

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:

P.P. Jari Merikari
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Testing Engineer

Date: July 25, 2014

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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 Särkiniementie 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

Maximum Peak Conducted Output Power

Standard:	90.205, 90.279, 2.1046 RSS-119 section 5.4
Method of measurement:	ANSI/TIA-603-C
Tested by:	THA
Date:	30.6.2014
Temperature:	23 °C
Humidity:	43 % RH
Measurement uncertainty	± 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	² 500	² 500	² 500	² 500	² 500	² 500	² 500	² 500
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.

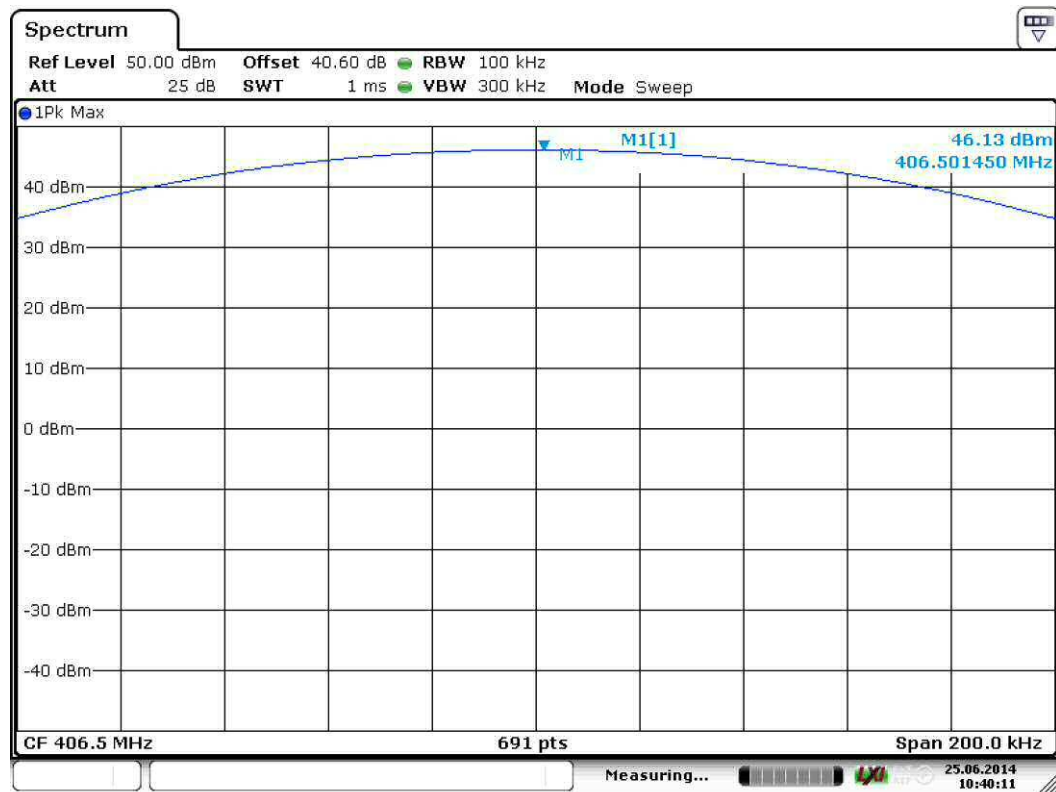
³ When the actual antenna HAAT is greater than the reference HAAT, the allowable ERP will be reduced in accordance with the following equation: $ERP_{allow} = ERP_{max} \times (HAAT_{ref}/HAAT_{actual})^2$.

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



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Figure 1. 1 Power Channel LOW.

Maximum Peak Conducted Output Power

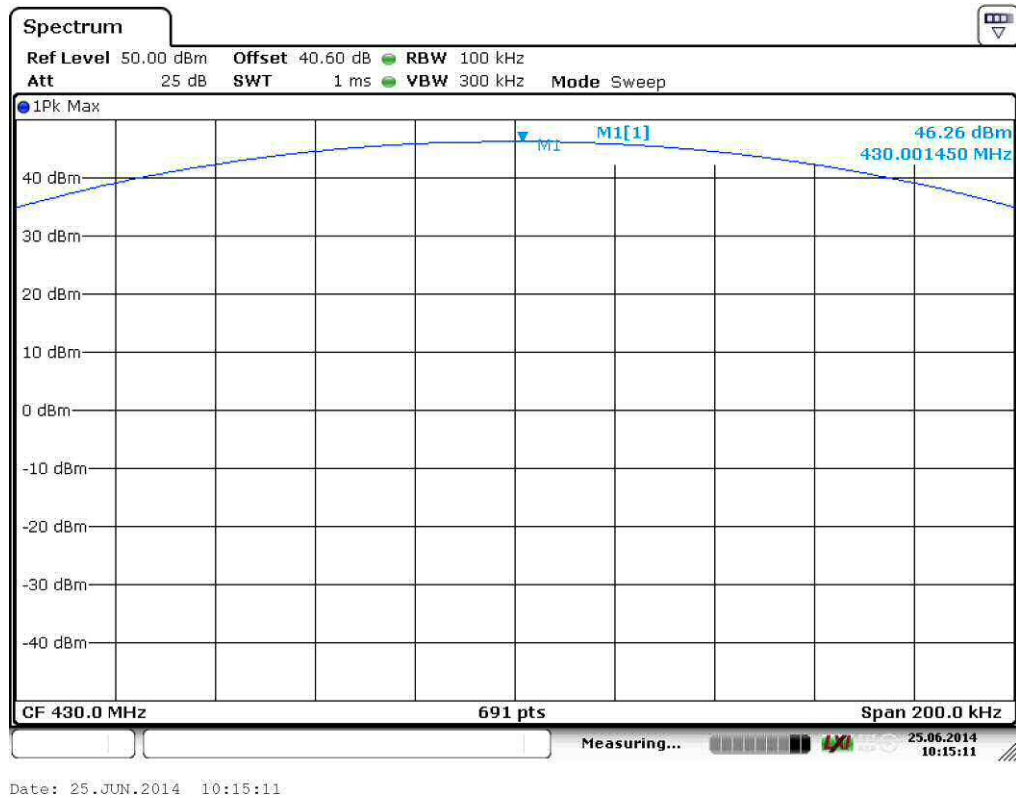


Figure 2. 1 Power Channel MID.

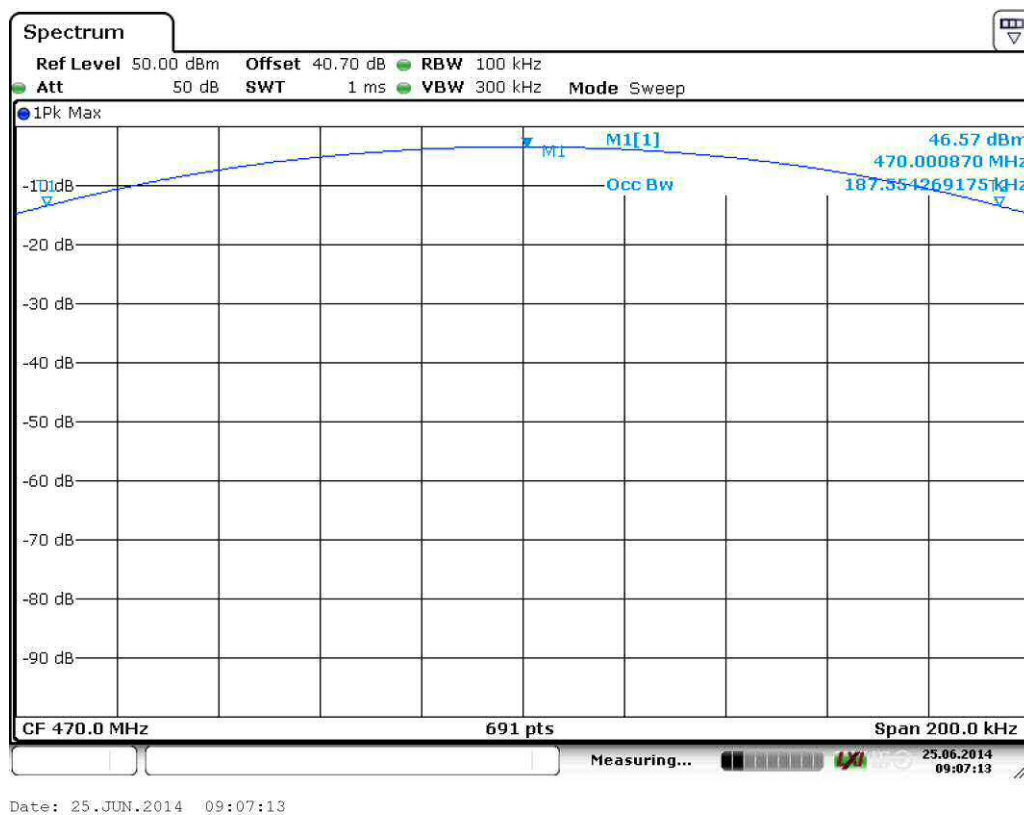


Figure 3. 1 Power Channel HIGH.

