

Date: ESPOO 19.02.2013Page: 1 (28)Appendices -Number:
No. 1 / 1**230528B**Date of handing in: 14.01.2013

Tested by:



Pekka Kälviäinen, Test Engineer

Reviewed by:



Timo Hietala, Test Engineer

SORT OF EQUIPMENT:

Tetra Base Station Radio Module

MARKETING NAME:

Cassidian TB3 TTRX800

TYPE:

DAH7974

MANUFACTURER:

Cassidian Finland Oy, Finland

SERIAL NUMBER:

-

CLIENT:

Cassidian Finland Oy

ADDRESS:

Hiomotie 32, FI-00380 Helsinki, Finland

TELEPHONE:

+358 10 4080 000TEST LABORATORY
FCC REG. NO.**Nemko Oy**
359859 October 20, 2011

IC FILE NO.

2040F-1 November 22, 2012

REMARKS:

Tested to FCC Part 90, FCC 12-114 and RSS-119 Issue 11.

The test results are valid for the tested unit only. Without a written permission of Nemko Oy it is allowed to copy this report as a whole, but not partially.

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1. General

Type:	DAH7974		
Alignment range:	851.0 – 869.0 MHz		
Switching range:	One channel		
Measurement	Equipment 1 Serial no. -	Equipment 2 Serial no. -	Equipment 3 Serial no.
Frequencies:	1) 854.0 MHz 2) 861.5 MHz 3) 869.0 MHz	4) 5) 6)	
Voltages:	Normal 48 VDC	Minimum 40.8 VDC	Maximum 55.2 VAC
Temperatures:	23.0°	-30.0°	50.0°
Humidity:	35 %		
Effective radiated power:	25 W	Antenna:	50 ohm
Number of channels:	1	Production model:	Pre-production model
Channel separation:	25 kHz	Modulation:	$\pi/4$-DQPSK

The transmitter was tested in a final base station configuration. The base station included one transceiver unit and one combiner.

2. Summary of performed tests and test results

(This interpretation of the test report's results does not belong to the scope of our accreditation.)

Section in CFR 47 / FCC 12-114	Section in RSS-119, Issue 11		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)	PASS
90.213 & 2.1055	5.3	Frequency stability	PASS
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/A
90.210 & 90.221	-	Adjacent Channel Power	PASS
15.107 (a)	RSS-Gen 7.2.2	Conducted emissions at mains ports	N.A.

According to the standard the measurement results have been compared directly with the limits without considering measurement uncertainties.

Explanations:

PASS The EUT passed that particular test.
 FAIL The EUT failed that particular test.

3. RF Power Output

NAME OF TEST: RF Power Output	FCC PARA.NO.: 2.1046 90.205
TESTED BY: Pekka Kälviäinen	RSS119: 5.4 DATE: 14/01/2013

Test Results: Complies.

Rated power: highest 25W = 43.98 dBm.
lowest: 0.63W = 28.00 dBm

Limit: ± 1.0 dB from rated power.

Measurement Data:

Modulation Type	Frequency (MHz)	Measured Output Power (dBm)	Power (W)
$\pi/4$ -DQPSK	854.0	44.36	27.29
$\pi/4$ -DQPSK	861.5	44.03	25.29
$\pi/4$ -DQPSK	869.0	43.98	25.00
$\pi/4$ -DQPSK	854.0	28.60	0.72
$\pi/4$ -DQPSK	861.5	28.52	0.71
$\pi/4$ -DQPSK	869.0	28.30	0.68

The output power was measured from the base station platform antenna terminal which was located at the top of the cabinet.

Equipment used: X4, X5, X6

**Measurement
Uncertainty:** ± 0.7 dB.

Temperature: 22.3 °C.

**Relative
Humidity:** 31.7 %.

4. 99% Occupied Bandwidth

NAME OF TEST: Occupied Bandwidth	FCC PARA.NO.: 2.1049 90.209
TESTED BY: Pekka Kälviäinen	RSS119: 5.5 DATE: 18/01/2013

Limit: 22 kHz

Test Results: Complies.

Test Data: See attached plot(s).

Channel spacing	Frequency (MHz)	Measured 99% Occupied Bandwidth (kHz)
25 kHz	854.0	21.35
25 kHz	861.5	21.29
25 kHz	869.0	21.39

