

Test Report



INTENTIONAL RADIATOR TESTS ACCORDING TO FCC PART 90 and INDUSTRY CANADA REQUIREMENTS

Equipment Under Test: Radio transceiver

Type/ Model: SATEL-TA18

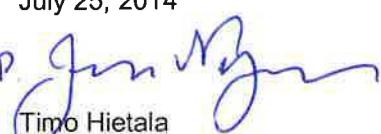
Manufacturer: Satel Oy
Meriniitynkatu 17
FI-24100 Salo, Finland
FINLAND

Customer: Satel Oy
Meriniitynkatu 17
FI-24100 Salo, Finland
FINLAND

FCC Rule Part: Cfr 47 part 90: 2013
IC Rule Part: RSS-119, Issue 11

Date: July 25, 2014

Issued by:


Timo Hietala
Testing Engineer

Date: July 25, 2014

Checked by:


Jari Merikari
Technical Manager

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Equipment Under Test (EUT)

Radio transceiver
Type/ Model: SATEL-TA18
Serial Number: 142200078
FCC ID: MRBSATEL-TA18

SATEL-TA18 is a radio transceiver. This report contains FCC part 90 test results.

One samples were used in tests.

Conducted measurements were made with the sample having an external antenna. Measurements were made from the antenna connector (TNC).

Classification of the device

| | |
|--|-------------------------------------|
| Fixed device | <input type="checkbox"/> |
| Mobile Device (Human body distance > 20cm) | <input checked="" type="checkbox"/> |
| Portable Device (Human body distance < 20cm) | <input type="checkbox"/> |

Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing

Ratings and declarations

Operating Frequency Range (OFR): 403 - 473 MHz
Channels 1
Channel separation: 12.5 kHz
Conducted power: 35 W
Transmission technique: DSS
Modulation: Multilevel state FM (9600 bps)
External antenna gain: -

Power Supply

DC 9 – 16V

Disclaimer

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SUMMARY OF TESTING

| Section in CFR 47 | Section in RSS-119, Issue 9 | | Result |
|-------------------------|-----------------------------|------------------------------------|-------------|
| 90.205 & 2.1046 | 5.4 | Transmitter power (conducted) | PASS |
| 90.210, 2.1057 & 2.1051 | 5.8 | Spurious emissions (conducted) | PASS |
| 90.210, 2.1057 & 2.1053 | 5.8 | Spurious emissions (radiated) | N/T |
| 90.213 & 2.1055 | 5.3 | Frequency stability | N/T |
| 90.209 & 2.1049 | 5.5 | 99% Occupied bandwidth | PASS |
| 90.210 & 2.1049 | 5.5 | Spectrum emission mask | PASS |
| 90.214 | 5.9 | Transient frequency behavior | N/T |
| 15.107 (a) | RSS-Gen 7.2.2 | Conducted emissions at mains ports | N/A |

Explanations:

PASS The EUT passed that particular test.
FAIL The EUT failed that particular test.
N/A Not applicable
N/T Not tested

EUT Test Conditions during Testing

The EUT was configured into the wanted channel and was in continuous transmit mode during all the tests.

Following channels were used during the tests:

| Channel | Frequency/ MHz |
|---------|----------------|
| LOW | 406.5 |
| MID | 430 |
| HIGH | 470 |

Test Facility

| | |
|--|--|
| <input type="checkbox"/> Testing Location / address: FCC registration number: 90598 | SGS Fimko Ltd Särkinlementie 3 FI-00210, HELSINKI FINLAND |
| <input checked="" type="checkbox"/> Testing Location / address: FCC registration number: 178986 Industry Canada registration number: 8708A-2 | SGS Fimko Ltd Karakaarenkuja 4 FI-02610, ESPOO FINLAND |

Maximum Peak Conducted Output Power

| | |
|--------------------------------|----------------------------------|
| Standard: | 90.205, 90.279, 2.1046 |
| Method of measurement: | RSS-119 section 5.4 |
| Tested by: | ANSI/TIA-603-C |
| Date: | THA |
| Temperature: | 30.6.2014 |
| Humidity: | 23 °C |
| Measurement uncertainty | 43 % RH |
| | ± 0.47dB |
| | Level of confidence 95 % (k = 2) |

Requirement RSS-119 section 5.4: The output power shall be within ±1.0 dB of the manufacturer's rated power.

Rated power: 35W (45.44 dBm)

The power at antenna terminal is measured by using the spectrum analyzer with peak detector (RBW>2xOBW).

Results:

| Channel | Conducted Power [W] | Conducted Power [dBm] | Result |
|---------|---------------------|-----------------------|--------|
| Low | 36.81 | 45.66 | PASS |
| Mid | 38.19 | 45.82 | PASS |
| High | 36.73 | 45.65 | PASS |

Limits:

90.205 (h) 450–470 MHz. The maximum allowable station effective radiated power (ERP) is dependent upon the station's antenna HAAT and required service area and will be authorized in accordance with table 2.

TABLE 2—450–470 MHz—MAXIMUM ERP/REFERENCE HAAT FOR A SPECIFIC SERVICE AREA RADIUS

| | Service area radius (km) | | | | | | | | | |
|---------------------------------------|--------------------------|-----|------|------|------|------|-----------------|-----------------|-----------------|-----------------|
| | 3 | 8 | 13 | 16 | 24 | 32 | 40 ⁴ | 48 ⁴ | 64 ⁴ | 80 ⁴ |
| Maximum ERP (w) ¹ | 2 | 100 | 2500 | 2500 | 2500 | 2500 | 2500 | 2500 | 2500 | 2500 |
| Up to reference HAAT (m) ³ | 15 | 15 | 15 | 27 | 63 | 125 | 250 | 410 | 950 | 2700 |

¹ Maximum ERP indicated provides for a 39 dBu signal strength at the edge of the service area per FCC Report R-6602, Fig. 29 (See § 73.699, Fig. 10 b).

² Maximum ERP of 500 watts allowed. Signal strength at the service area contour may be less than 39 dBu.

³ When the actual antenna HAAT is greater than the reference HAAT, the allowable ERP will be reduced in accordance with the following equation: $ERP_{allow} = ERP_{max} \times (HAAT_{ref}/HAAT_{actual})^2$.

⁴ Applications for this service area radius may be granted upon specific request with justification and must include a technical demonstration that the signal strength at the edge of the service area does not exceed 39 dBu.

Maximum Peak Conducted Output Power

90.279 (a) Base station authorizations in the 421–430 MHz band will be subject to Effective Radiated Power (ERP) and Effective Antenna Height (EAH) limitations as shown in the table below.

| Effective antenna height (EAH) in meters (feet) | Maximum effective radiated power (ERP) (watts) |
|---|--|
| 0–152 (0–500) | 250 |
| Above 152–305 (above 500–1000) | 150 |
| Above 305–457 (above 1000–1500) | 75 |
| Above 457–610 (above 1500–2000) | 40 |
| Above 610–762 (above 2000–2500) | 20 |
| Above 762–914 (above 2500–3000) | 15 |
| Above 914–1219 (above 3000–4000) | 10 |
| Above 1219 (above 4000) | 5 |