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_o 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

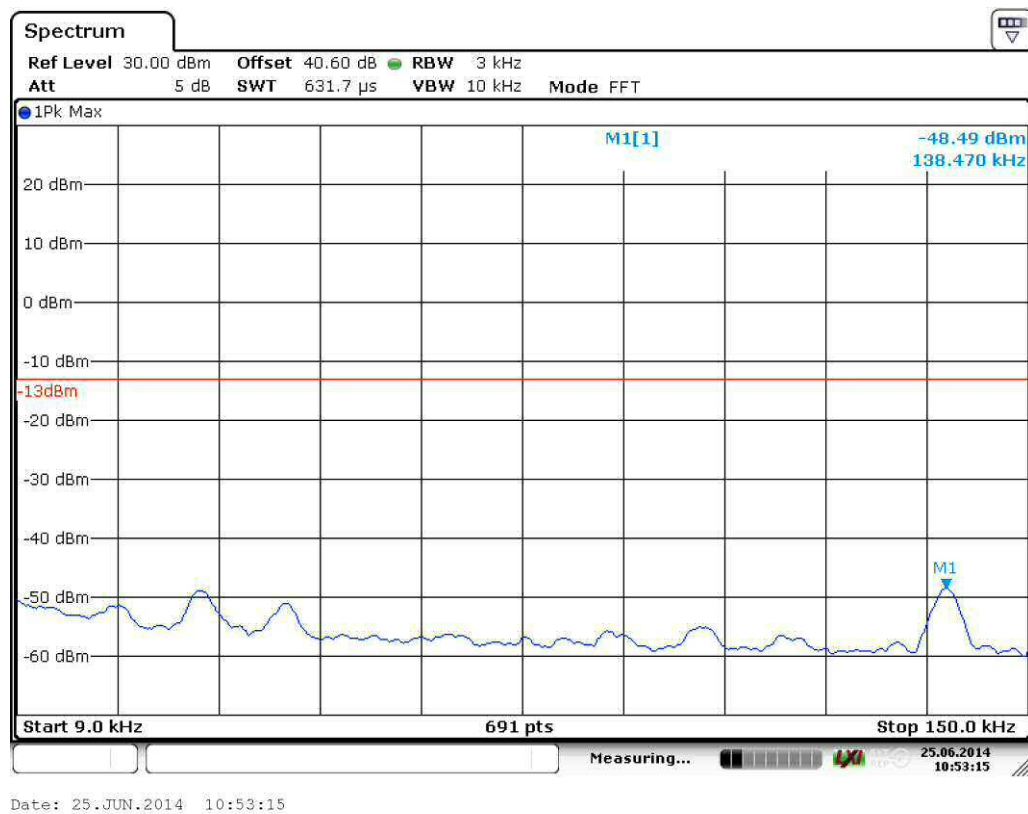


Figure 4. Low channel conductive emission 9 kHz to 150 kHz.

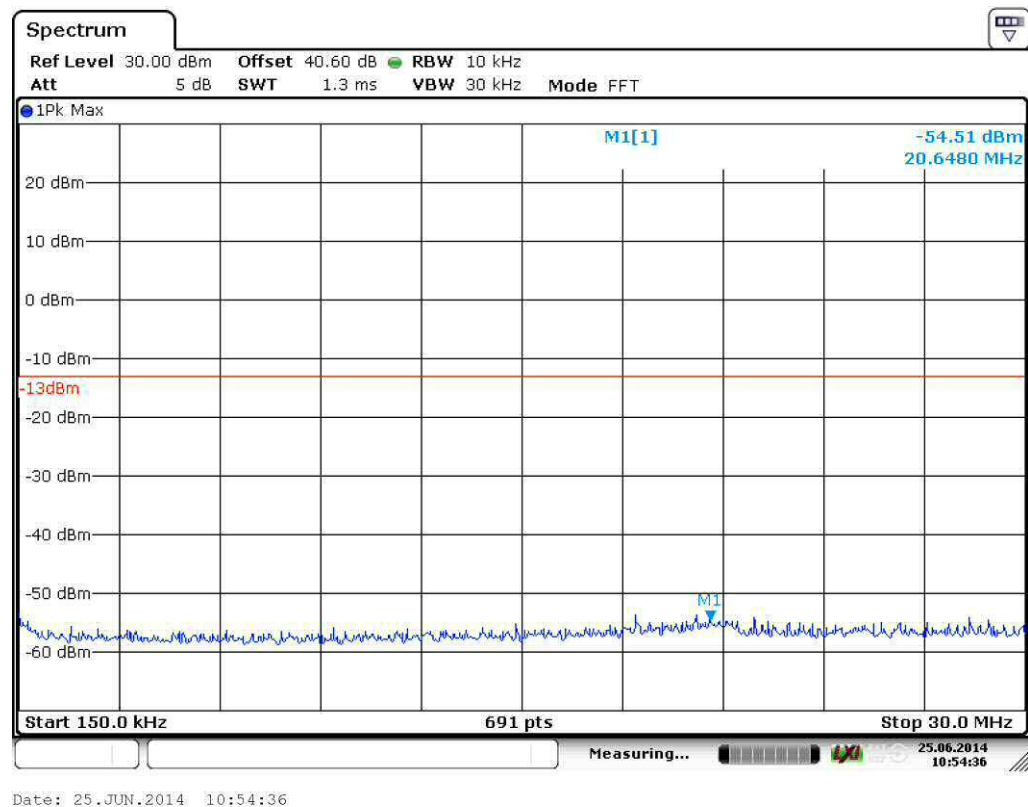


Figure 5. Low channel conductive emission 150 kHz to 30 MHz.