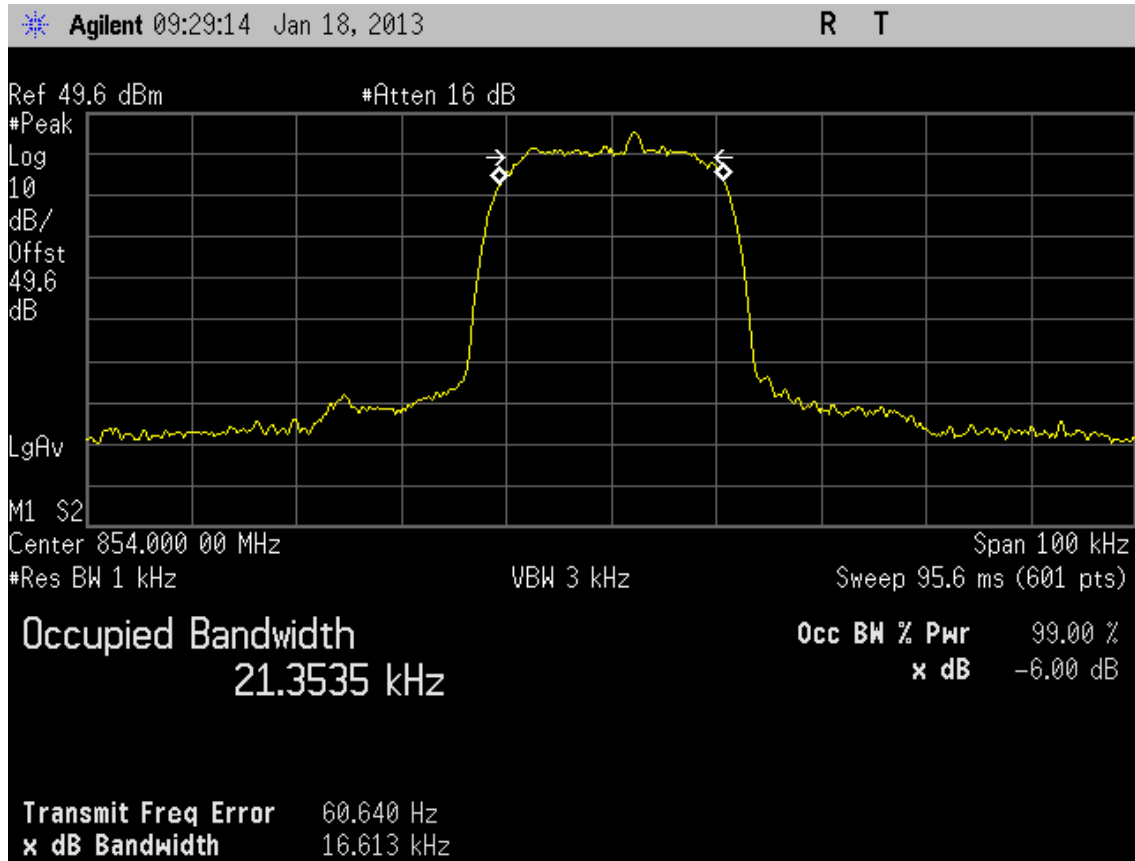
Equipment used: 566, X4, X5

**Measurement
Uncertainty:** ± 0.7 dB.

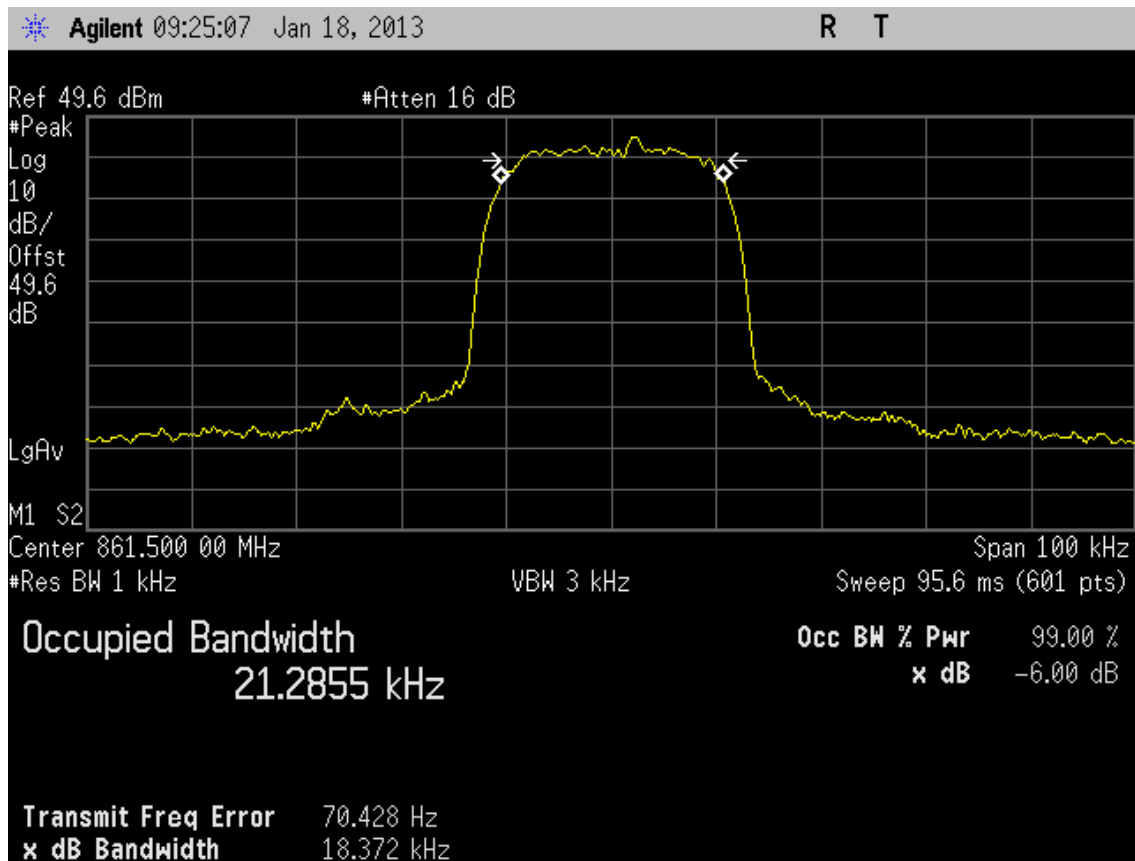
Temperature: 23 °C.