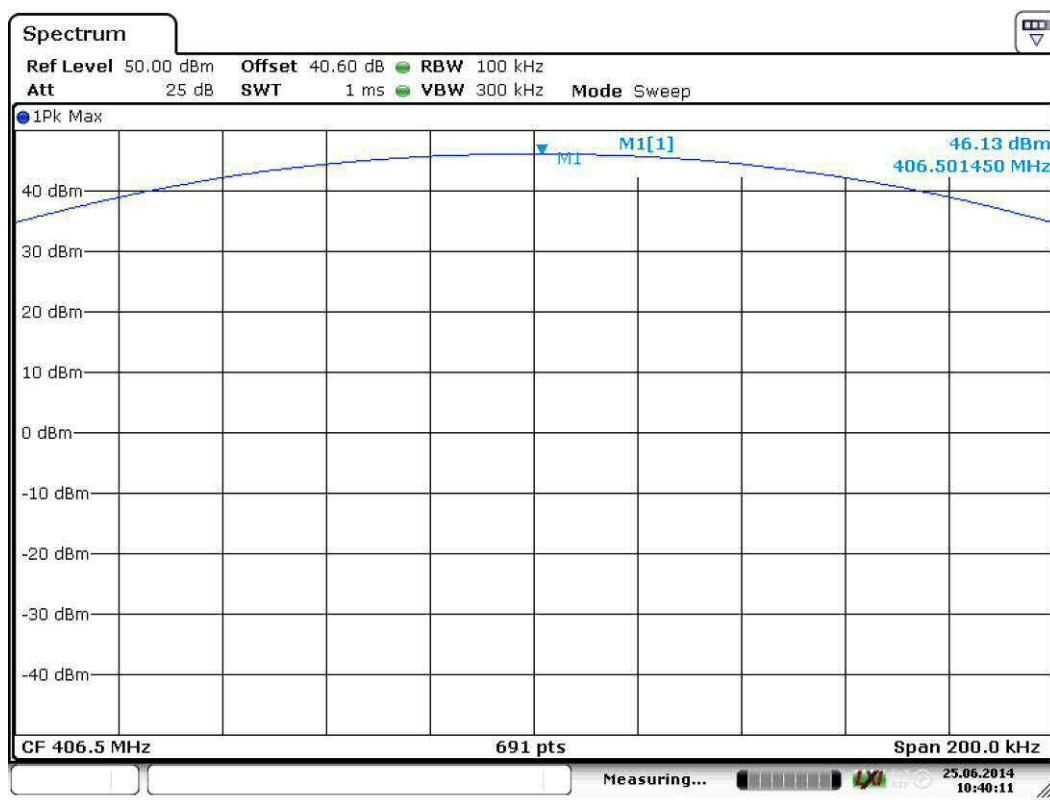
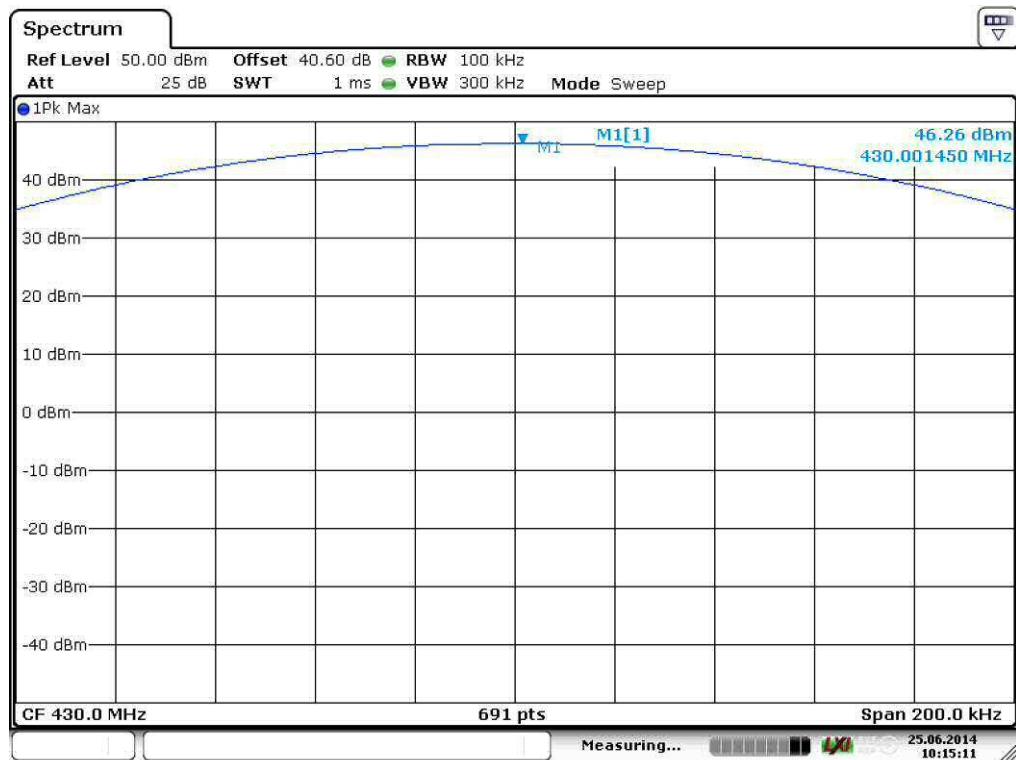
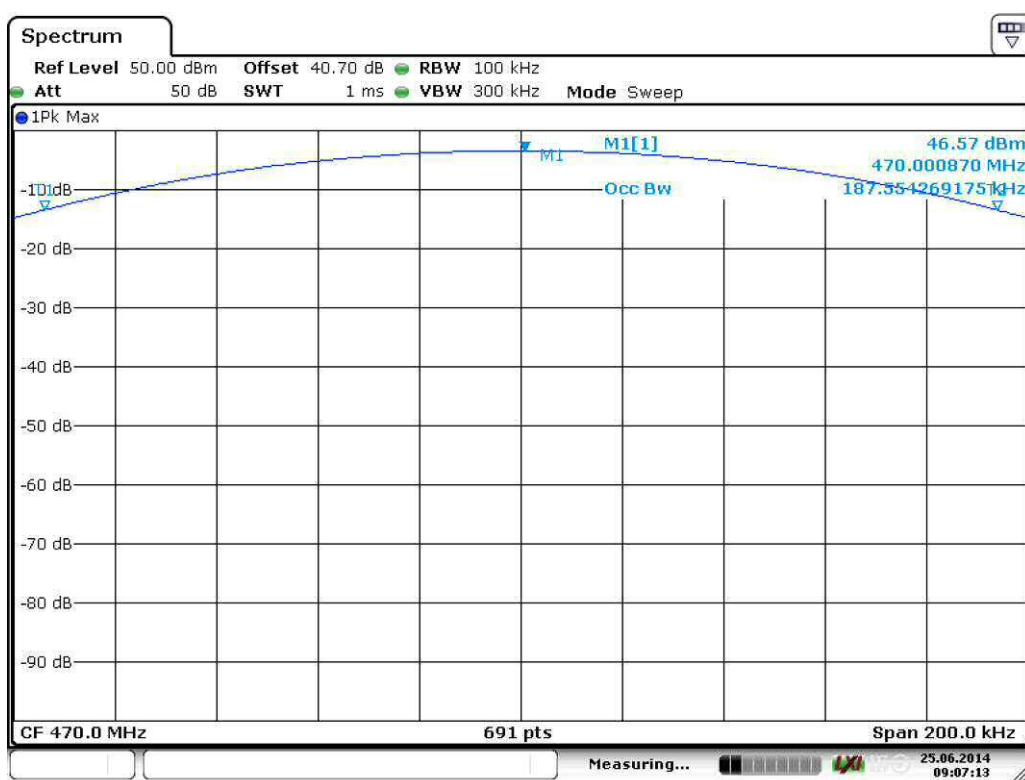


Figure 1. 1 Power Channel LOW.

Maximum Peak Conducted Output Power

**Figure 2. 1 Power Channel MID.****Figure 3. Power Channel HIGH.**

Conducted Spurious Emissions 9 kHz to 5 GHz

Standard: 90.210, 2.1051
RSS-119 section 5.8

Method of measurement: ANSI/TIA-603-C

Tested by: THA

Date: 25.6.2014

Temperature: 23 °C

Humidity: 37 % RH

Requirement: On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz: At least $50 + 10 \log (P)$ dB (-20dBm) or 70 dB, whichever is the lesser attenuation.

The spectrum was searched from 9 kHz to the 10th harmonic of the carrier (5GHz).

Results:**Channel Low**

| Frequency [MHz] | Peak Level [dBm] | Limit [dBm] | Margin [dB] | Result |
|-----------------|------------------|-------------|-------------|--------|
| 0.1385 | -48.49 | -20 | 28.49 | PASS |
| 419.610 | -24.29 | -20 | 4.29 | PASS |
| 424.100 | -25.13 | -20 | 5.13 | PASS |
| 812.990 | -46.83 | -20 | 26.83 | PASS |

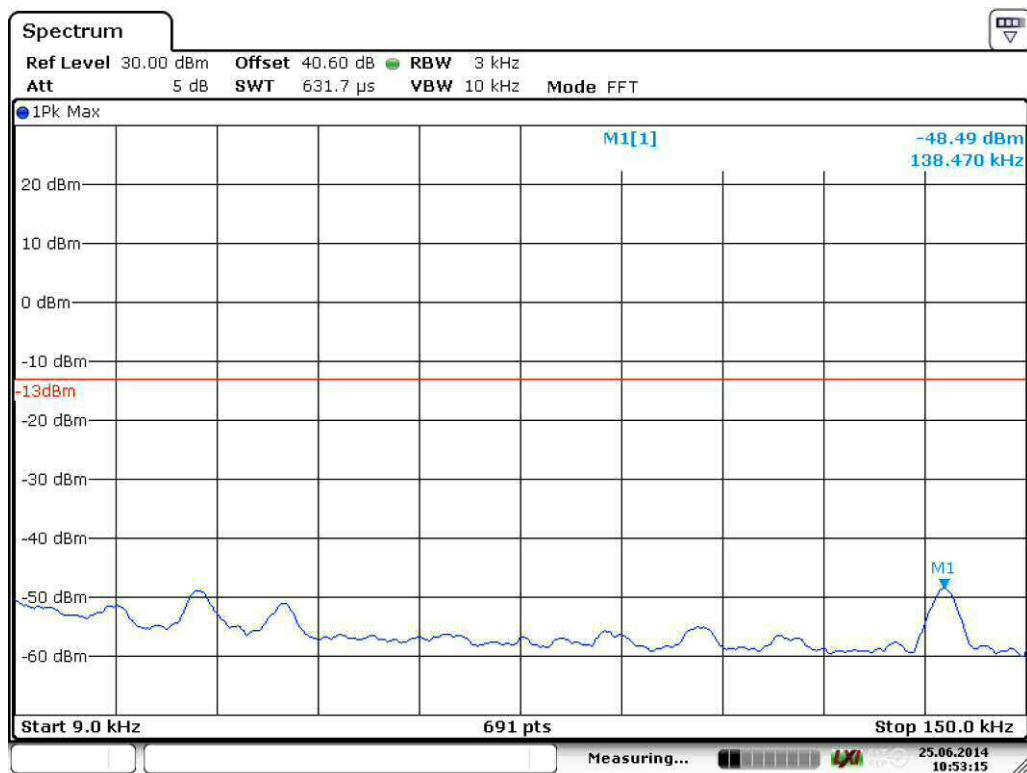
Channel Mid

| Frequency [MHz] | Peak Level [dBm] | Limit [dBm] | Margin [dB] | Result |
|-----------------|------------------|-------------|-------------|--------|
| 0.1383 | -47.18 | -20 | 27.18 | PASS |
| 408.430 | -27.05 | -20 | 7.05 | PASS |
| 442.400 | -27.64 | -20 | 7.64 | PASS |
| 856.970 | -45.17 | -20 | 25.17 | PASS |