Conducted Spurious Emission 9 kHz to 5 GHz

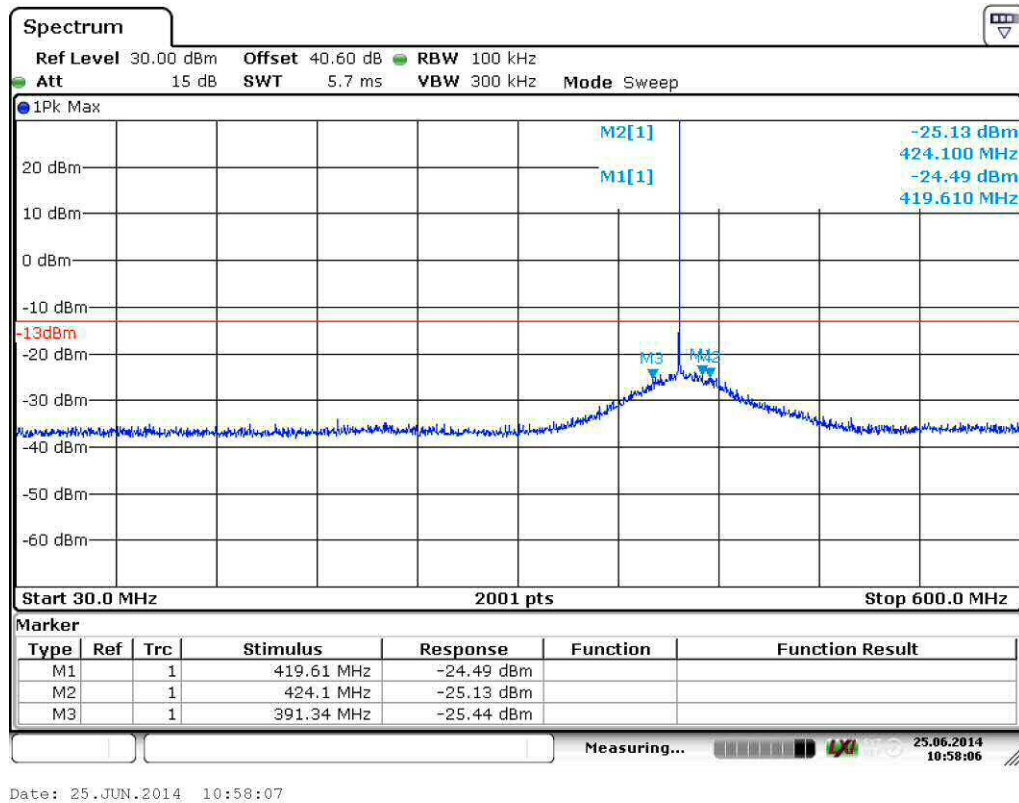


Figure 6. Low channel conductive emission 30 MHz to 600 MHz.

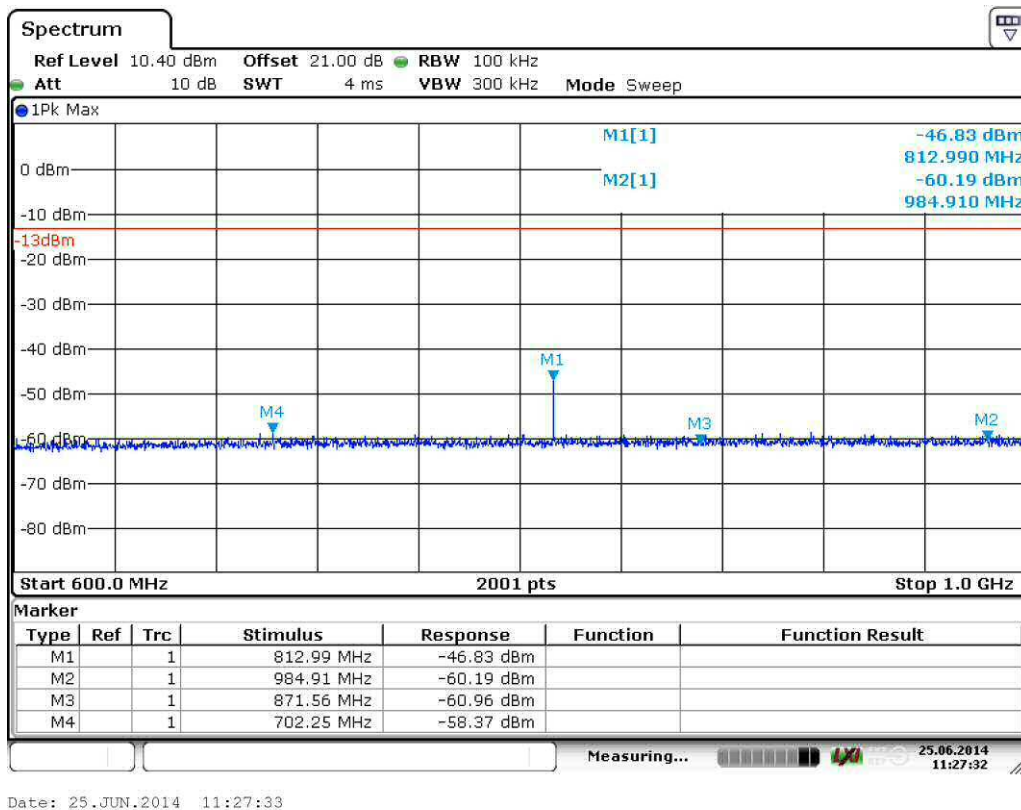
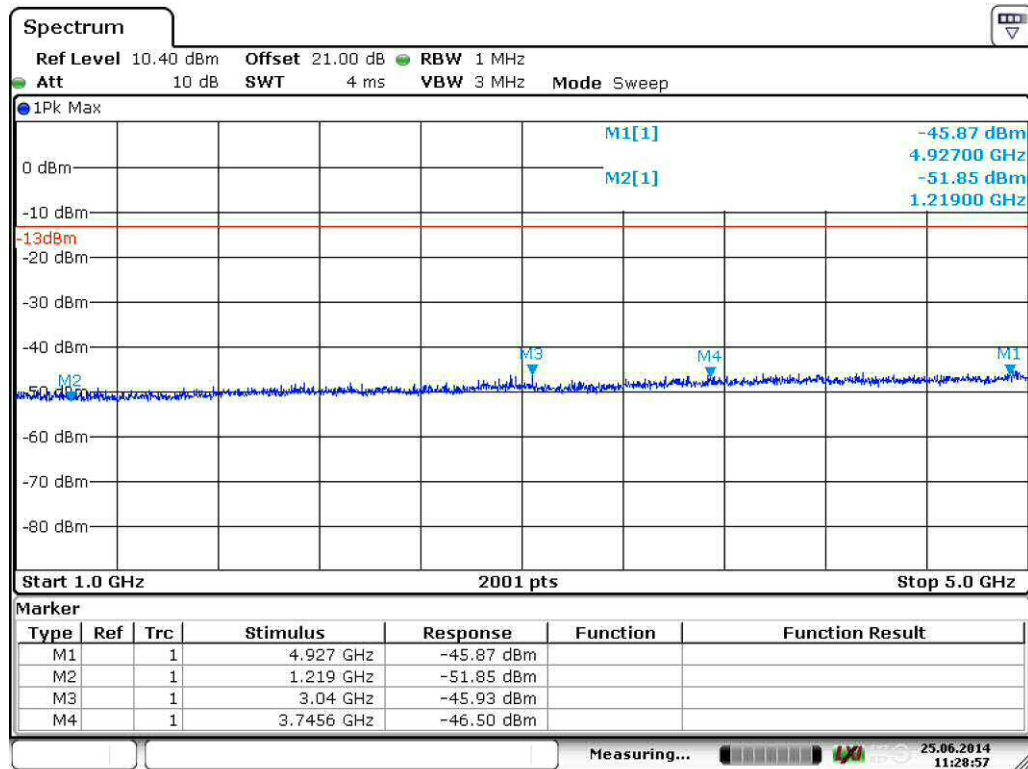


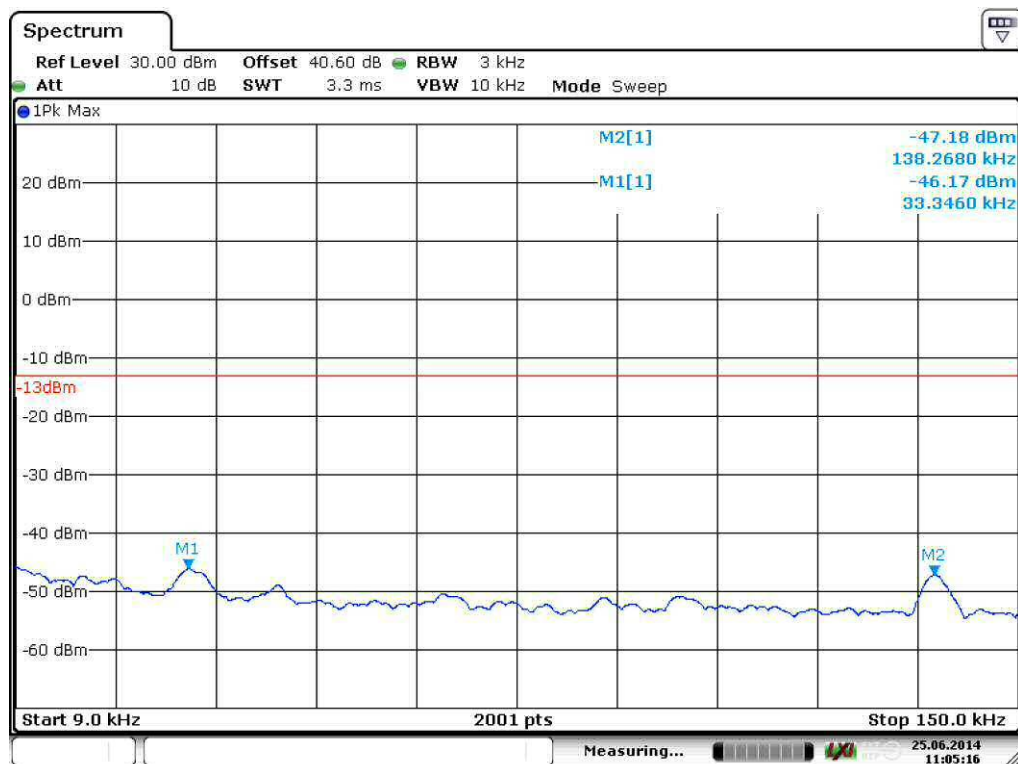
Figure 7. Low channel conductive emission 600 MHz to 1000 MHz.