**Relative
Humidity:** 35 %.

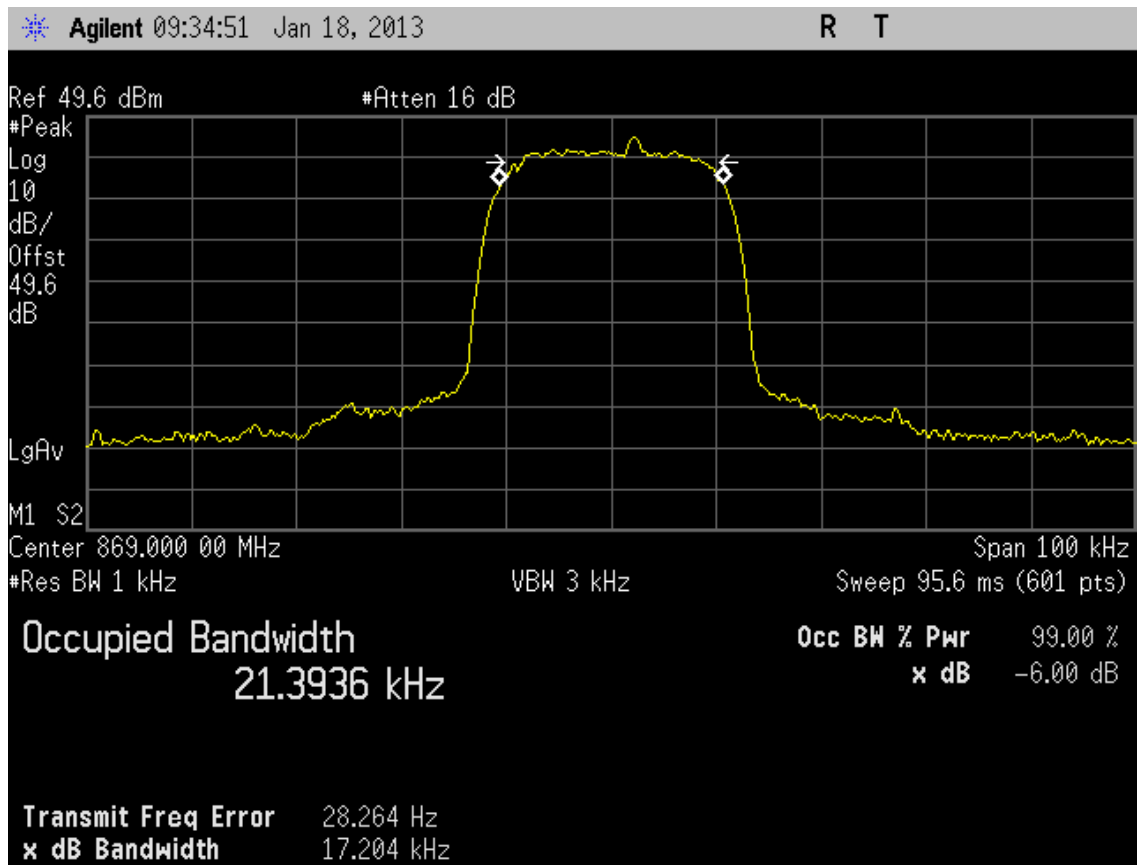
The 99% occupied bandwidth of the carrier emission is measured using a spectrum analyzer with Resolution Bandwidth set to 1-5 % of the necessary bandwidth of the transmitted carrier. The EUT is in a high power mode.



