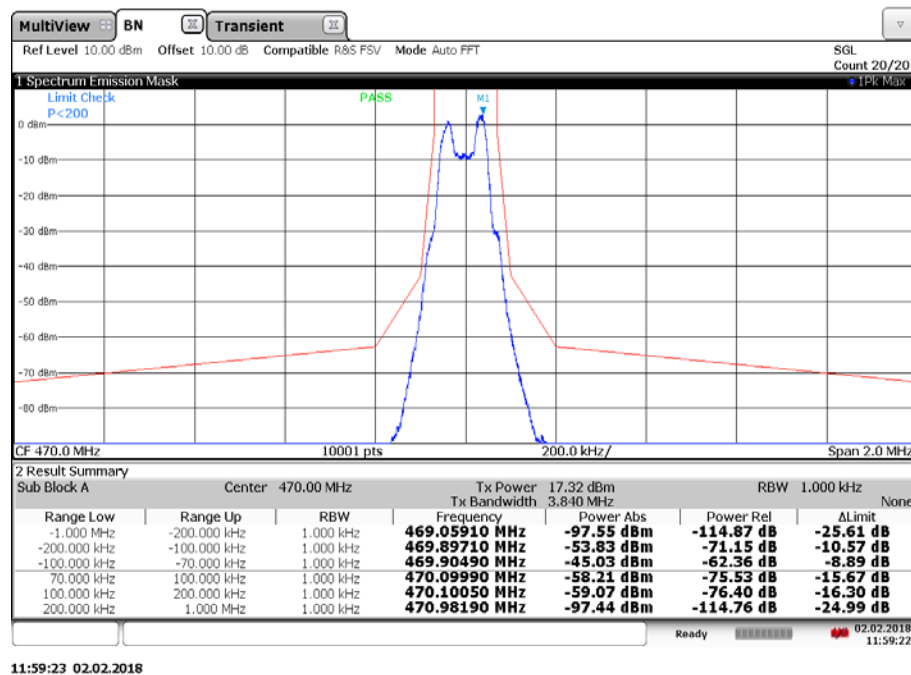


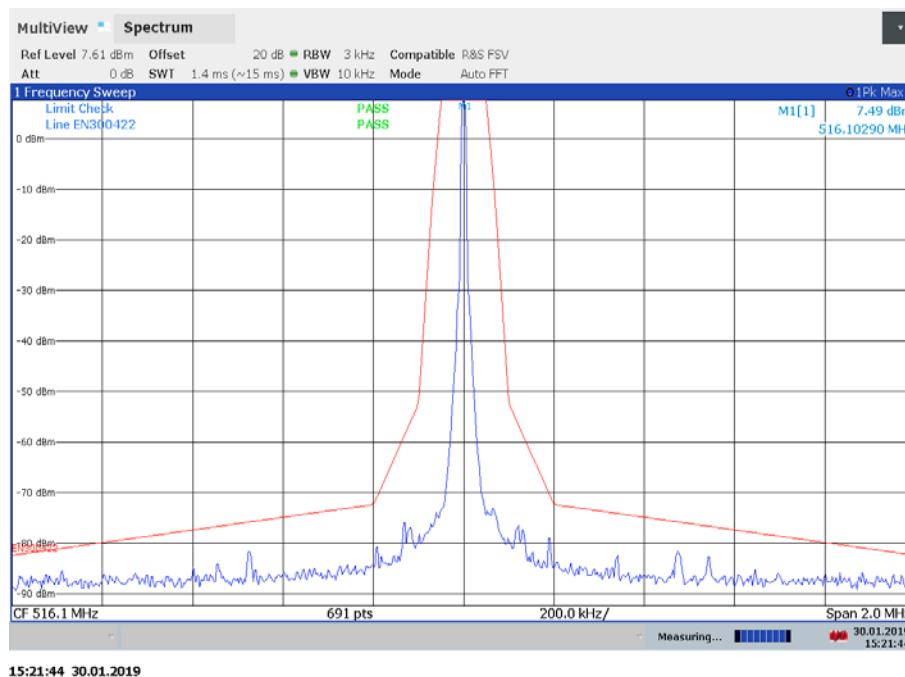
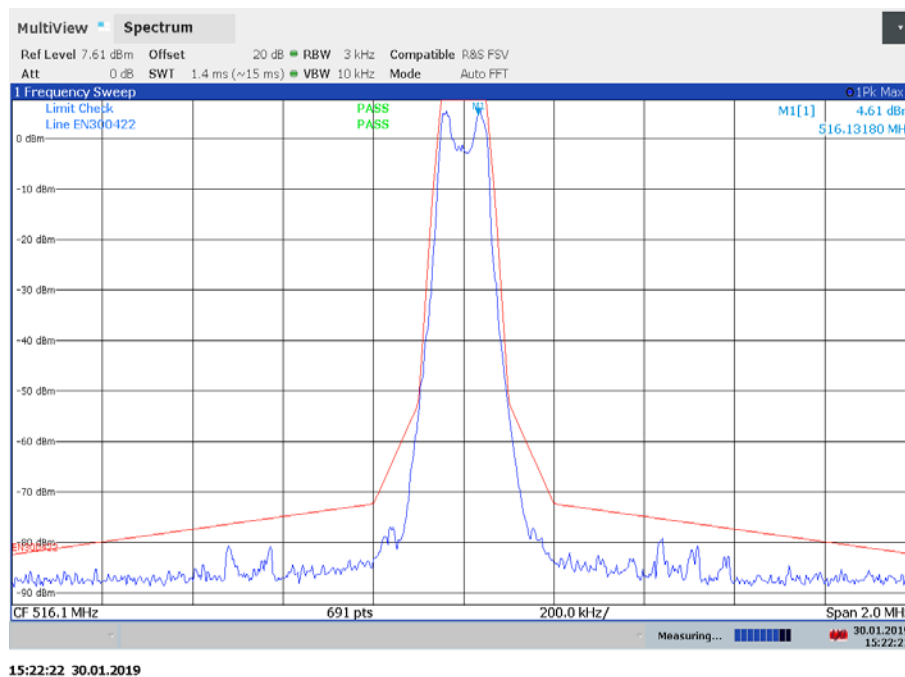
**Plots:** Band Aw+, lowest channel