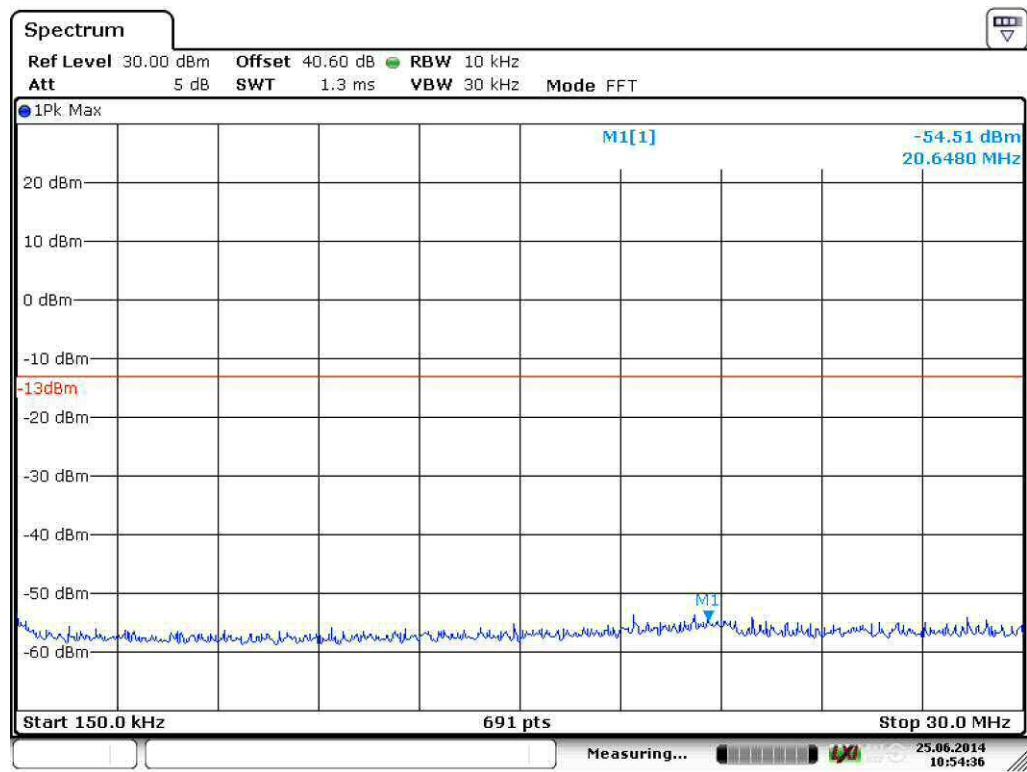
Channel High

| Frequency [MHz] | Peak Level [dBm] | Limit [dBm] | Margin [dB] | Result |
|-----------------|------------------|-------------|-------------|--------|
| 0.1381 | -46.92 | -20 | 26.92 | PASS |
| 453.440 | -25.19 | -20 | 5.19 | PASS |
| 476.800 | -25.42 | -20 | 5.42 | PASS |
| 940.130 | -52.34 | -20 | 32.34 | PASS |
| 1410.800 | -44.81 | -20 | 24.81 | PASS |
| 4701.100 | -42.20 | -20 | 22.20 | PASS |

Conducted Spurious Emission 9 kHz to 5 GHz



Date: 25.JUN.2014 10:53:15

Figure 4. Low channel conductive emission 9 kHz to 150 kHz.

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Figure 5. Low channel conductive emission 150 kHz to 30 MHz.

Conducted Spurious Emission 9 kHz to 5 GHz

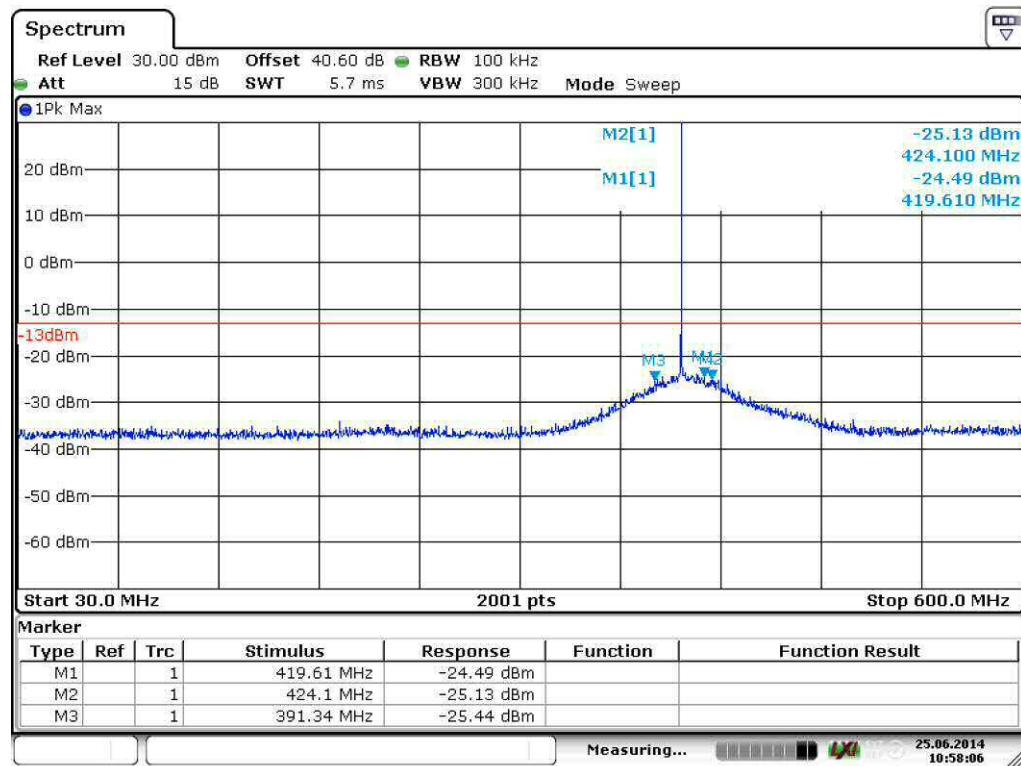


Figure 6. Low channel conductive emission 30 MHz to 600 MHz.

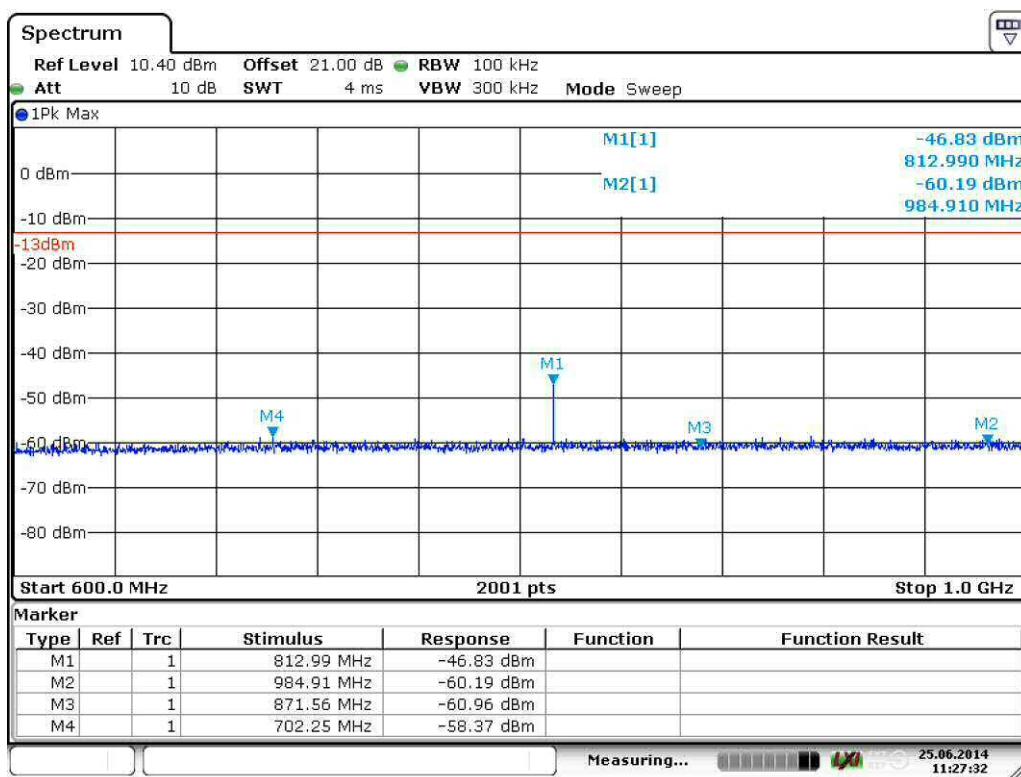


Figure 7. Low channel conductive emission 600 MHz to 1000 MHz.