Low channel 854.0 MHz



Middle channel 861.5 MHz



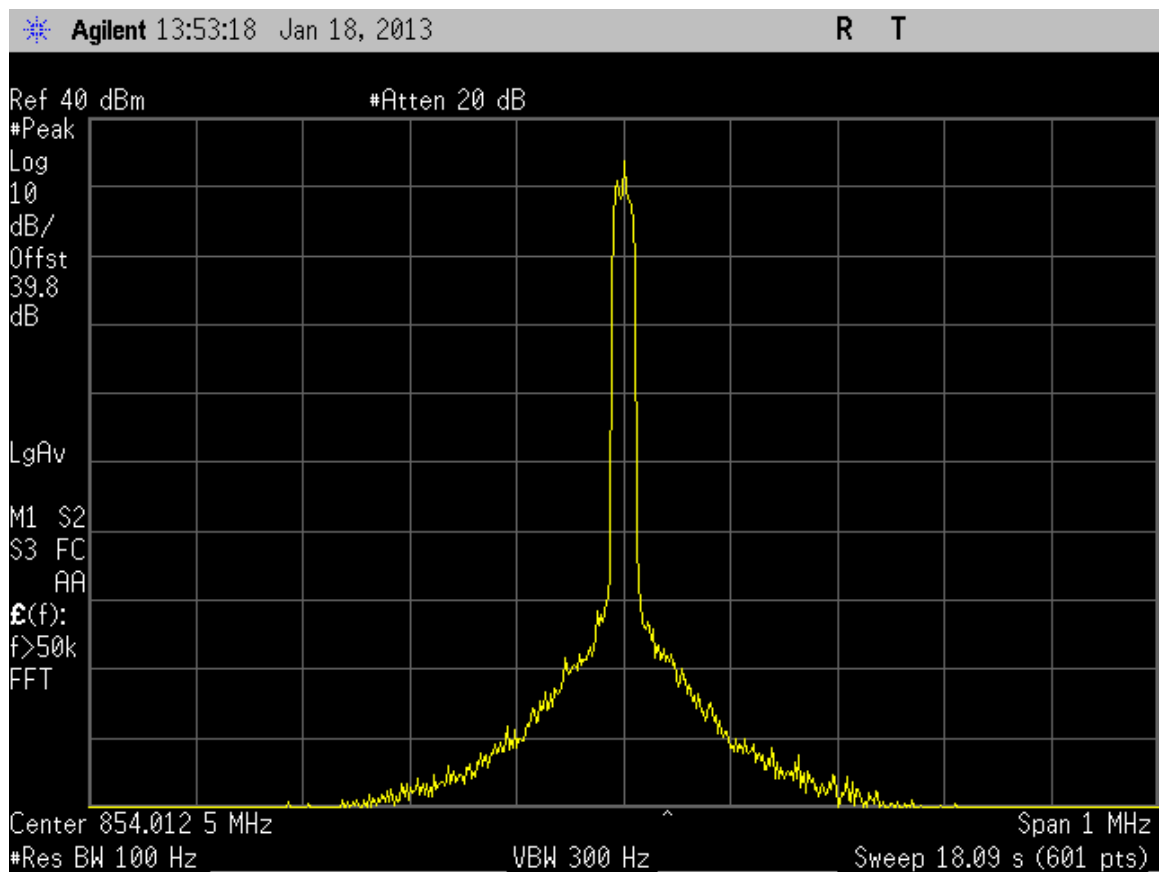
High channel 869.0 MHz

5. Spectrum Emission mask

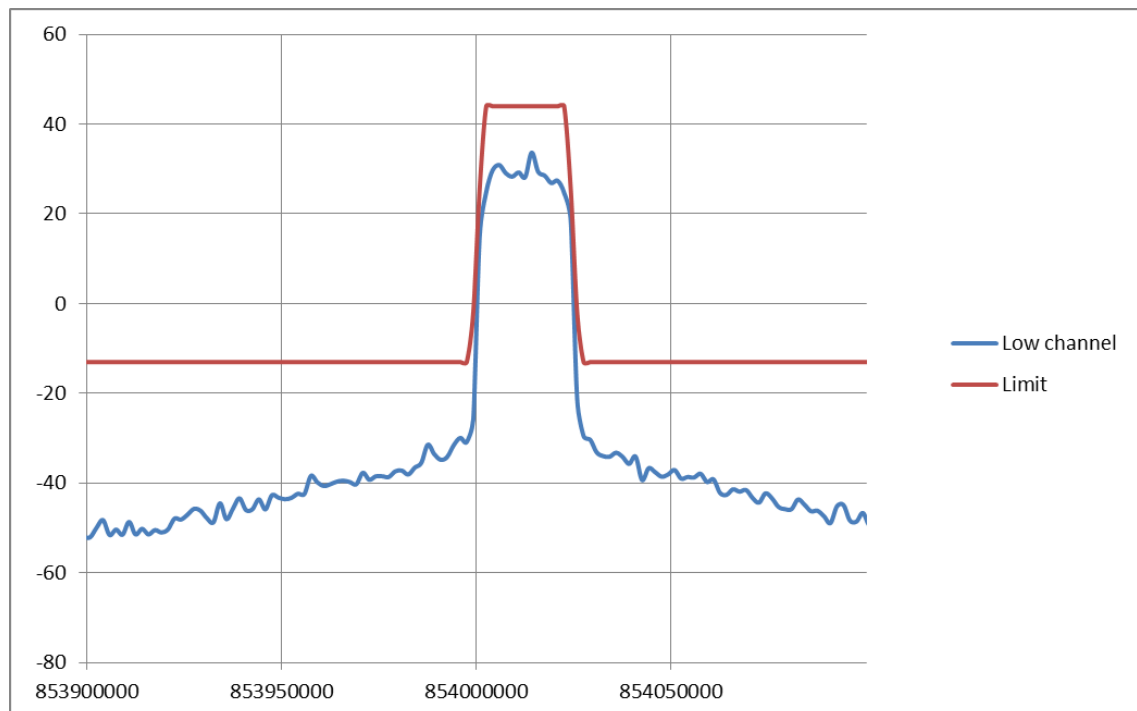
NAME OF TEST: Spectrum emission mask	FCC PARA.NO.: 2.1049 90.210
TESTED BY: Pekka Kälviäinen	RSS119: 5.5 DATE: 18/01/2013

Test Results:	Complies.
Test Data:	See attached plot(s).
Limit FCC 90.210:	No limit if the EUT fulfils the ACP limit in chapter 6.
Limit RS119:	Emission mask Y: $12.375 < f_d \leq 13.975$: Attenuation = $30 + 16.67(f_d - 12.375)$ $f_d > 13.975$: Attenuation = 57 dB
Power:	25 W (43.98 dBm)
Equipment used:	566, X4, X5
Measurement Uncertainty:	± 0.7 dB.
Temperature:	23 °C.
Relative Humidity:	35 %.

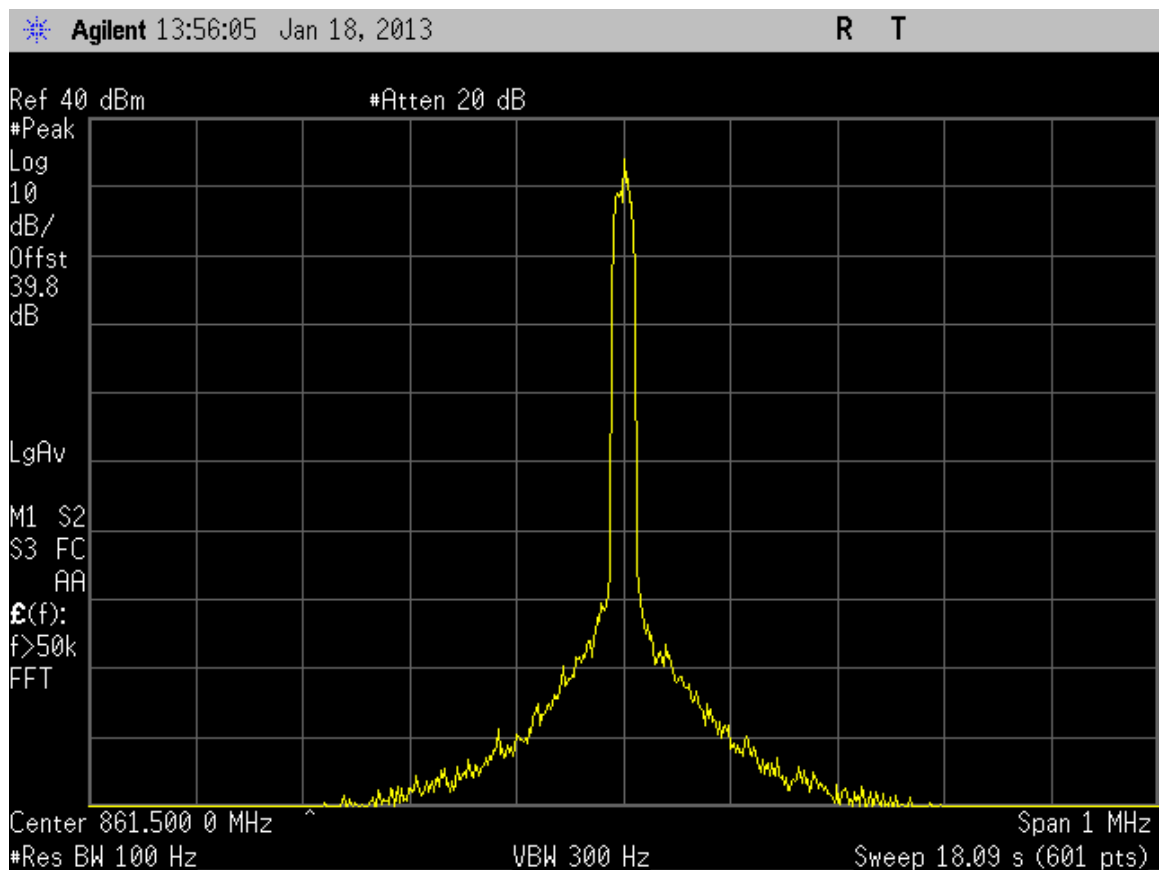
The emission mask of the modulated carrier is measured by using a spectrum analyzer with resolution bandwidth set to 100 Hz for emission mask Y.