**Plot 1:** Unmodulated carrier reference (with pilot-tone)



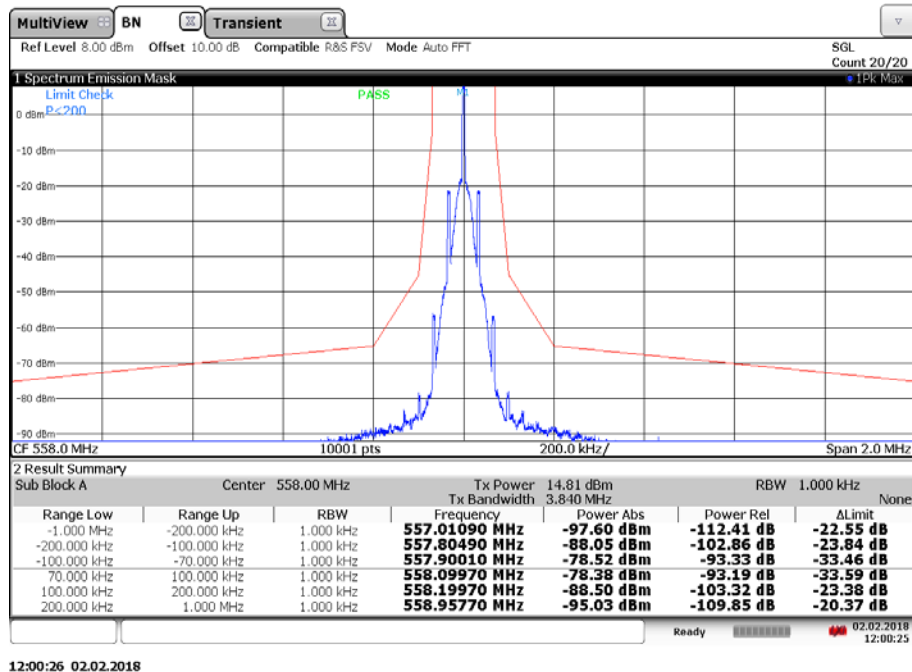
**Plot 2:** Modulated carrier with the weighted noise source



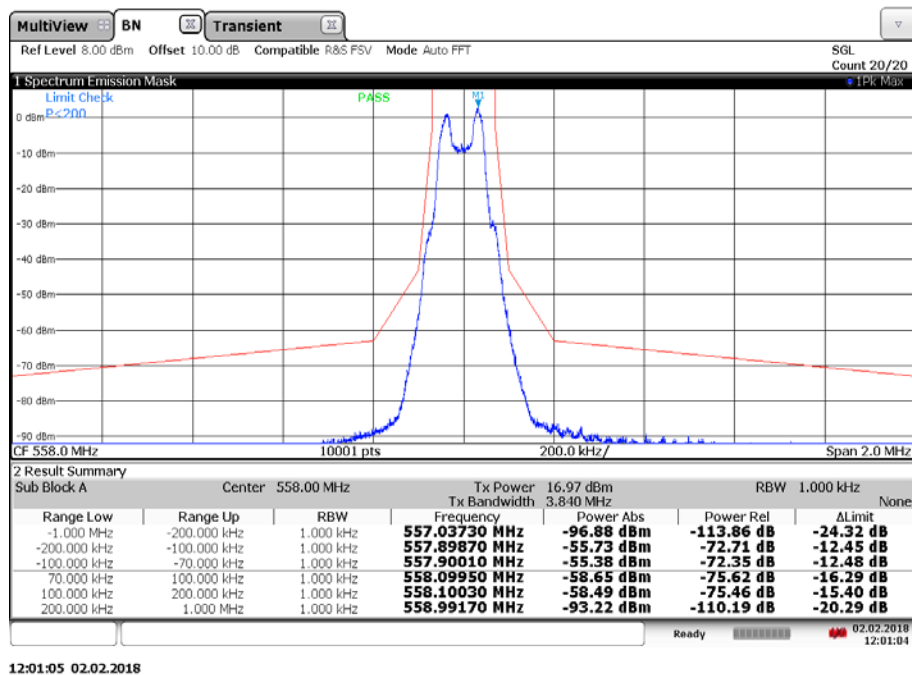
**Plots:** Middle channel**Plot 1:** Unmodulated carrier reference (with pilot-tone)**Plot 2:** Modulated carrier with the weighted noise source