Conducted Spurious Emission 9 kHz to 5 GHz

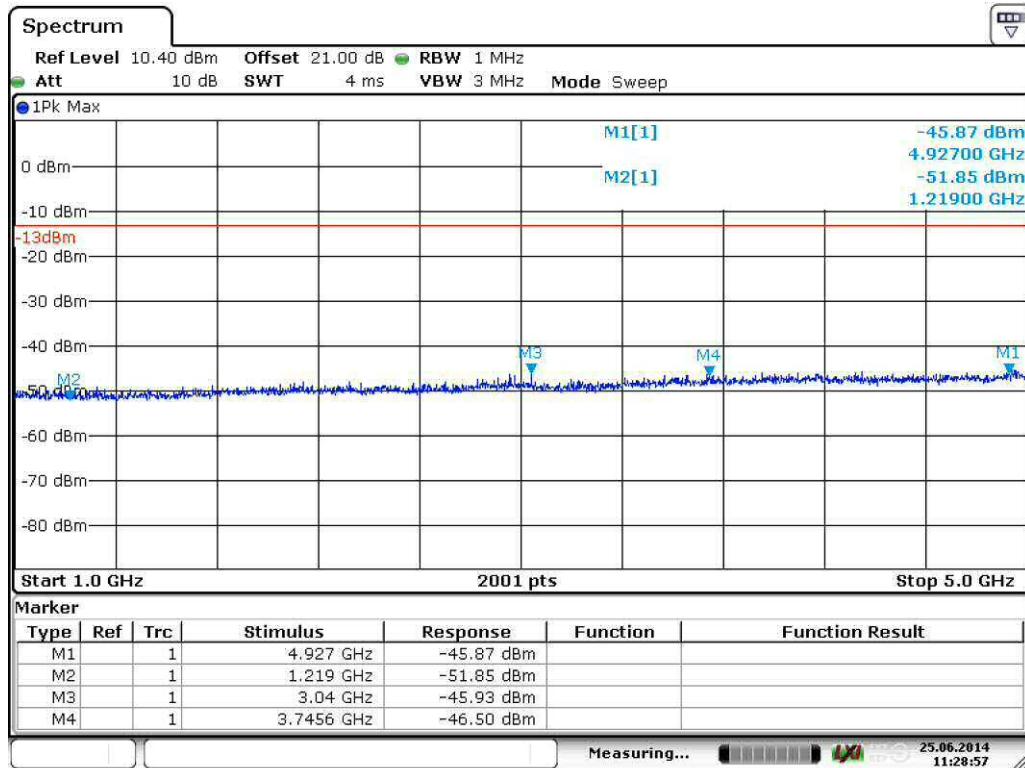
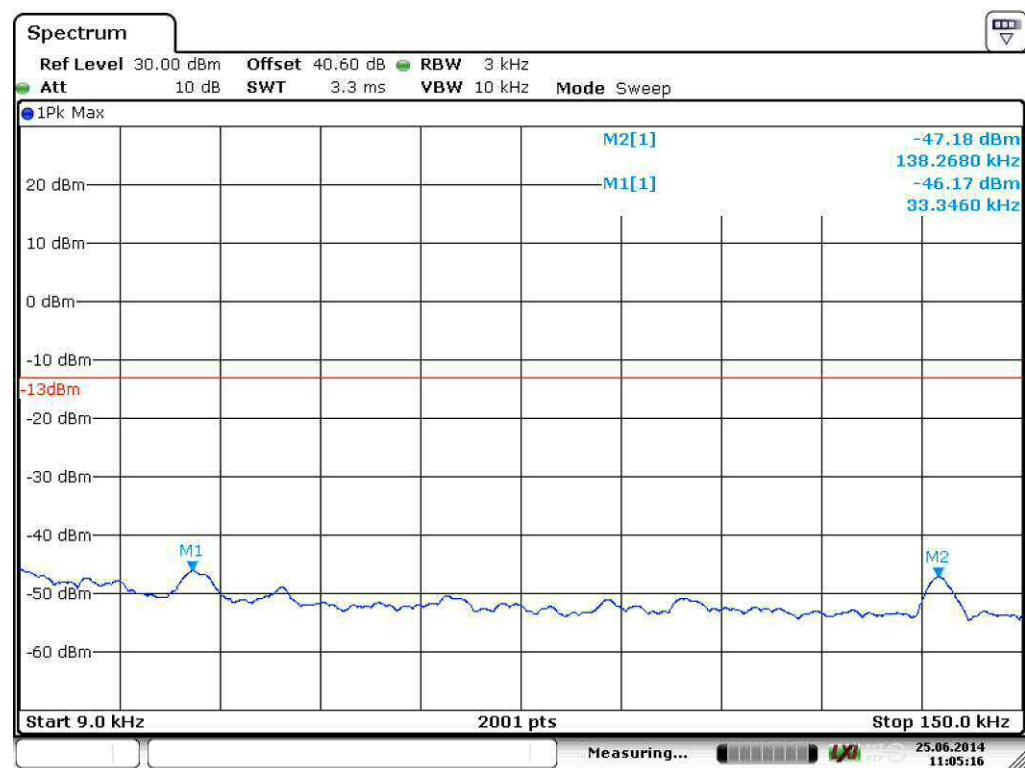


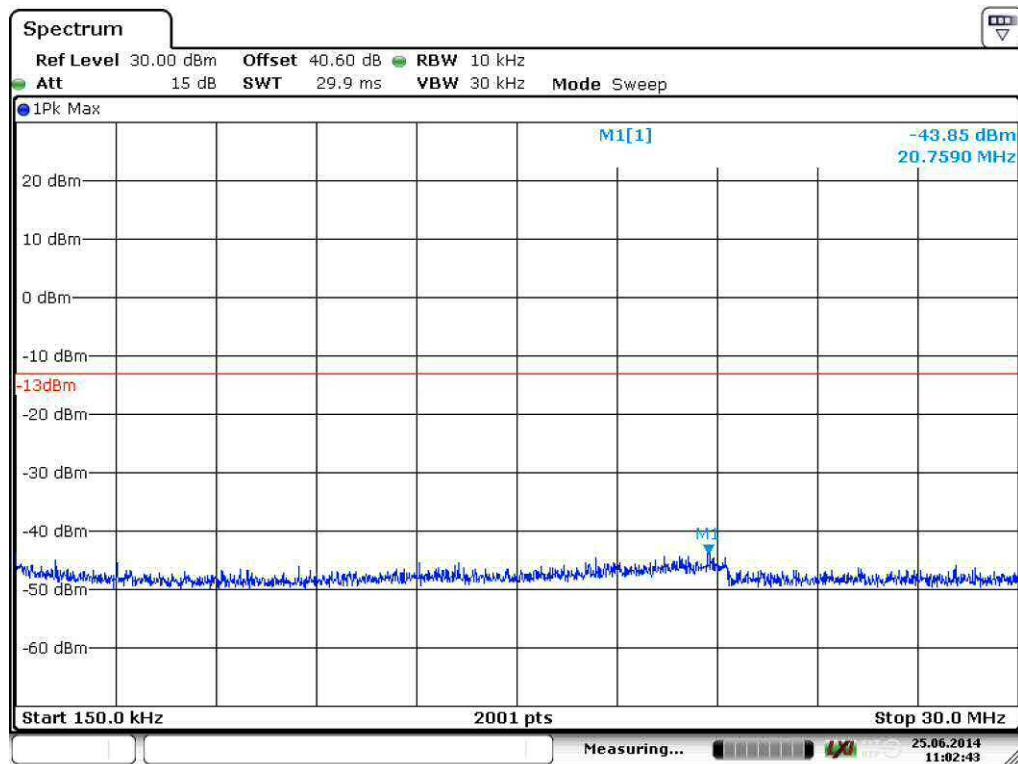
Figure 8. Mid channel conductive emission 1000 MHz to 5000 MHz.