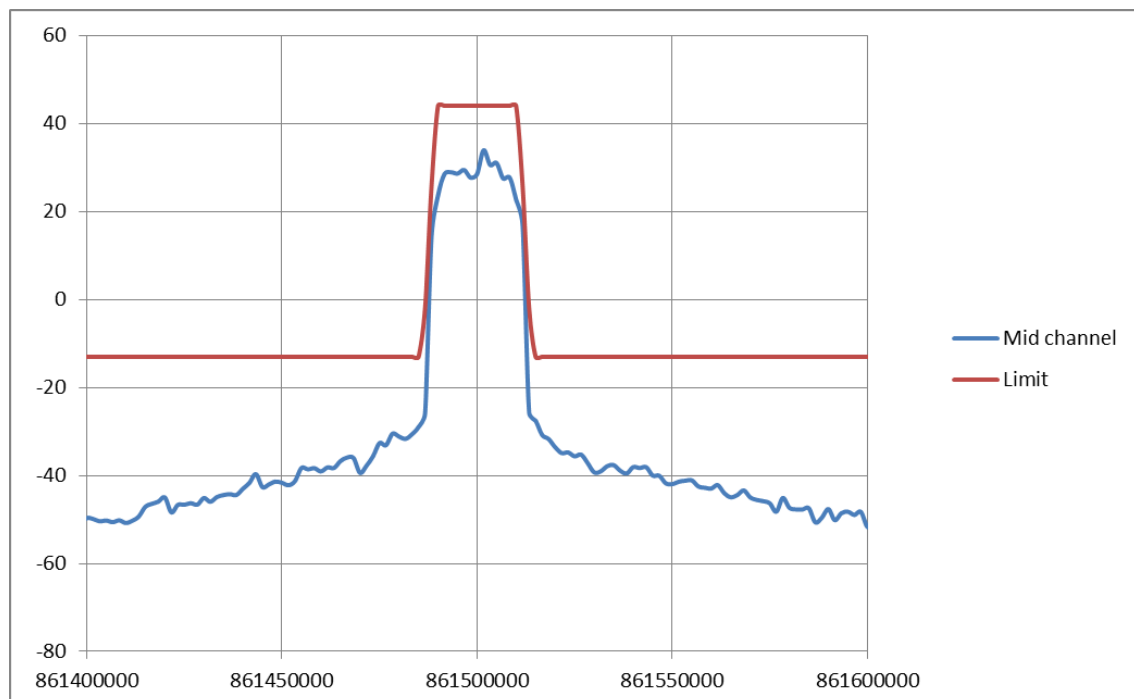
Low channel.



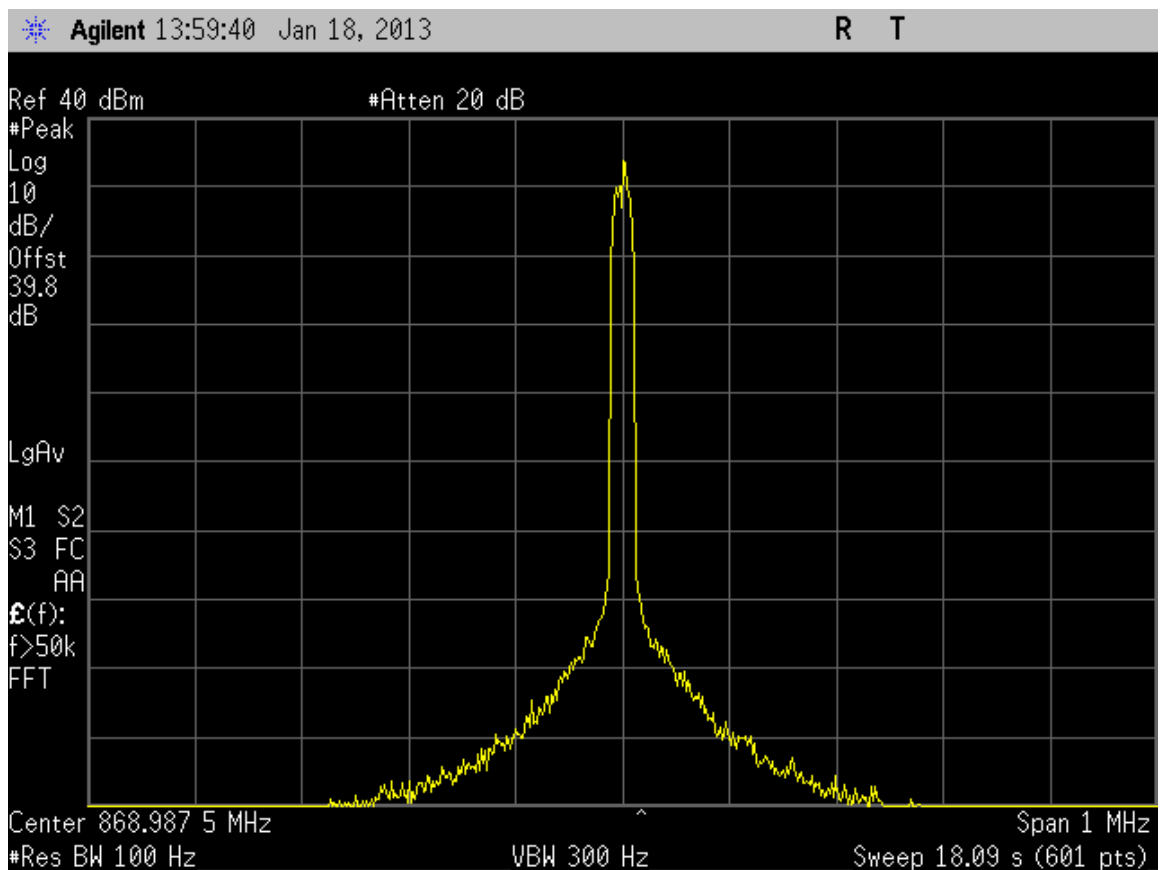
Low channel with limit value, power 25 W (43.98 dBm)