Conducted Spurious Emission 9 kHz to 5 GHz



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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

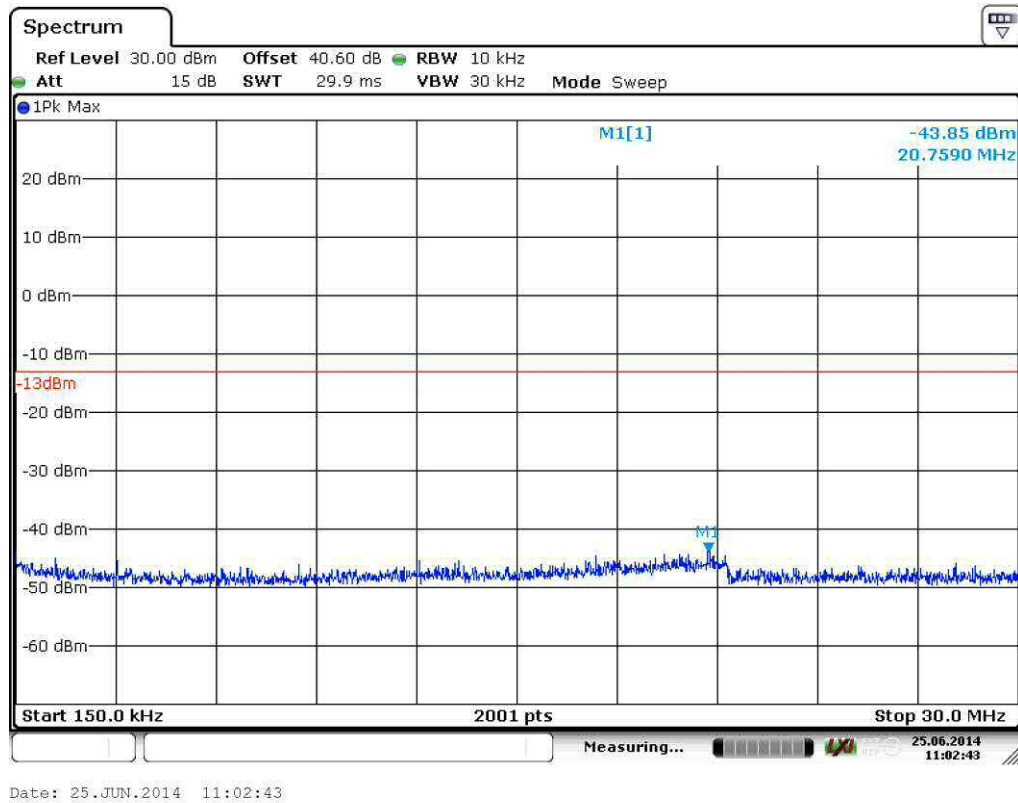


Figure 10. Mid channel conductive emission 150 kHz to 30 MHz.

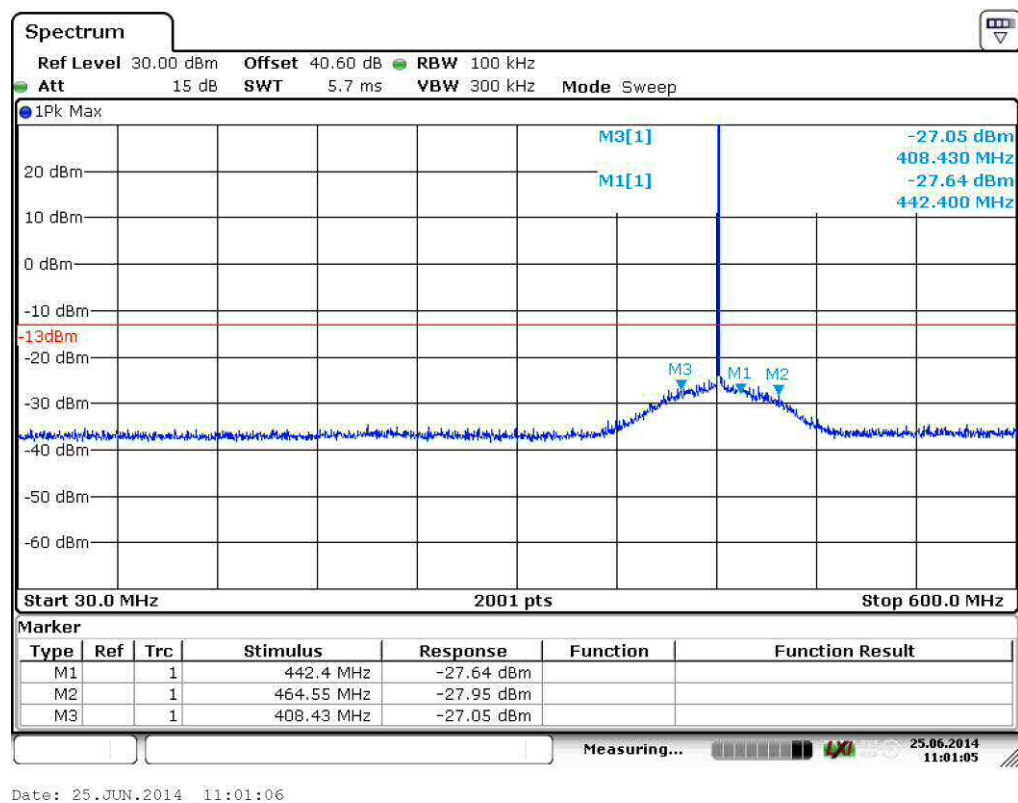


Figure 11. Mid channel conductive emission 30 MHz to 600 MHz.