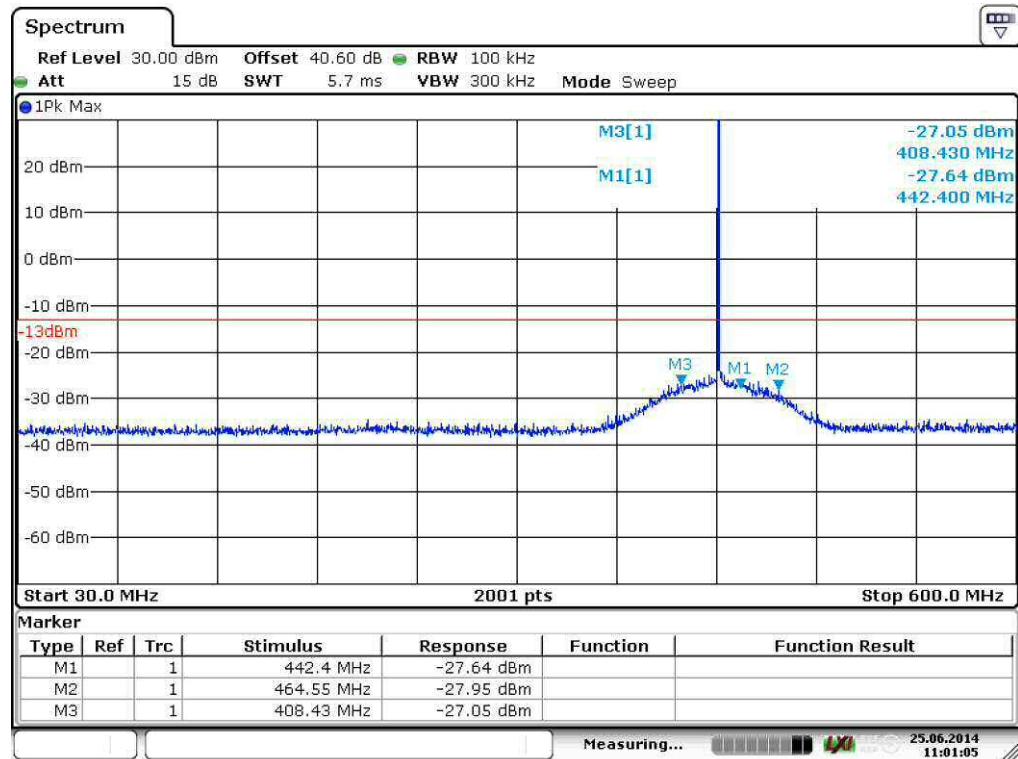
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Figure 9. Mid channel conductive emission 9 kHz to 150 kHz.

Conducted Spurious Emission 9 kHz to 5 GHz



Date: 25.JUN.2014 11:02:43

Figure 10. Mid channel conductive emission 150 kHz to 30 MHz.

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Figure 11. Mid channel conductive emission 30 MHz to 600 MHz.

Conducted Spurious Emission 9 kHz to 5 GHz

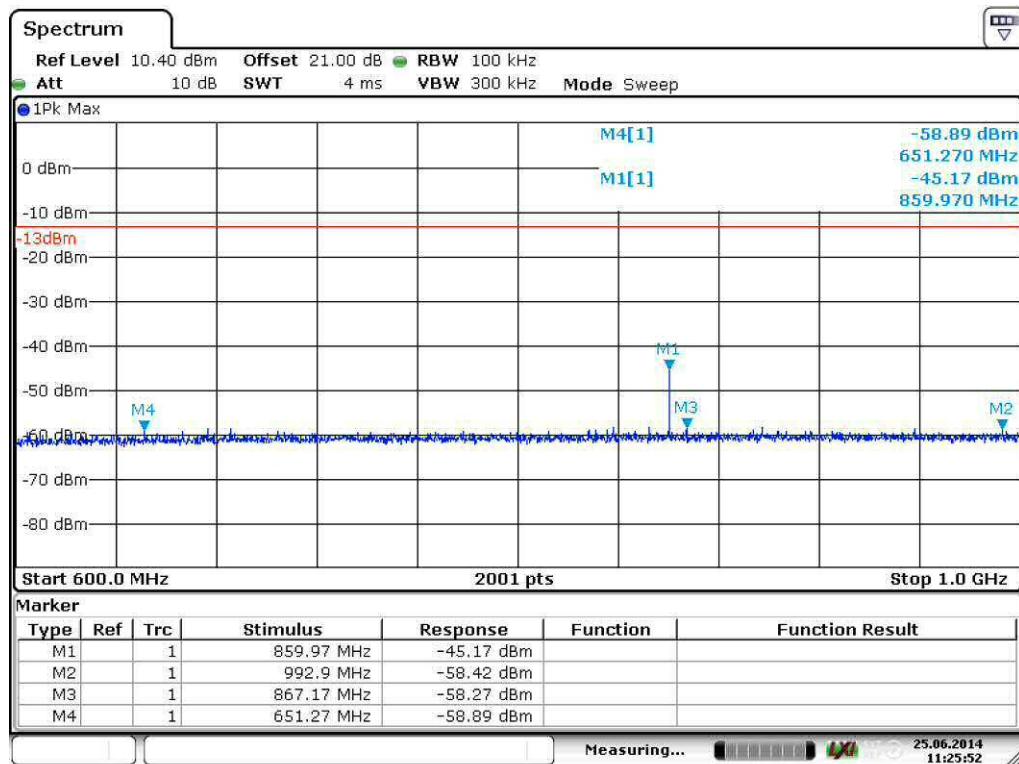


Figure 12. Mid channel conductive emission 600 MHz to 1000 MHz.

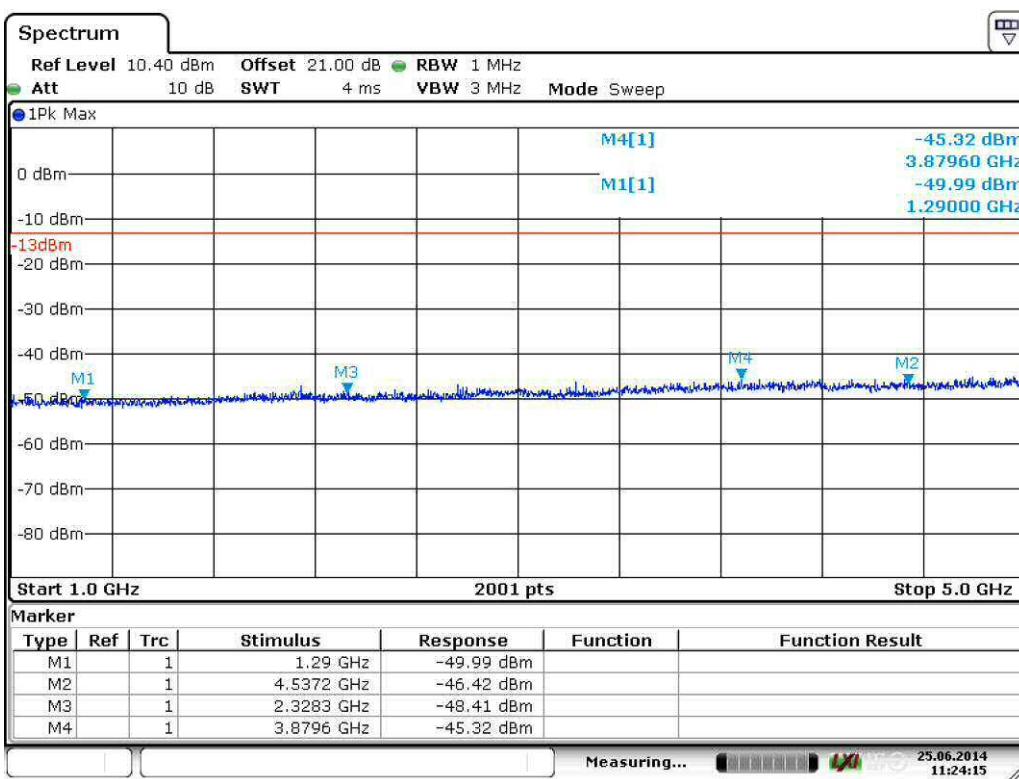
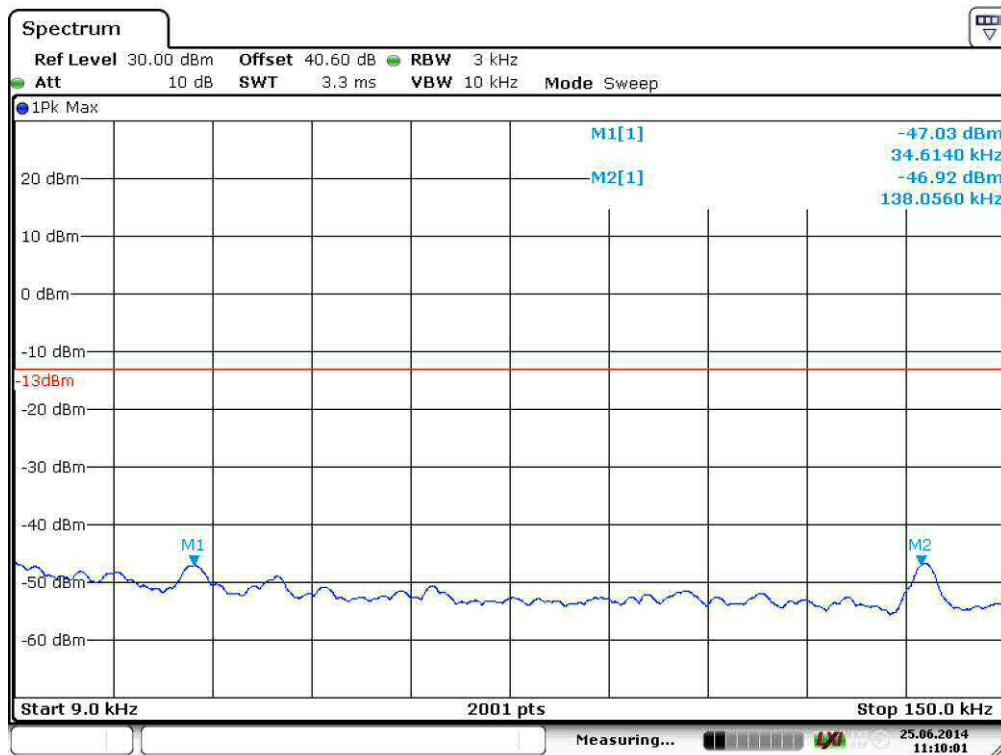