**Plots:** Band Aw+, highest channel

**Plot 1:** Unmodulated carrier reference (with pilot-tone)

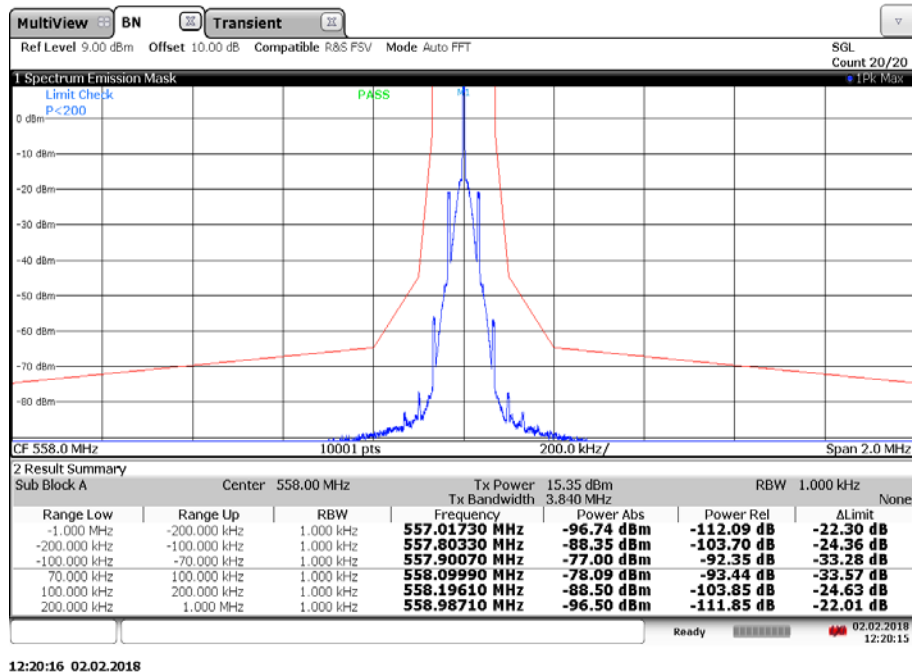


**Plot 2:** Modulated carrier with the weighted noise source

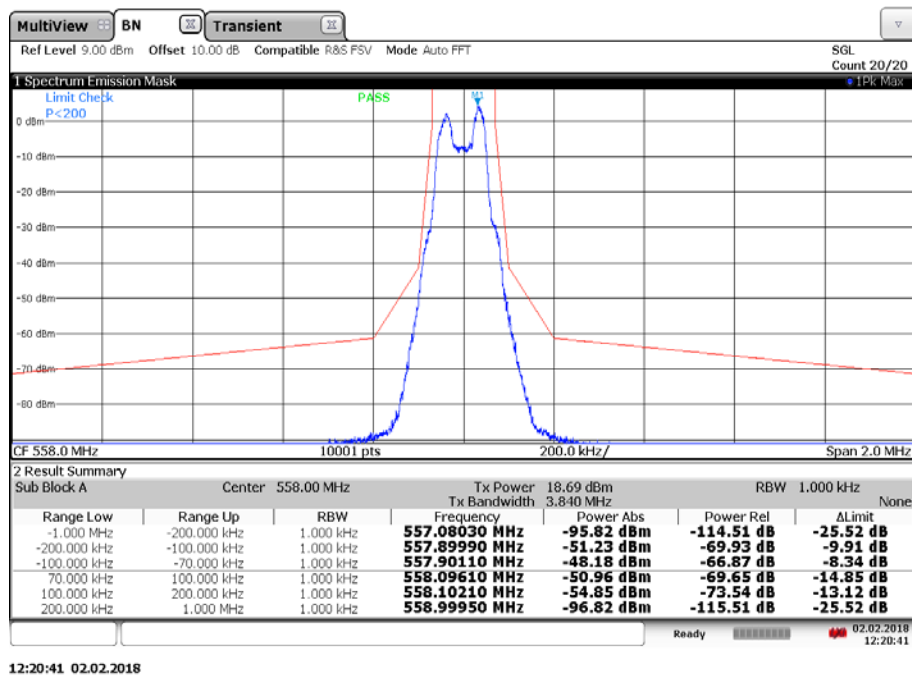


**Plots:** Band Gw1, lowest channel

**Plot 1:** Unmodulated carrier reference (with pilot-tone)

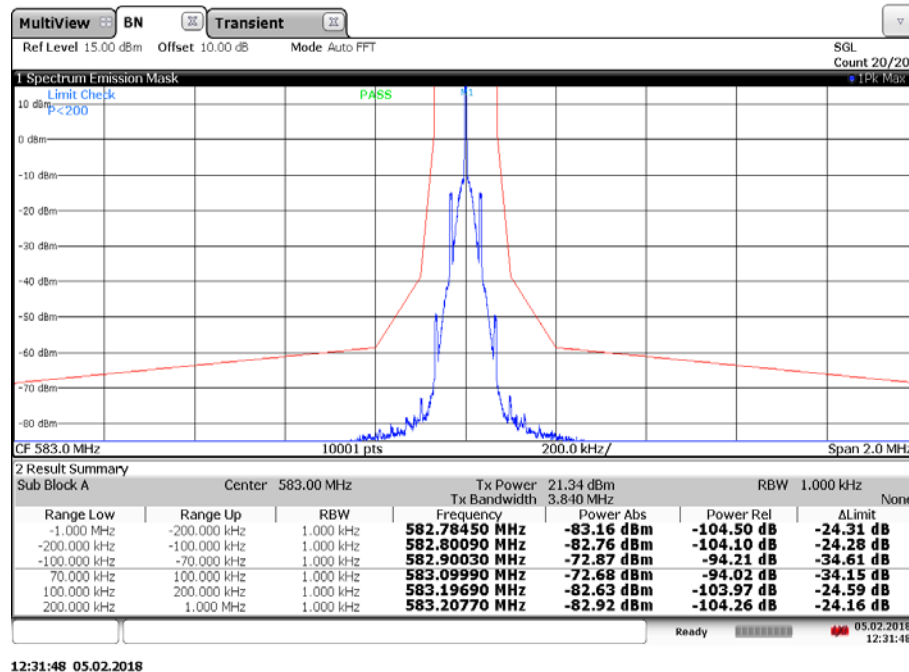