Conducted Spurious Emission 9 kHz to 5 GHz

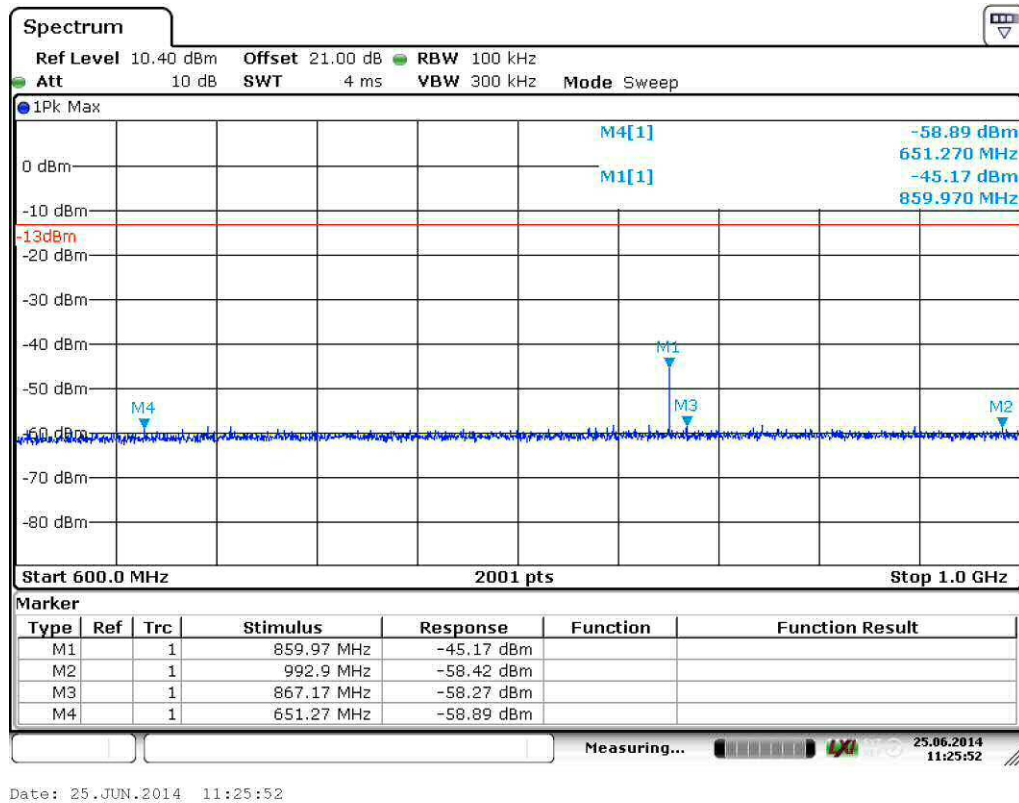


Figure 12. Mid channel conductive emission 600 MHz to 1000 MHz.

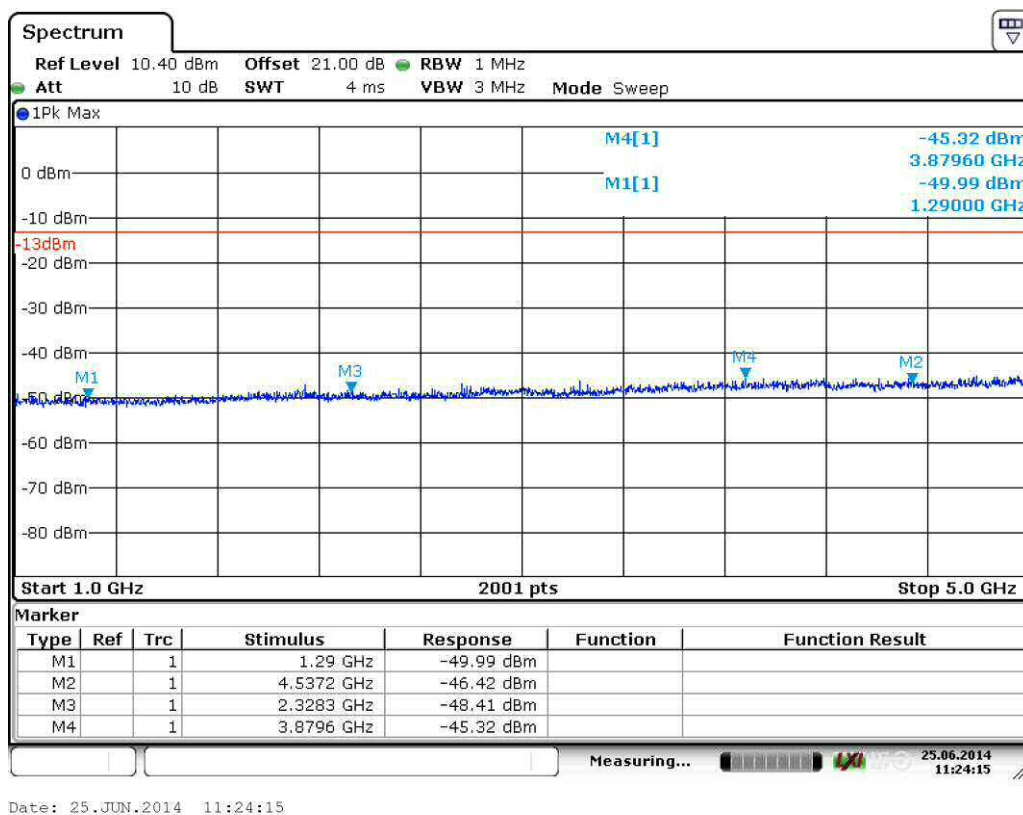


Figure 13. Mid channel conductive emission 1000 MHz to 5000 MHz.

Conducted Spurious Emission 9 kHz to 5 GHz

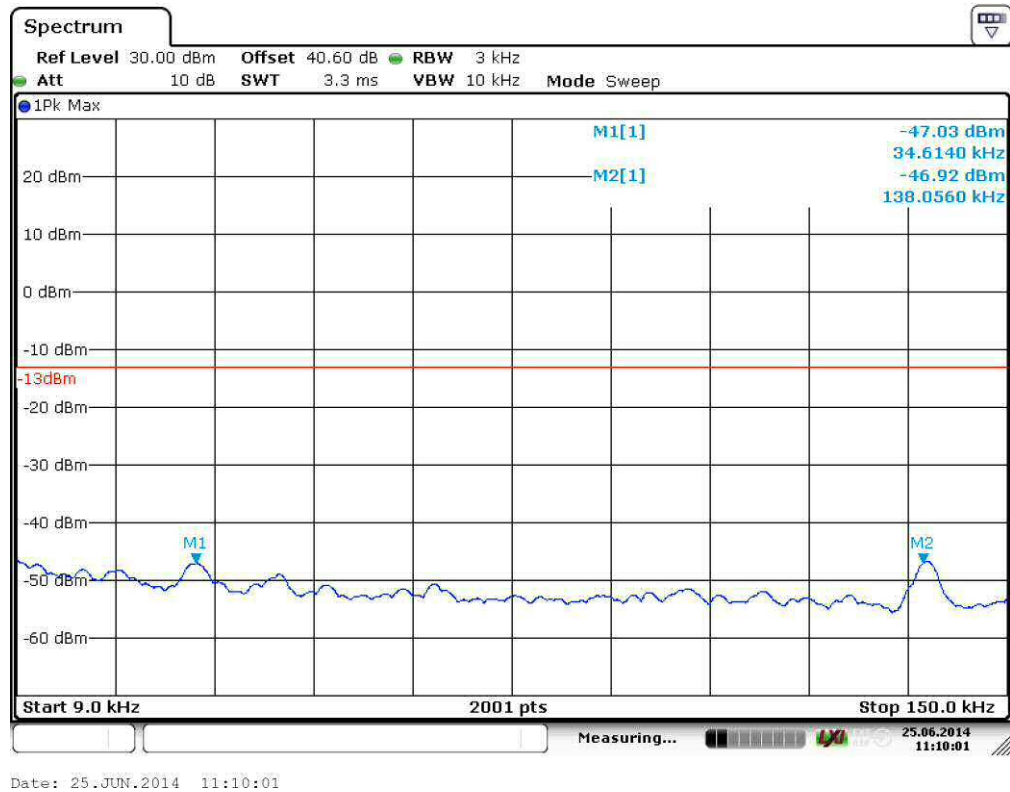


Figure 14. High channel conductive emission 9 kHz to 150 kHz.