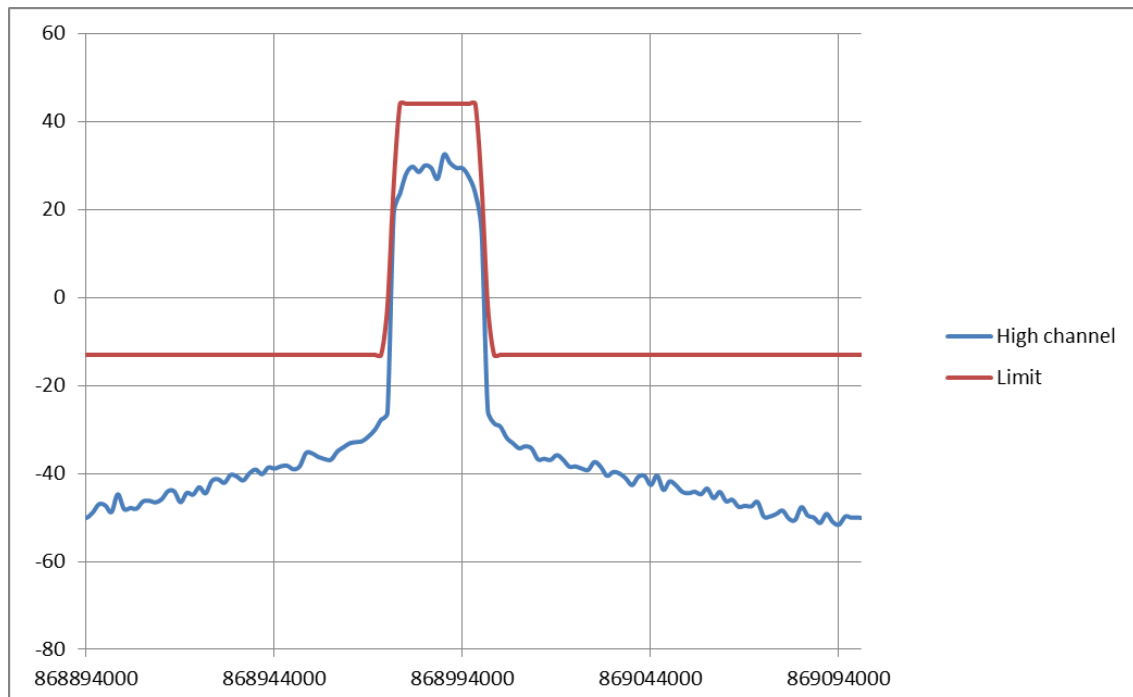
Mid channel.



Mid channel with limit value, power 25 W (43.98 dBm)



High channel.



High channel with limit value, power 25 W (43.98 dBm)

6. Adjacent Channel Power

NAME OF TEST:	Spurious Emissions conducted	FCC PARA.NO.:	90.210 90.221 FCC 12-114
TESTED BY:	Pekka Kälviäinen	RSS119:	-
		DATE:	18/01/2013

Test Results: Complies.

Test Data: See attached plots.

Requirement: See below on the table
On any frequency removed from the assigned frequency by more than 75 kHz, the attenuation of any emission must be at least $43 + 10 \log (P_{\text{watts}})$ dB.

Transmitter tuned at 854.0, 861.5 and 869.0 MHz

ACP results:

Displacement	Low Channel	Mid Channel	High Channel	Limit dBc
43.98 dBm (25 W)	854.0 MHz	861.5 MHz	869.0 MHz	
-75 kHz	-75.07	-75.07	-75.17	-70
-50 kHz	-69.76	-69.85	-69.87	-65
-25 kHz	-63.59	-63.97	-63.95	-55
+25 kHz	-64.15	-64.55	-64.36	-55
+50 kHz	-69.61	-69.98	-69.68	-65
+75 kHz	-75.13	-75.22	-75.27	-70