**Plot 2:** Modulated carrier with the weighted noise source

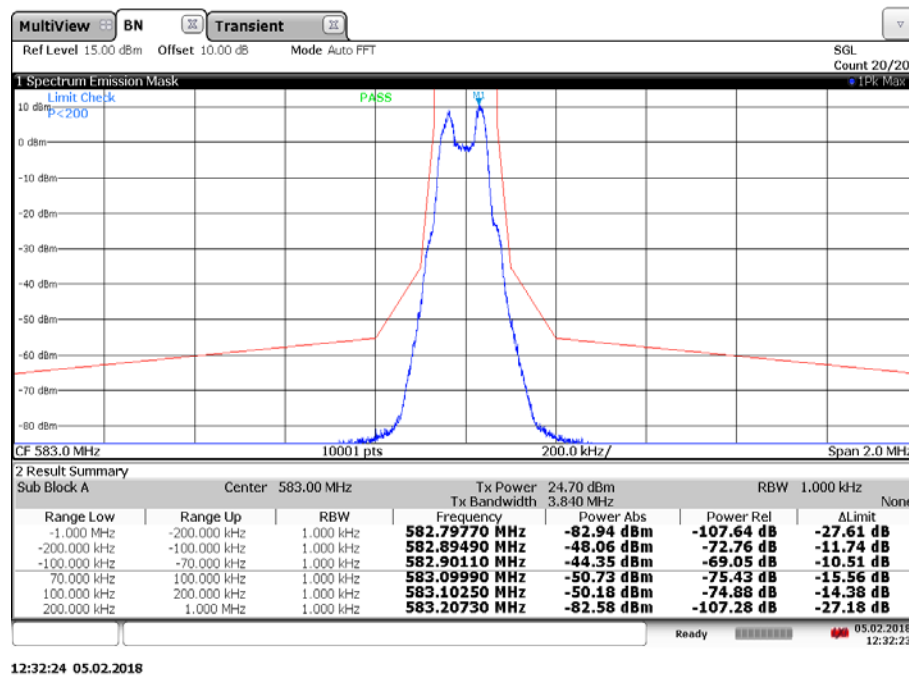


**Plots:** Band Gw1, middle channel

**Plot 1:** Unmodulated carrier reference (with pilot-tone)

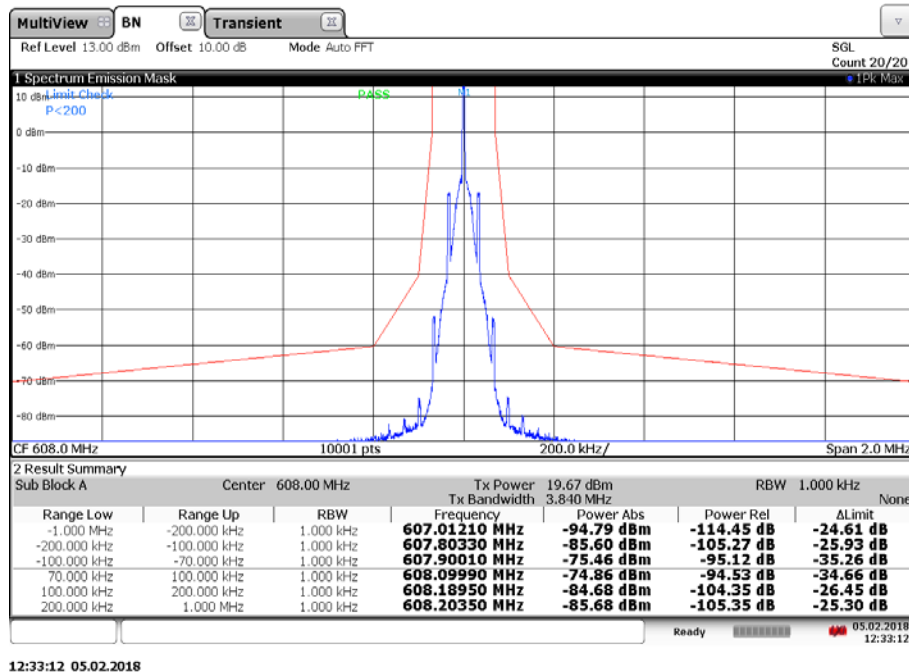