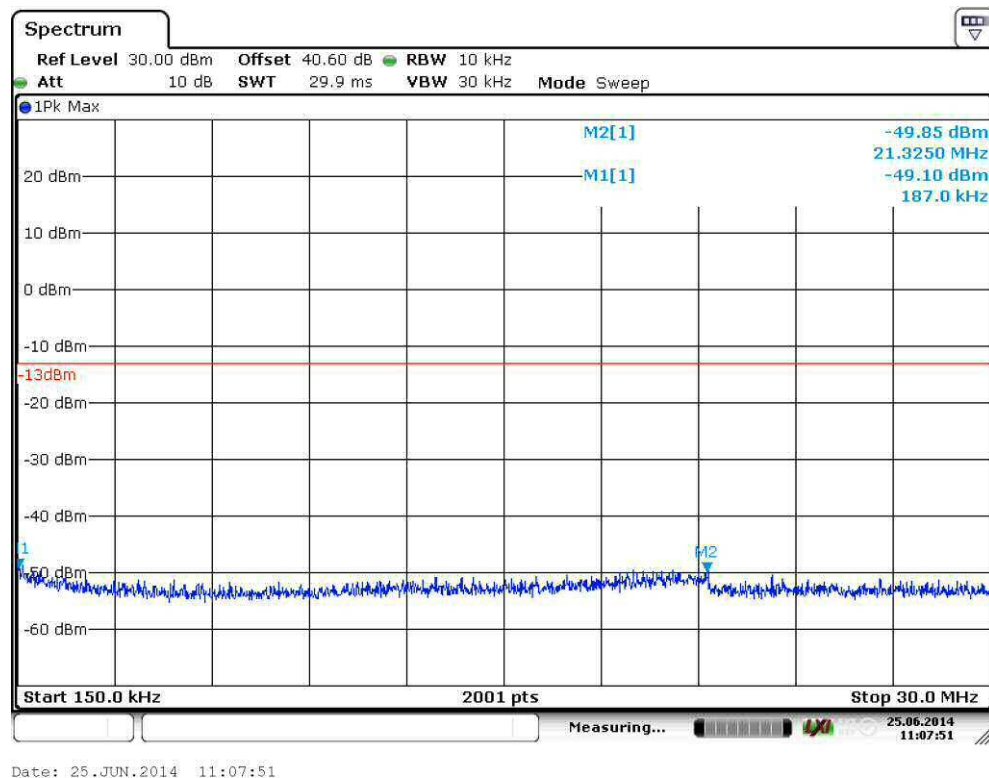


Figure 15. High channel conductive emission 150 kHz to 30 MHz.

Conducted Spurious Emission 9 kHz to 5 GHz

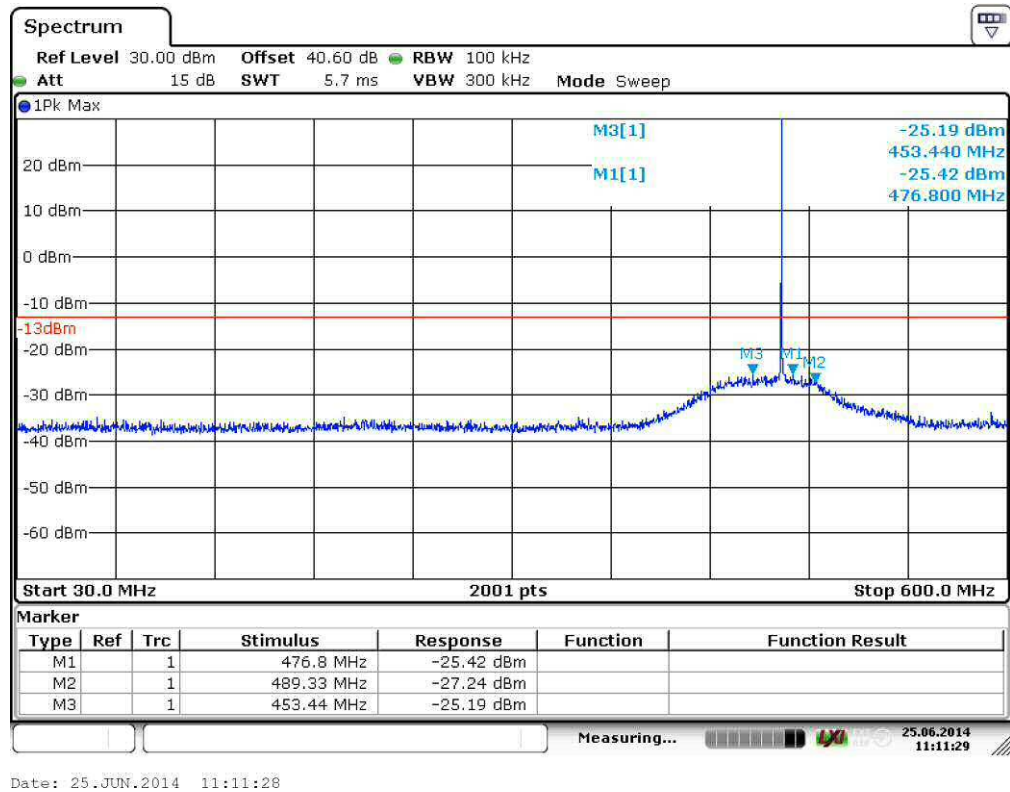


Figure 16. High channel conductive emission 30 MHz to 600 MHz.

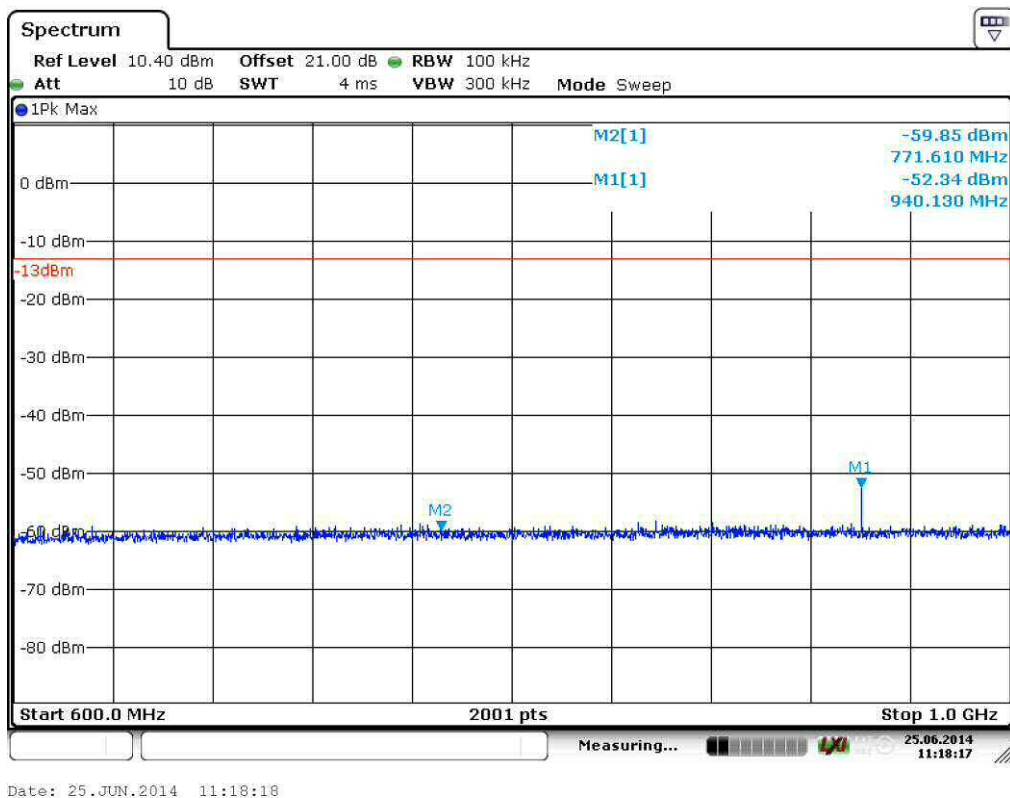


Figure 17. High channel conductive emission 600 MHz to 1000 MHz.