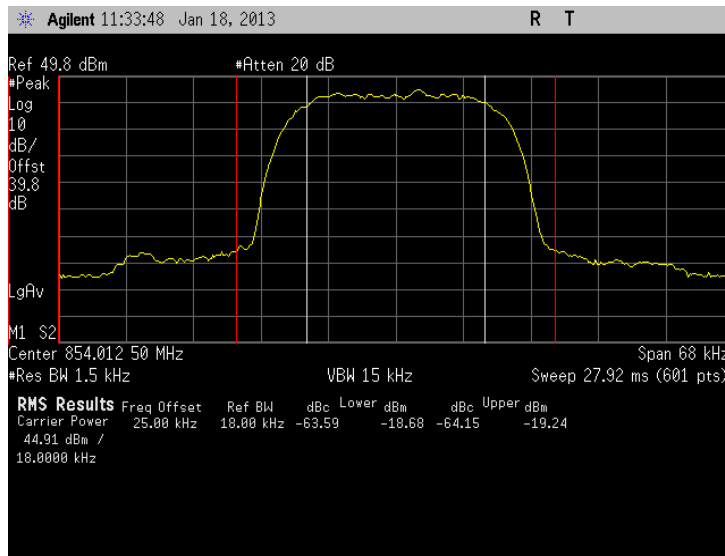
Equipment used: 566, X4, X5

**Measurement
Uncertainty:** ± 1.8 dB.

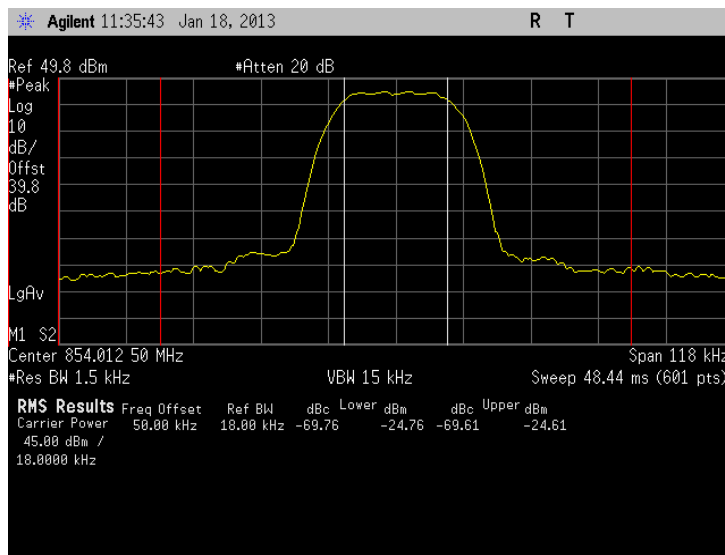
Temperature: 23 °C.