**Plot 2:** Modulated carrier with the weighted noise source

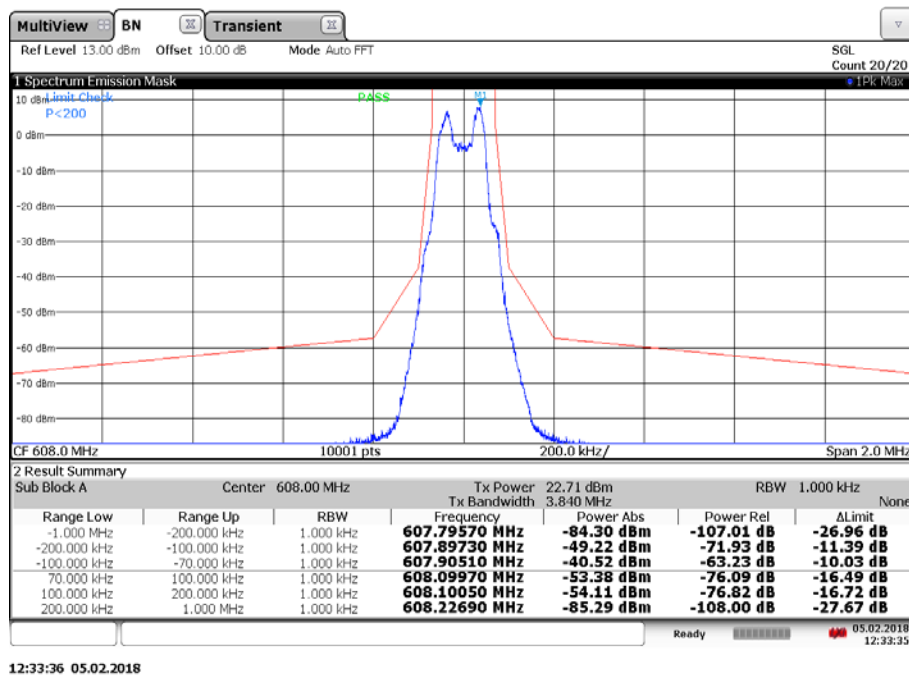


**Plots:** Band Gw1, highest channel

**Plot 1:** Unmodulated carrier reference (with pilot-tone)



**Plot 2:** Modulated carrier with the weighted noise source



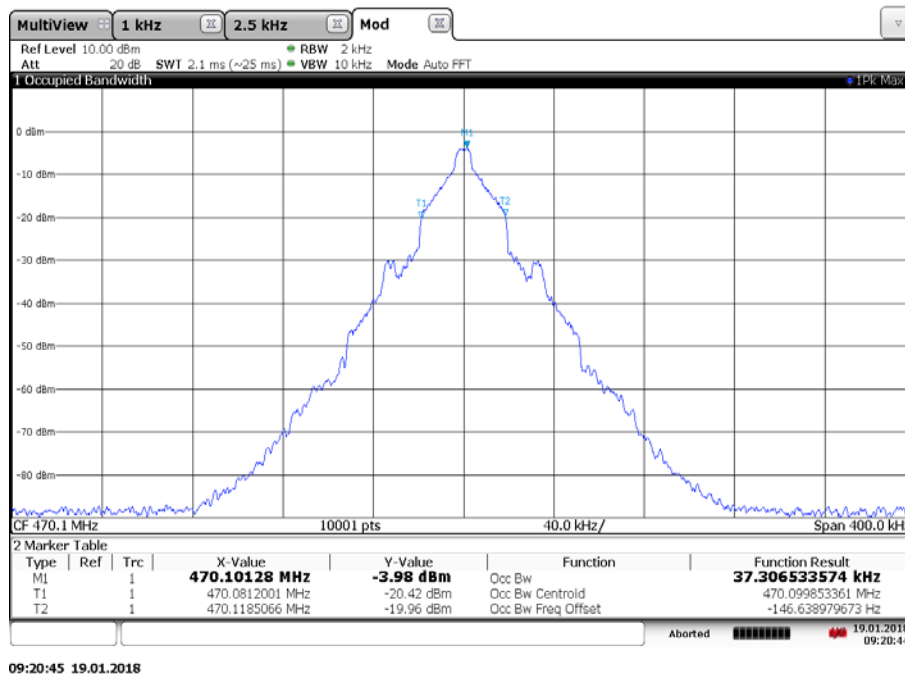
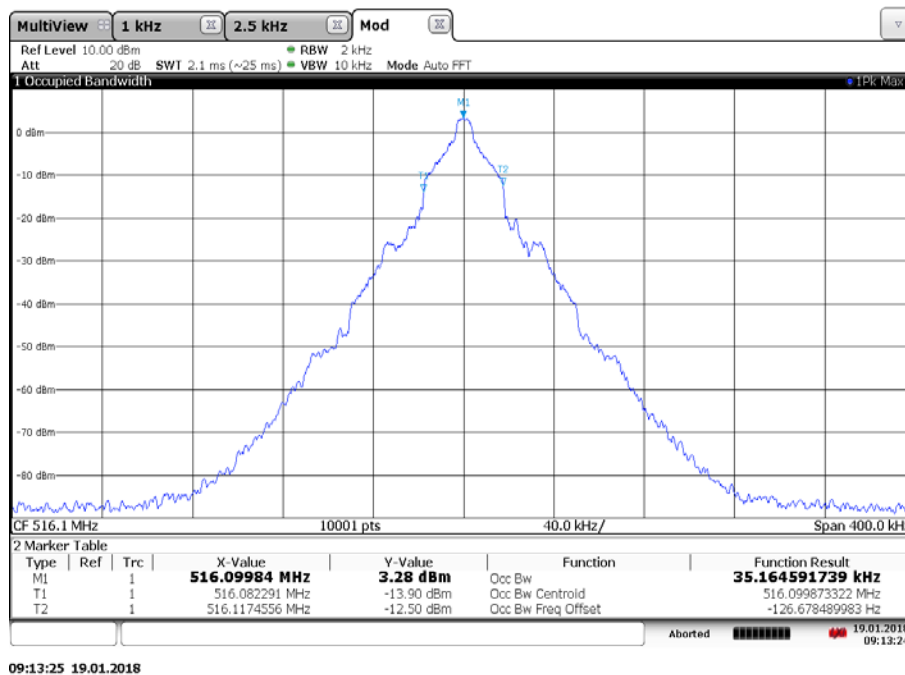
## 10.7 Frequency modulation