Conducted Spurious Emission 9 kHz to 5 GHz

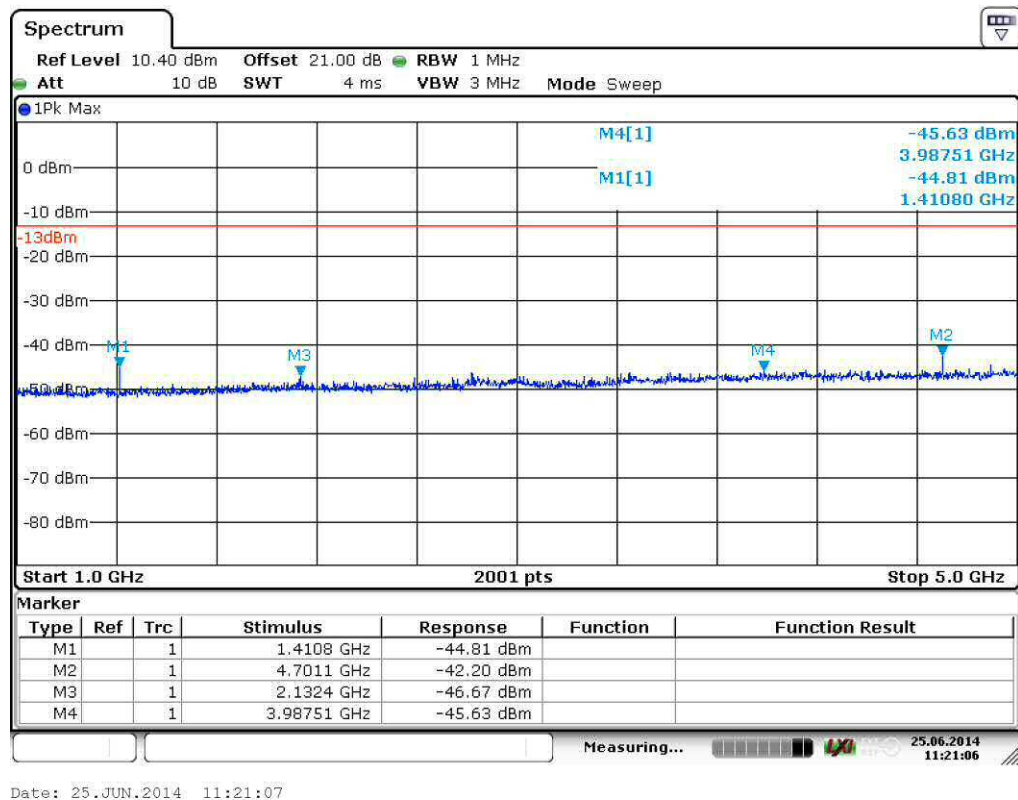


Figure 18. High channel conductive emission 1000 MHz to 5000 MHz.

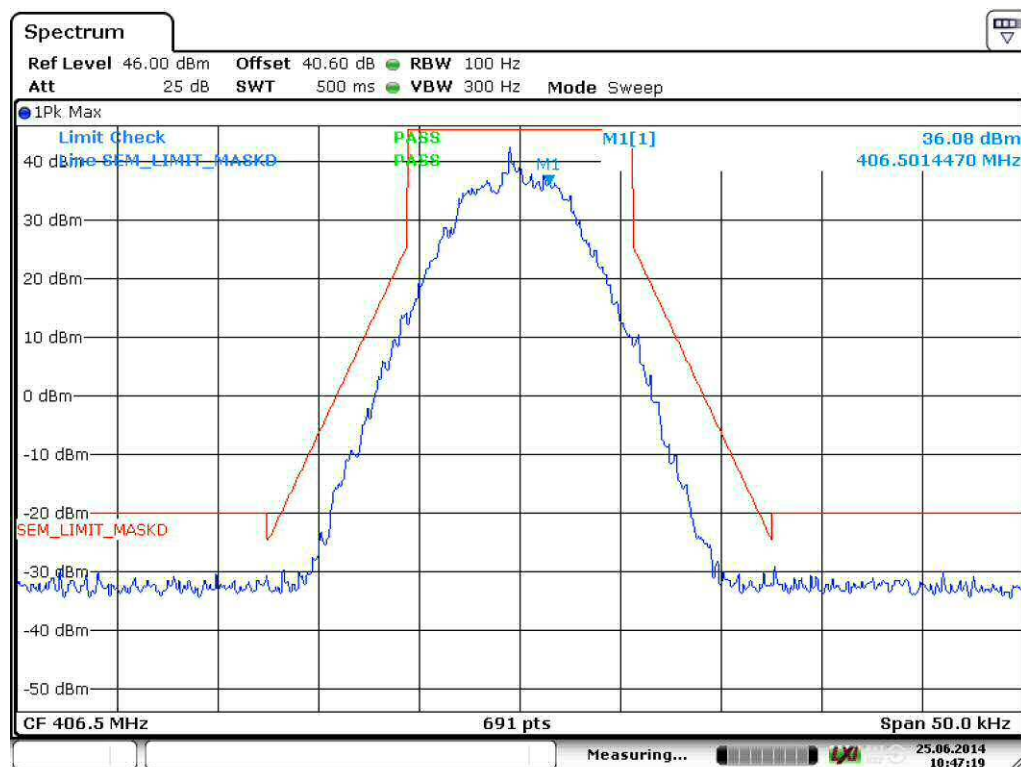
Spectrum Emission mask

Standard: 90.210 (d), 2.1049
RSS-119 section 5.5
Method of measurement: ANSI/TIA-603-C
THA 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



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Figure 19. Low channel spectrum emission mask.

Spectrum Emission Mask

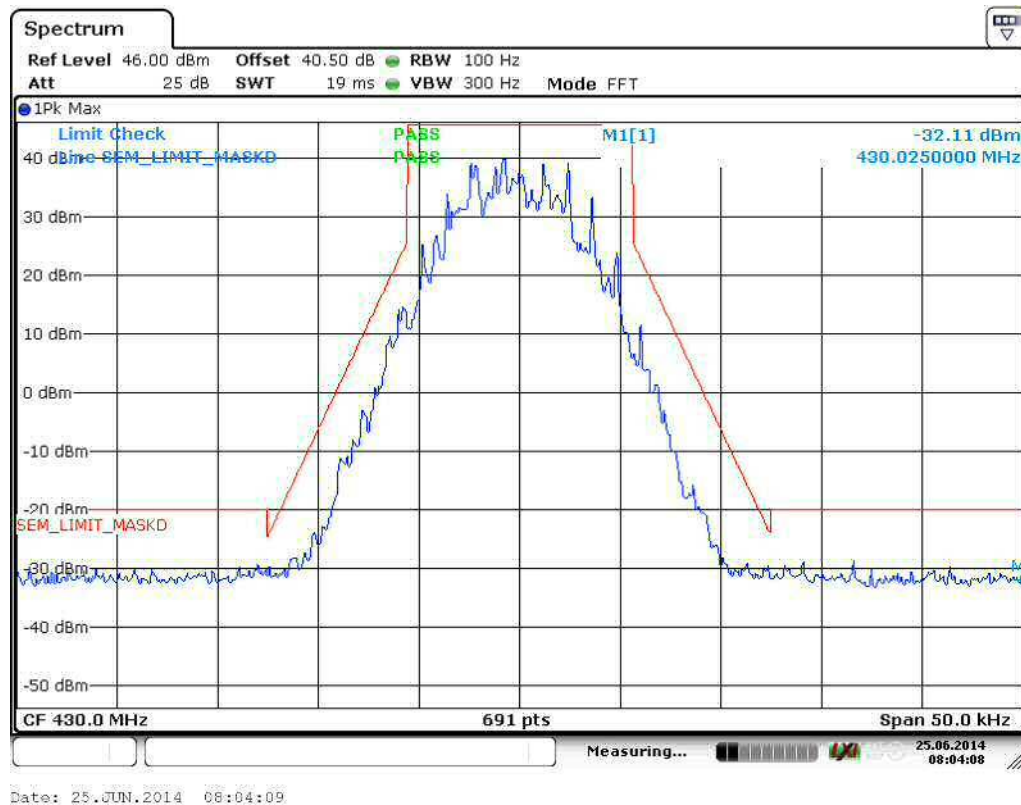


Figure 20. Mid channel spectrum emission mask.