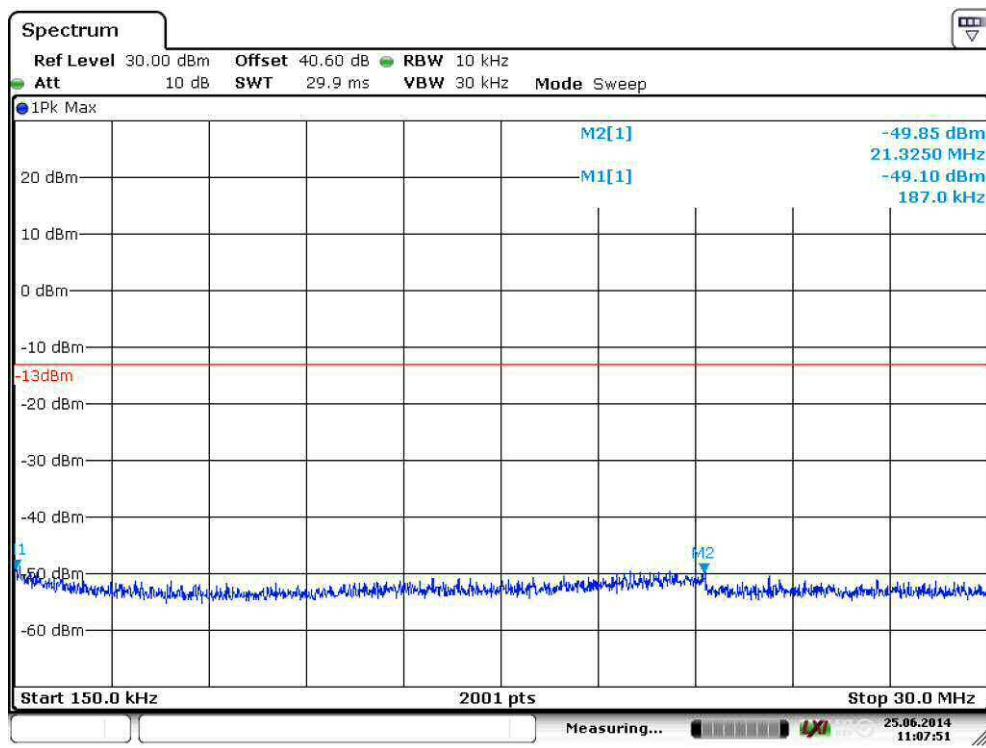
Figure 13. Mid channel conductive emission 1000 MHz to 5000 MHz.

Conducted Spurious Emission 9 kHz to 5 GHz



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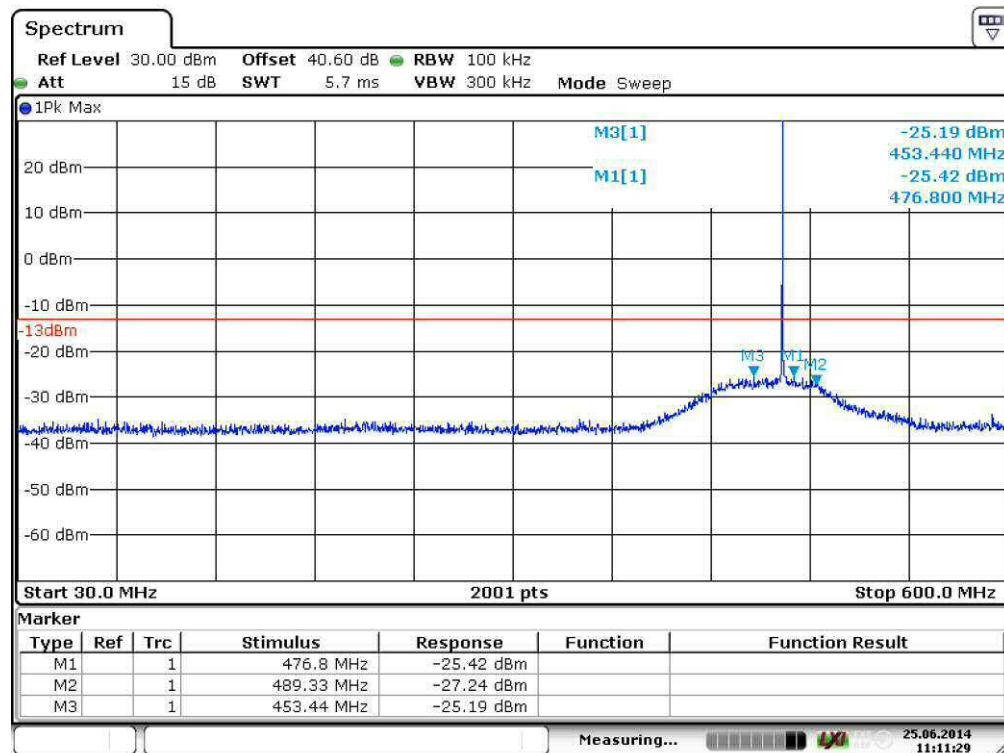
Figure 14. High channel conductive emission 9 kHz to 150 kHz.



Date: 25.JUN.2014 11:07:51

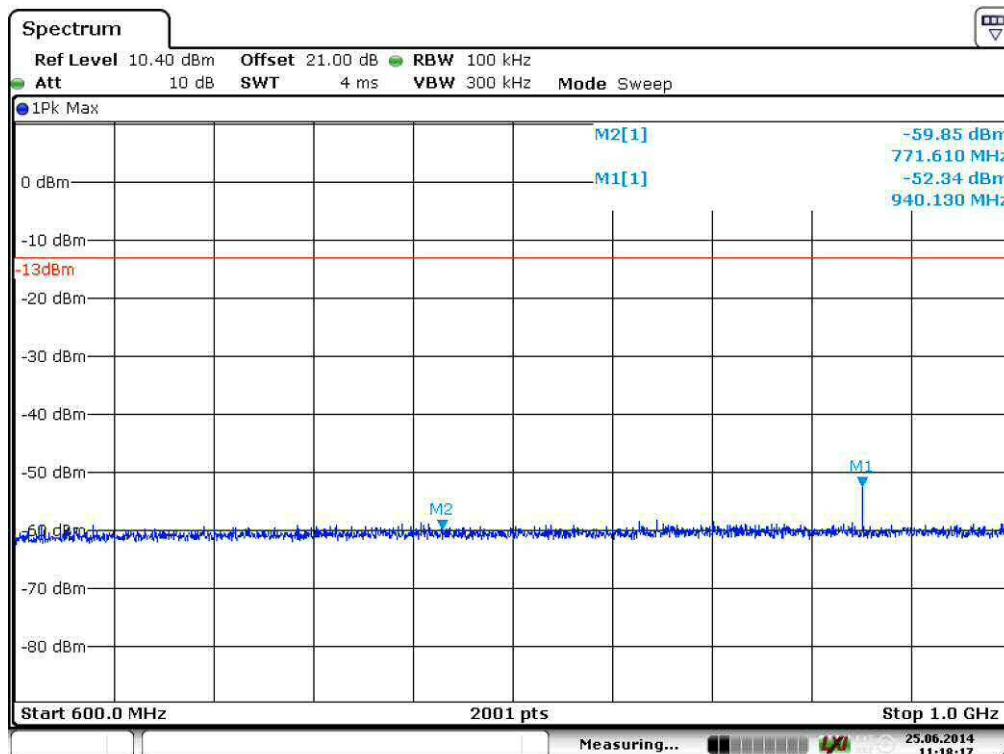
Figure 15. High channel conductive emission 150 kHz to 30 MHz.

Conducted Spurious Emission 9 kHz to 5 GHz



Date: 25.JUN.2014 11:11:28

Figure 16. High channel conductive emission 30 MHz to 600 MHz.



Date: 25.JUN.2014 11:18:18

Figure 17. High channel conductive emission 600 MHz to 1000 MHz.