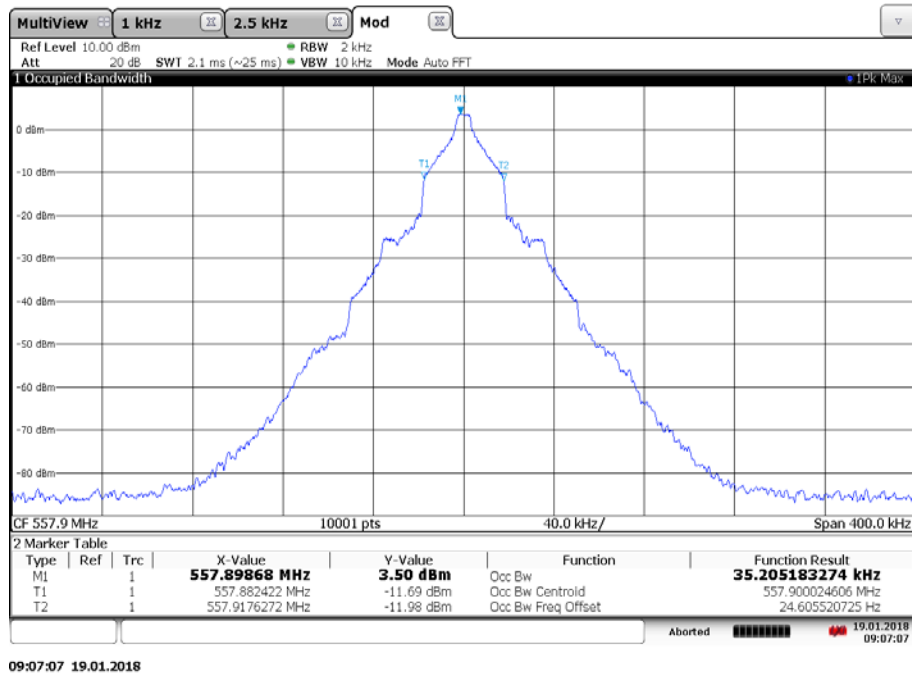
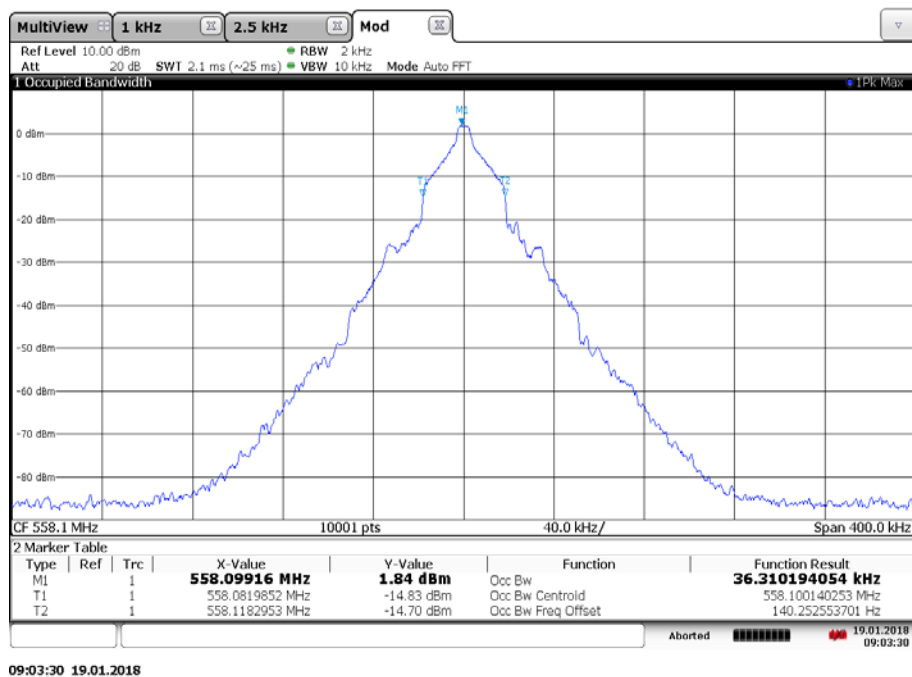
### Measurement:

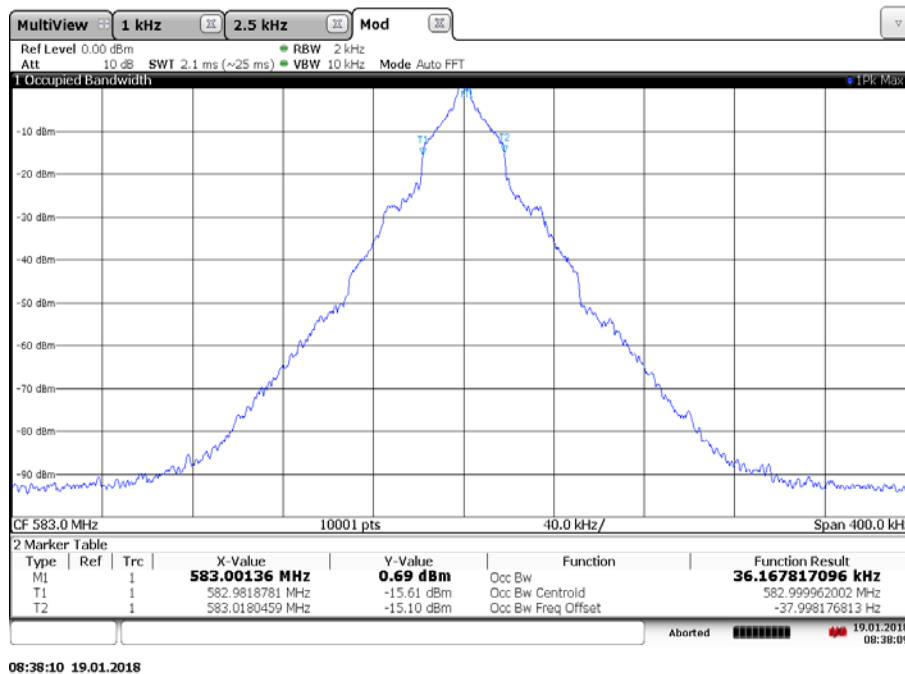
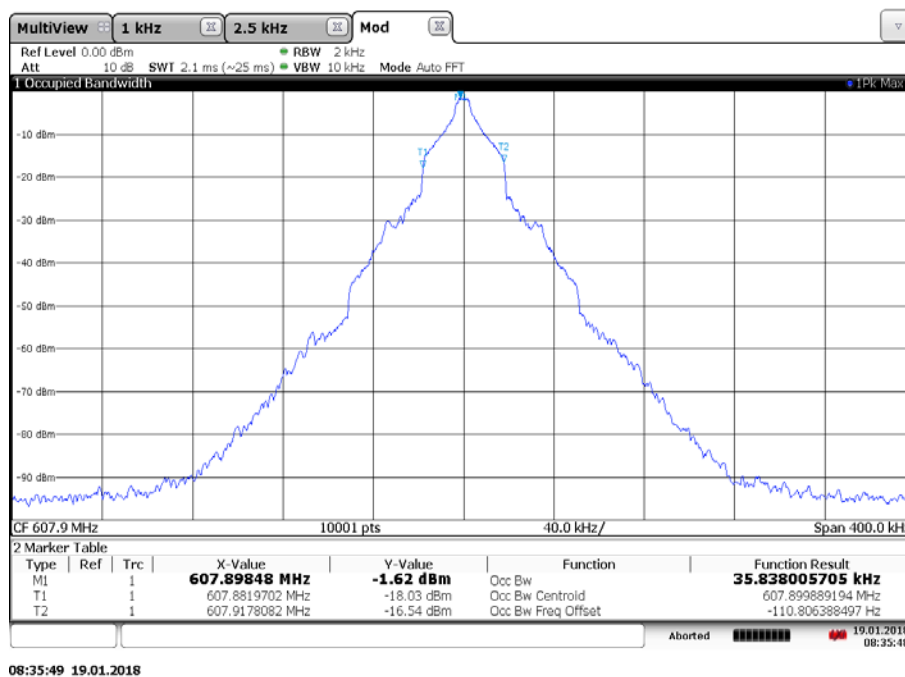
| Measurement parameter    |                                                                 |
|--------------------------|-----------------------------------------------------------------|
| Detector:                | Peak                                                            |
| Sweep time:              | Auto                                                            |
| Resolution bandwidth:    | 1 % to 5 % of the occupied bandwidth                            |
| Video bandwidth:         | 3 x resolution bandwidth                                        |
| Span:                    | 2 x emission bandwidth                                          |
| Trace mode:              | Max. hold                                                       |
| Analyzer function:       | 99% power occupied bandwidth function                           |
| EUT:                     | Modulated signal with frequency varied between 50 Hz and 15 kHz |
| Test setup:              | See sub clause 6.2 - B                                          |
| Measurement uncertainty: | See sub clause 8                                                |

### Limits:

| FCC & IC                                            |
|-----------------------------------------------------|
| Frequency deviation up to a maximum of $\pm 75$ kHz |

**Plots:** Band Aw+**Plot 1:** lowest channel, max hold with frequency variation from 50 Hz to 15 kHz**Plot 2:** middle channel, max hold with frequency variation from 50 Hz to 15 kHz

**Plot 3:** highest channel, max hold with frequency variation from 50 Hz to 15 kHz**Plots:** Band Gw1**Plot 1:** lowest channel, max hold with frequency variation from 50 Hz to 15 kHz

**Plot 2:** middle channel, max hold with frequency variation from 50 Hz to 15 kHz**Plot 3:** highest channel, max hold with frequency variation from 50 Hz to 15 kHz

## 11 Observations

No observations except those reported with the single test cases have been made.