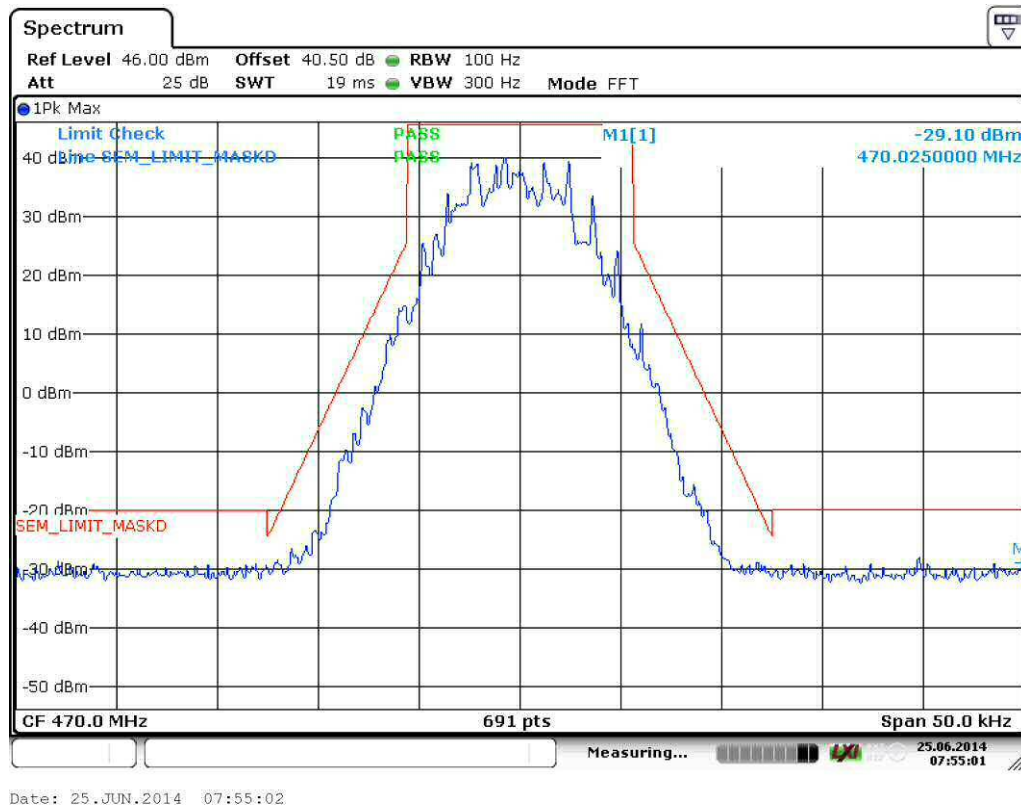


Figure 21. High channel spectrum emission mask.

99% Occupied Power Bandwidth

99% Occupied Power Bandwidth

Standard: 90.209, 2.1049
RSS-119 section 5.5
Method of measurement: ANSI/TIA-603-C
THA 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

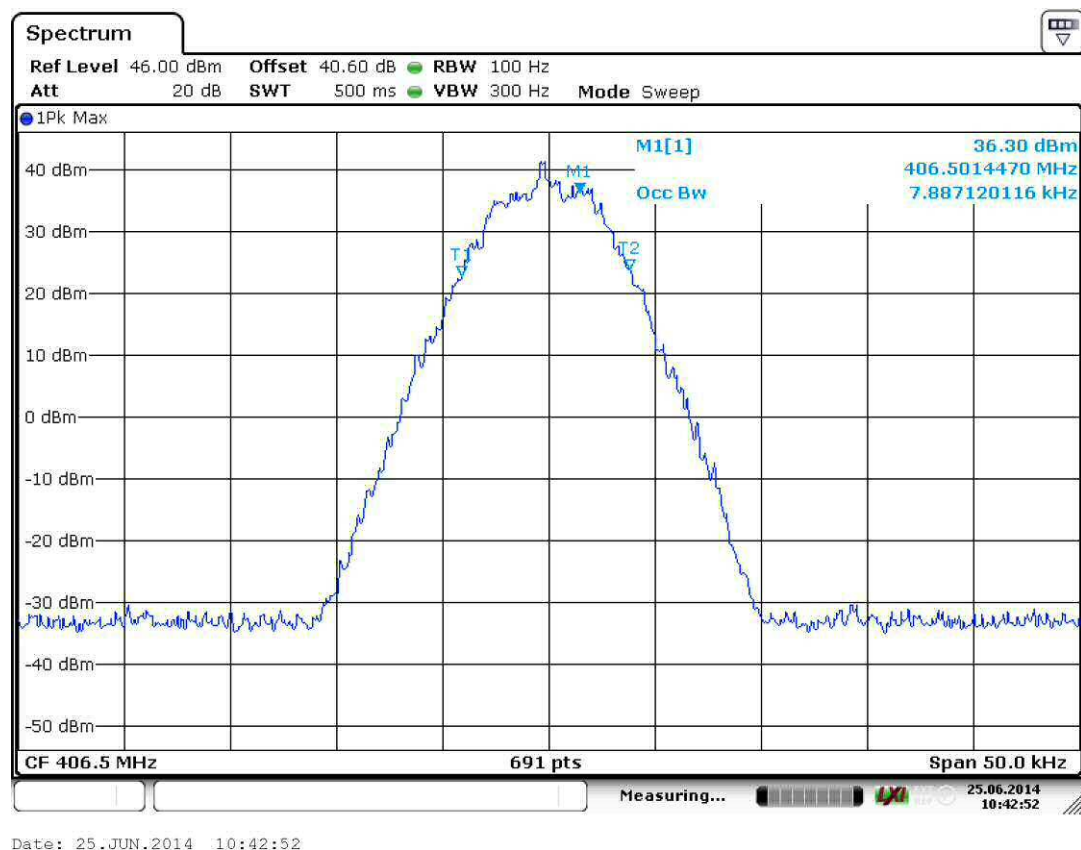
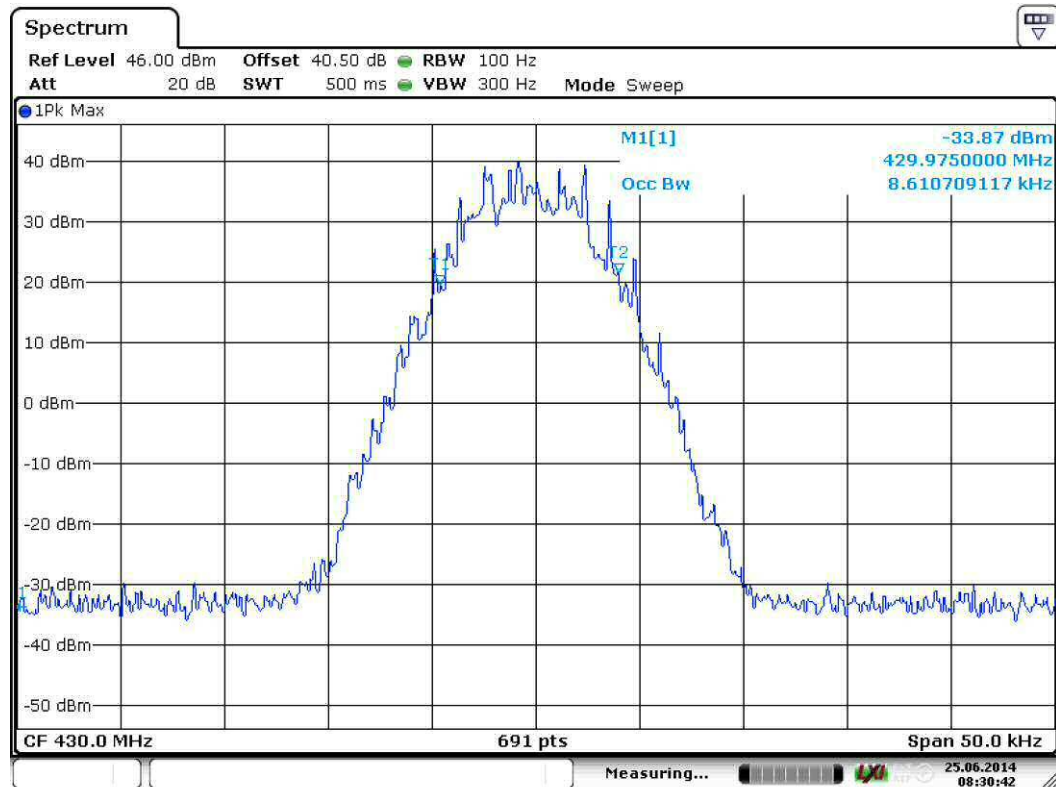


Figure 22. Low channel 99% Occupied Power Bandwidth.

99% Occupied Power Bandwidth



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Figure 23. Mid channel 99% Occupied Power Bandwidth.



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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).