Conducted Spurious Emission 9 kHz to 5 GHz

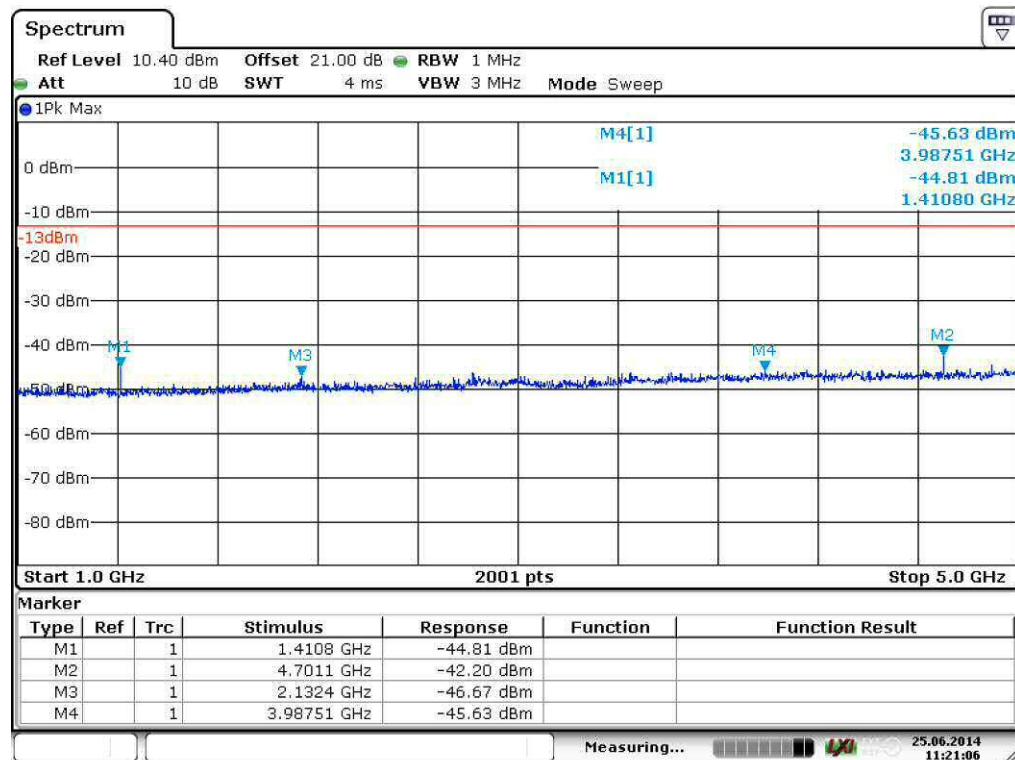


Figure 18. High channel conductive emission 1000 MHz to 5000 MHz.

Spectrum Emission mask

Standard: 90.210 (d), 2.1049
RSS-119 section 5.5

Method of measurement: ANSI/TIA-603-C
THA

Date: 25.6.2014

Temperature: 23 °C

Humidity: 37 % RH

The emission mask of the modulated carrier is measured by using a spectrum analyzer with resolution bandwidth set to 100 Hz for emission mask D (12.5kHz bandwidth).

Transmitter was set to transmit random data file 9600 bps at 12.5kHz channel.

Table 1. Data rate 9600 bps, 12.5kHz channel

| Channel | Limit | Result |
|---------|--------|--------|
| Low | MASK D | PASS |
| Mid | MASK D | PASS |
| High | MASK D | PASS |

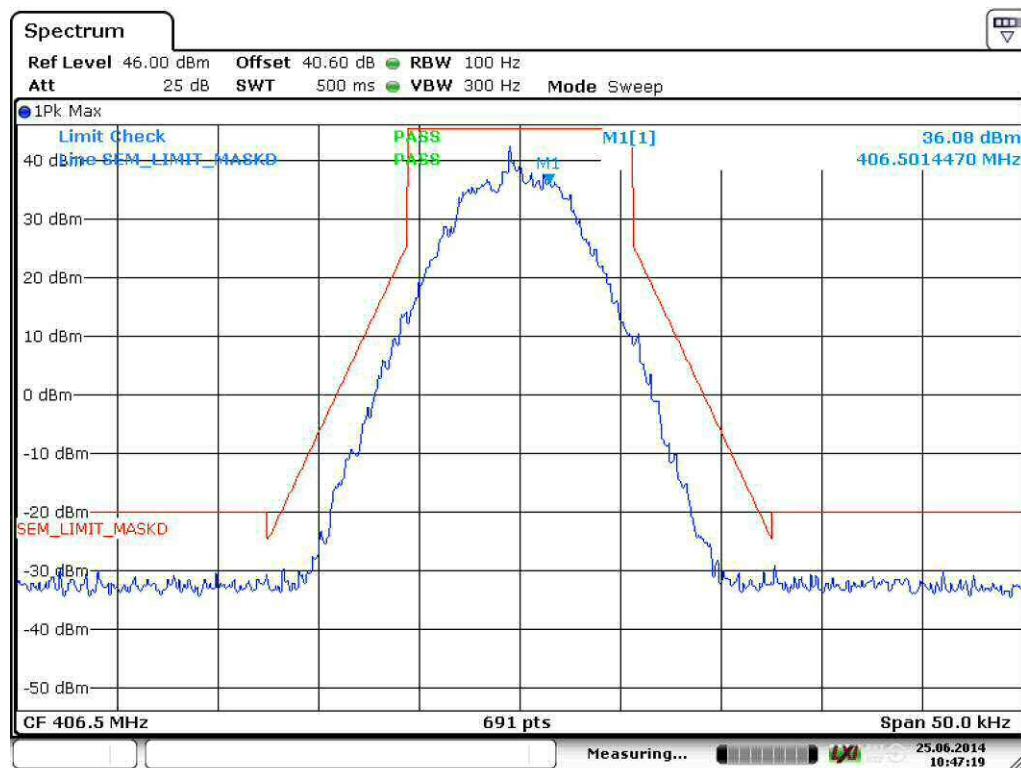


Figure 19. Low channel spectrum emission mask.

Spectrum Emission Mask

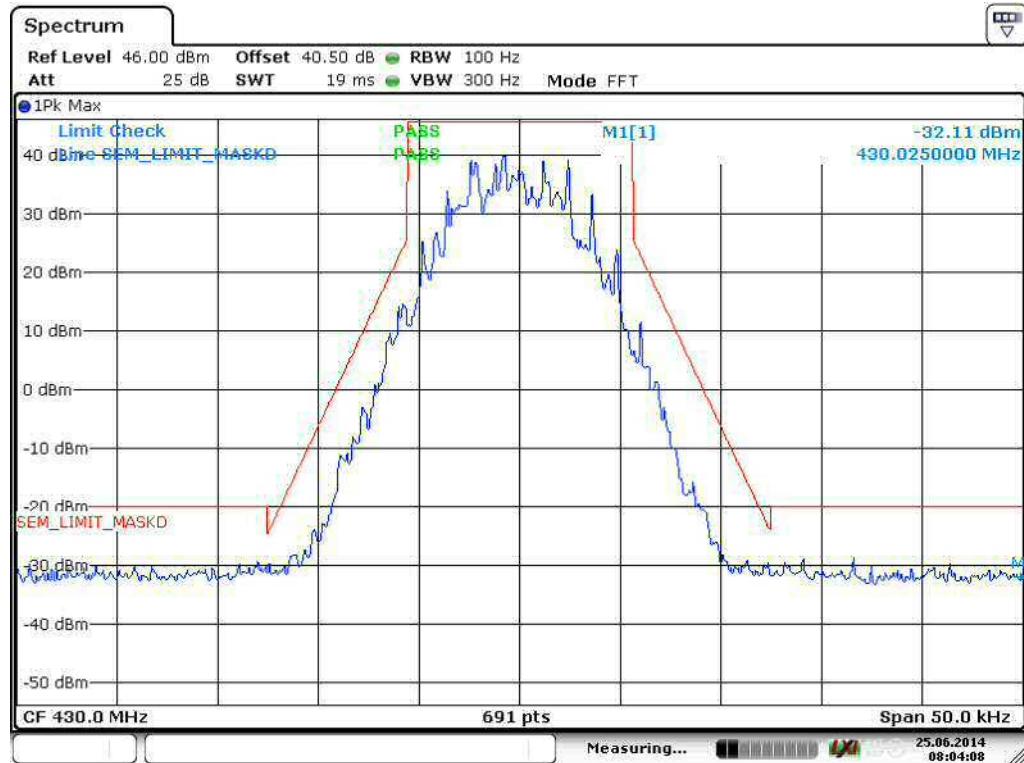


Figure 20. Mid channel spectrum emission mask.



Figure 21. High channel spectrum emission mask.