## Annex A Glossary

|                        |                                                    |
|------------------------|----------------------------------------------------|
| <b>EUT</b>             | Equipment under test                               |
| <b>DUT</b>             | Device under test                                  |
| <b>UUT</b>             | Unit under test                                    |
| <b>GUE</b>             | GNSS User Equipment                                |
| <b>ETSI</b>            | European Telecommunications Standards Institute    |
| <b>EN</b>              | European Standard                                  |
| <b>FCC</b>             | Federal Communications Commission                  |
| <b>FCC ID</b>          | Company Identifier at FCC                          |
| <b>IC</b>              | Industry Canada                                    |
| <b>PMN</b>             | Product marketing name                             |
| <b>HMN</b>             | Host marketing name                                |
| <b>HVIN</b>            | Hardware version identification number             |
| <b>FVIN</b>            | Firmware version identification number             |
| <b>EMC</b>             | Electromagnetic Compatibility                      |
| <b>HW</b>              | Hardware                                           |
| <b>SW</b>              | Software                                           |
| <b>Inv. No.</b>        | Inventory number                                   |
| <b>S/N or SN</b>       | Serial number                                      |
| <b>C</b>               | Compliant                                          |
| <b>NC</b>              | Not compliant                                      |
| <b>NA</b>              | Not applicable                                     |
| <b>NP</b>              | Not performed                                      |
| <b>PP</b>              | Positive peak                                      |
| <b>QP</b>              | Quasi peak                                         |
| <b>AVG</b>             | Average                                            |
| <b>OC</b>              | Operating channel                                  |
| <b>OCW</b>             | Operating channel bandwidth                        |
| <b>OBW</b>             | Occupied bandwidth                                 |
| <b>OOB</b>             | Out of band                                        |
| <b>DFS</b>             | Dynamic frequency selection                        |
| <b>CAC</b>             | Channel availability check                         |
| <b>OP</b>              | Occupancy period                                   |
| <b>NOP</b>             | Non occupancy period                               |
| <b>DC</b>              | Duty cycle                                         |
| <b>PER</b>             | Packet error rate                                  |
| <b>CW</b>              | Clean wave                                         |
| <b>MC</b>              | Modulated carrier                                  |
| <b>WLAN</b>            | Wireless local area network                        |
| <b>RLAN</b>            | Radio local area network                           |
| <b>DSSS</b>            | Dynamic sequence spread spectrum                   |
| <b>OFDM</b>            | Orthogonal frequency division multiplexing         |
| <b>FHSS</b>            | Frequency hopping spread spectrum                  |
| <b>GNSS</b>            | Global Navigation Satellite System                 |
| <b>C/N<sub>0</sub></b> | Carrier to noise-density ratio, expressed in dB-Hz |

## Annex B Document history

| Version | Applied changes               | Date of release |
|---------|-------------------------------|-----------------|
| -/-     | Initial release               | 2019-03-07      |
| -A      | Editorial Changes FCC ID / IC | 2019-05-28      |
| -B      | Editorial changes HVIN / FVIN | 2019-06-18      |

## Annex C Accreditation Certificate

| first page                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | last page                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
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|  <p>Deutsche Akkreditierungsstelle GmbH</p> <p>Entrusted according to Section 8 subsection 1 AkkStelleG in connection with Section 1 subsection 1 AkkStelleGBV<br/>Signatory to the Multilateral Agreements of EA, ILAC and IAF for Mutual Recognition</p> <p><b>Accreditation</b> </p> <p>The Deutsche Akkreditierungsstelle GmbH attests that the testing laboratory<br/><b>CTC advanced GmbH</b><br/>Untertürkheimer Straße 6-10, 66117 Saarbrücken</p> <p>is competent under the terms of DIN EN ISO/IEC 17025:2005 to carry out tests in the following fields:<br/><b>Telecommunication</b></p> <p>The accreditation certificate shall only apply in connection with the notice of accreditation of 02.06.2017 with the accreditation number D-PL-12076-01 and is valid until 21.04.2021. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 43 pages.</p> <p>Registration number of the certificate: D-PL-12076-01-03</p> <p>Frankfurt, 02.06.2017</p> <p>Deputy (1st) Head of Division</p> | <p>Deutsche Akkreditierungsstelle GmbH</p> <p>Office Berlin<br/>Spittelmarkt 10<br/>10117 Berlin</p> <p>Office Frankfurt am Main<br/>Europa-Allee 52<br/>60327 Frankfurt am Main</p> <p>Office Braunschweig<br/>Bundesallee 100<br/>38116 Braunschweig</p> <p>The publication of extracts of the accreditation certificate is subject to the prior written approval by Deutsche Akkreditierungsstelle GmbH (DAKKS). Exempted is the unchanged form of separate disseminations of the cover sheet by the conformity assessment body mentioned overleaf.</p> <p>No impression shall be made that the accreditation also extends to fields beyond the scope of accreditation attested by DAKKS.</p> <p>The accreditation was granted pursuant to the Act on the Accreditation Body (AkkStelleG) of 31 July 2009 (Federal Law Gazette I p. 2625) and the Regulation (EC) No 765/2008 of the European Parliament and of the Council of 9 July 2008 setting out the requirements for accreditation and market surveillance relating to the marketing of products (Official Journal of the European Union L 218 of 9 July 2008, p. 30). DAKKS is a signatory to the Multilateral Agreements for Mutual Recognition of the European co-operation for Accreditation (EA), International Accreditation Forum (IAF) and International Laboratory Accreditation Cooperation (ILAC). The signatories to these agreements recognise each other's accreditations.</p> <p>The up-to-date state of membership can be retrieved from the following websites:<br/>EA: <a href="http://www.european-accreditation.org">www.european-accreditation.org</a><br/>ILAC: <a href="http://www.ilac.org">www.ilac.org</a><br/>IAF: <a href="http://www.iaf.nu">www.iaf.nu</a></p> |

**Note: The current certificate annex is published on the website (link see below) of the Accreditation Body DAKKS or may be received by CTC advanced GmbH on request**

<https://www.dakks.de/as/ast/d/D-PL-12076-01-03.pdf>

##### END OF TEST REPORT #####