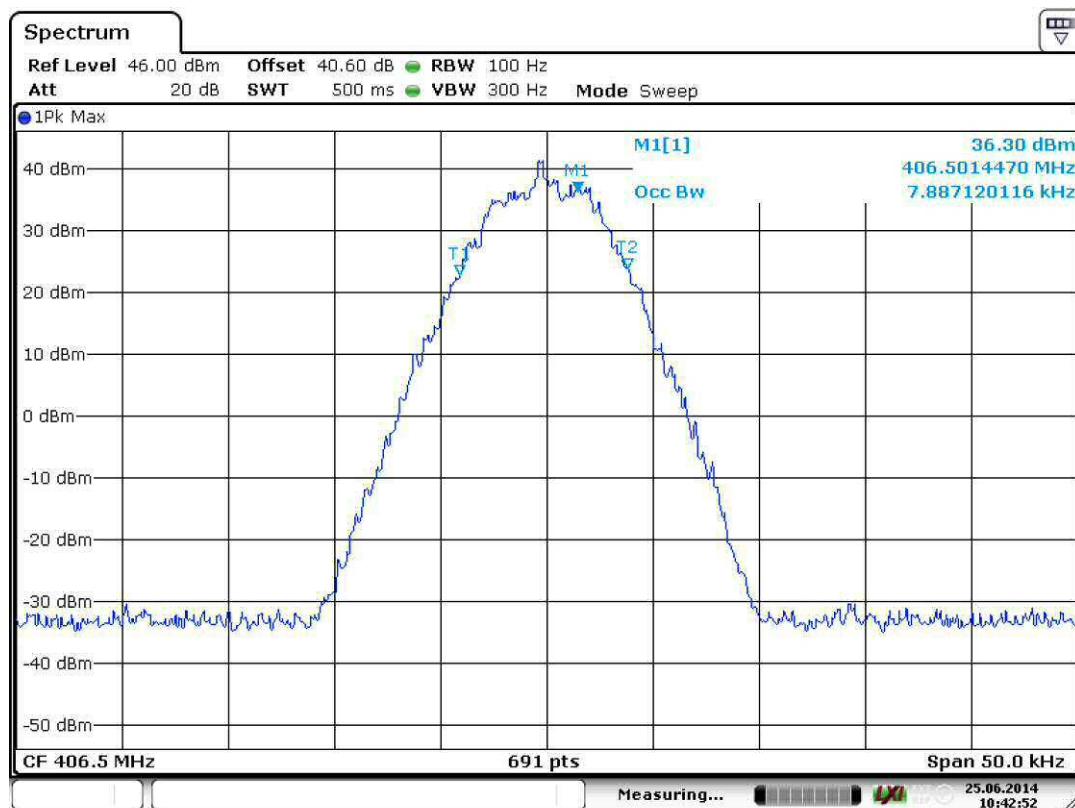
99% Occupied Power Bandwidth

Standard: 90.209, 2.1049
Method of measurement: RSS-119 section 5.5
THA
Date: 25.6.2014
Temperature: 23 °C
Humidity: 37 % RH

The 99% occupied bandwidth of the carrier emission is measured using a spectrum analyzer with Resolution Bandwidth set to 1% of the necessary bandwidth of the transmitted carrier.
Transmitter was set to transmit random data file 9600 bps at 12.5kHz channel.

Table 2. Data rate 9600 bps

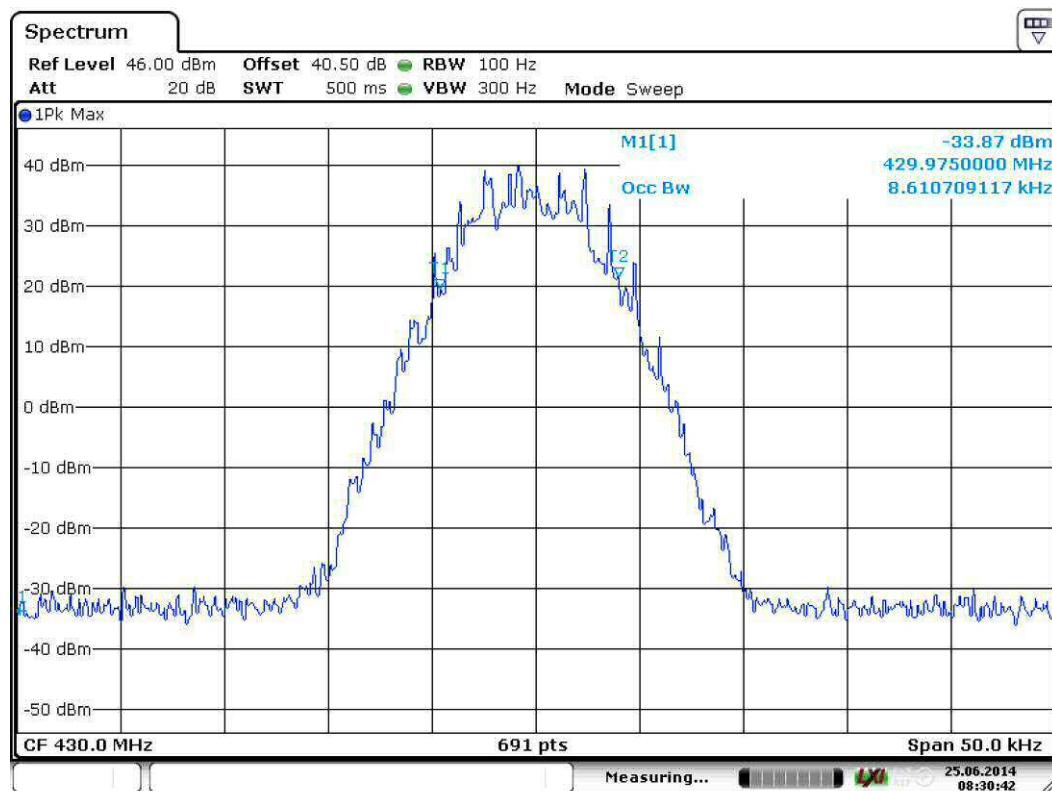
| Channel | 99% BW [kHz] | Limit | Result |
|---------|--------------|-------|--------|
| Low | 7.89 | 11.25 | PASS |
| Mid | 8.61 | 11.25 | PASS |
| High | 8.54 | 11.25 | PASS |



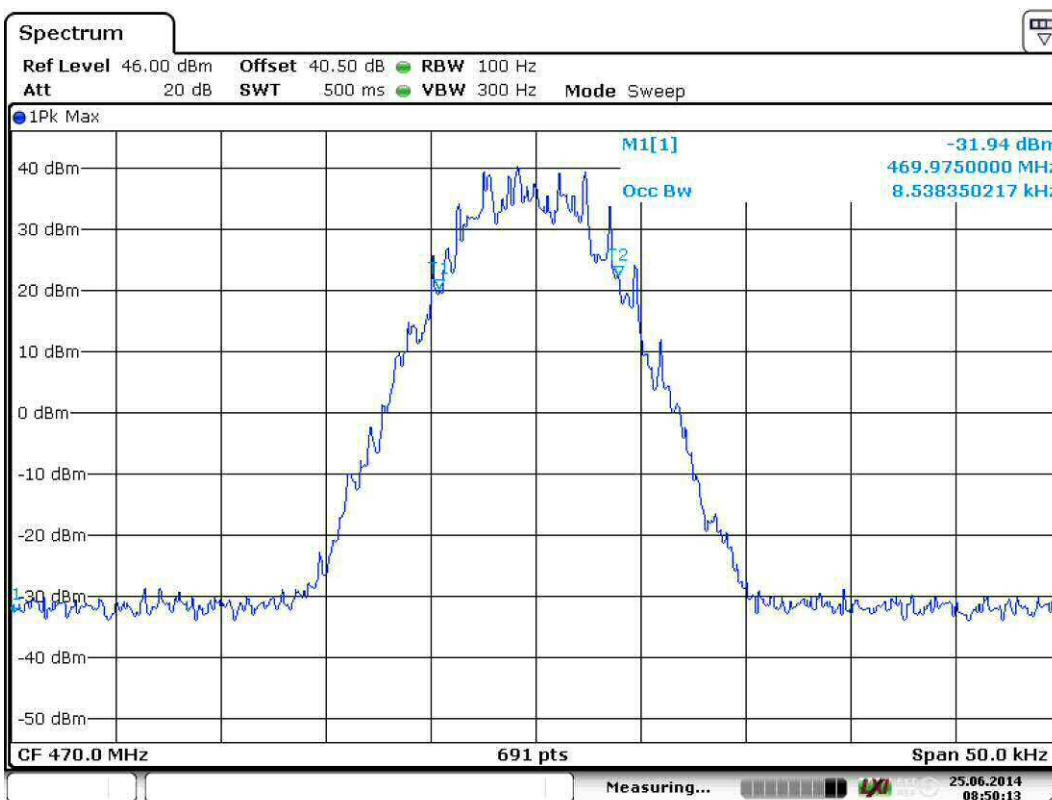
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Figure 22. Low channel 99% Occupied Power Bandwidth.

99% Occupied Power Bandwidth



Date: 25.JUN.2014 08:30:43

Figure 23. Mid channel 99% Occupied Power Bandwidth.

Date: 25.JUN.2014 08:50:13

Figure 24. High channel 99% Occupied Power Bandwidth.

LIST OF TEST EQUIPMENT

| Manufacturer | Type | Serial no | Inv. no |
|----------------------------|-----------------|-----------|---------|
| ROHDE & SCHWARZ | | | |
| Signal Analyzer | FSV40 | 101068 | 9093 |
| DAVIS | | | |
| Weather station | Vantage Pro | - | 5297 |
| NARDA | | | |
| Attenuator 20dB | 765-20 | - | 327 |
| Attenuator 20dB | 765-20 | - | 120 |
| WAINWRIGHT | | | |
| High Pass Filter | WHK0.6/13G-10SS | 1 | 571 |

All used measurement equipment was calibrated (if required).