**Relative
Humidity:** 45 %.

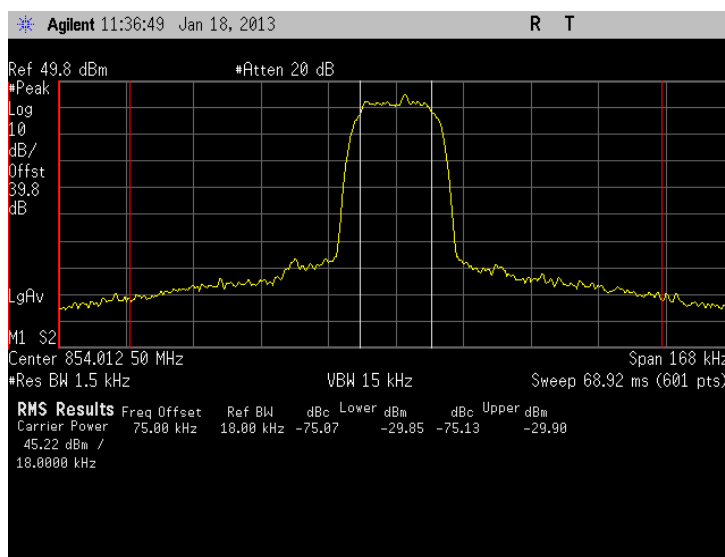
Rated output power: 25W



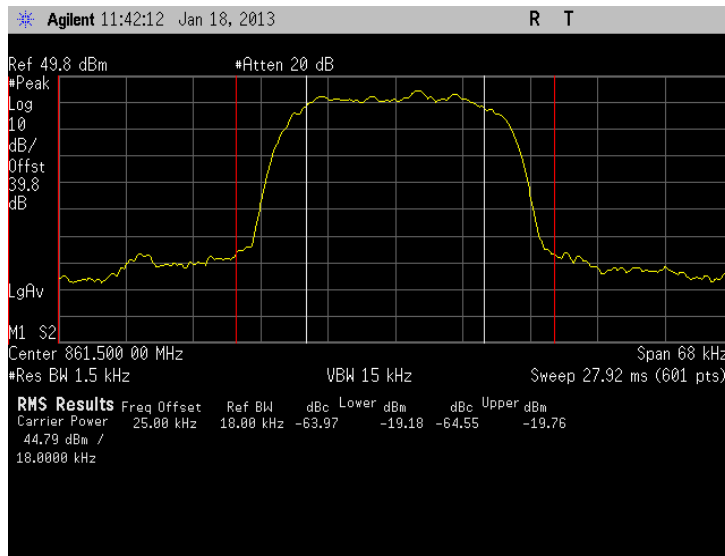
Low channel, displacement ± 25 kHz



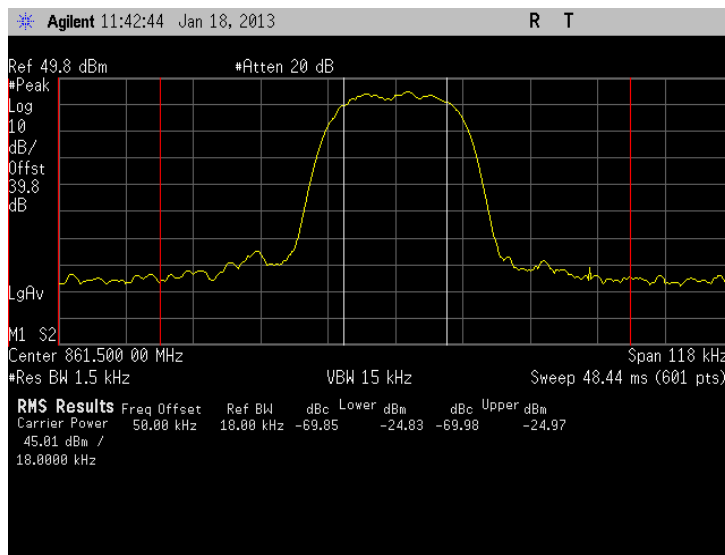
Low channel, displacement ± 50 kHz



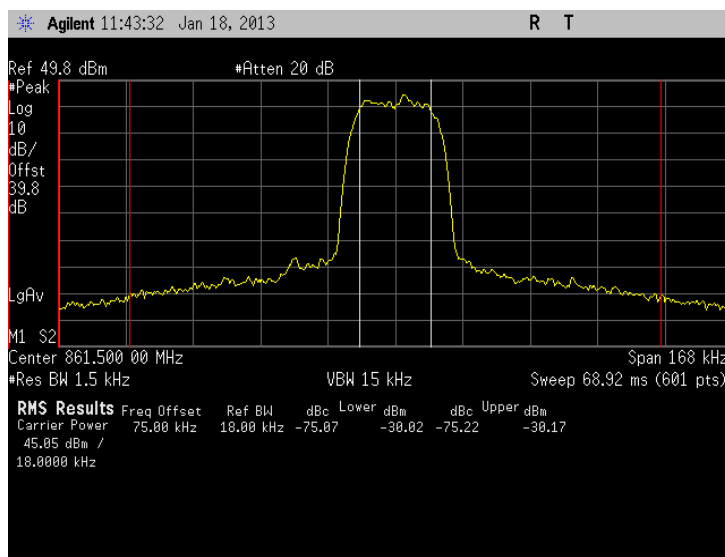
Low channel, displacement ± 75 kHz



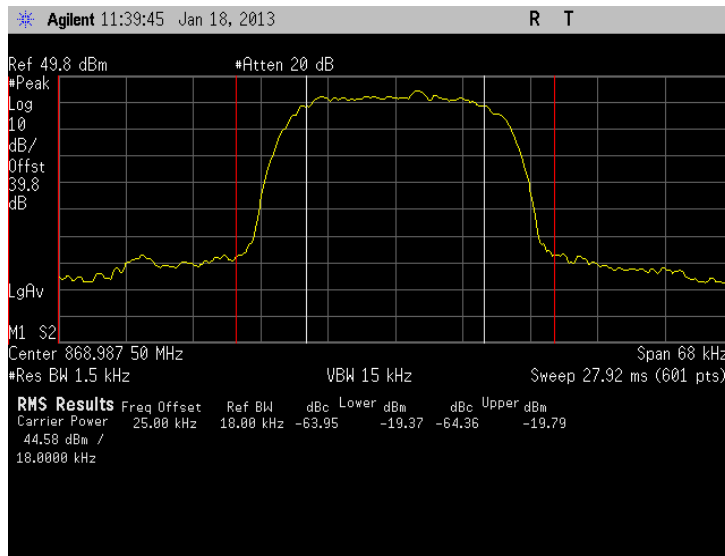
Mid channel, displacement ± 25 kHz



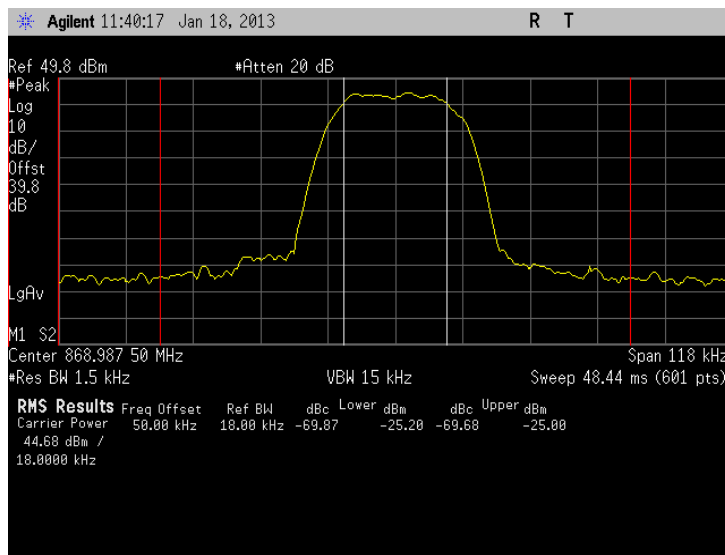
Mid channel, displacement ± 50 kHz



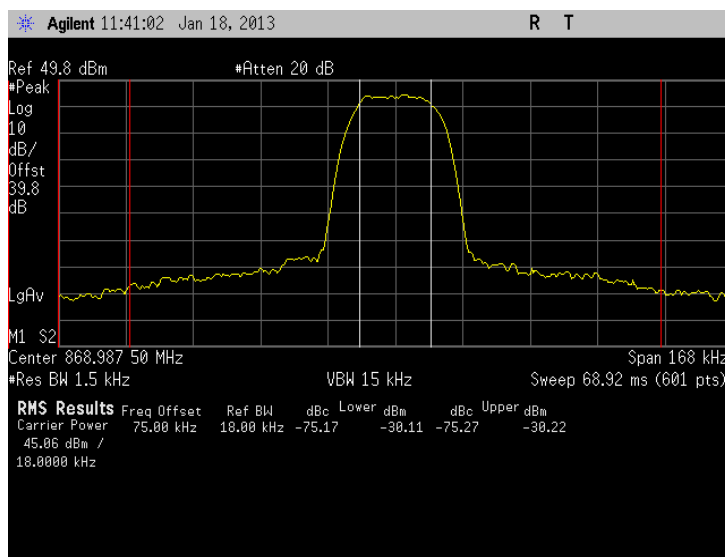
Mid channel, displacement ± 75 kHz



High channel, displacement ± 25 kHz



High channel, displacement ± 50 kHz



High channel, displacement ± 75 kHz

7. Transmitter Spurious Emissions (Conducted)

NAME OF TEST: Spurious Emissions conducted	FCC PARA.NO.: 2.1051 90.210
TESTED BY: Pekka Kälviäinen	RSS119: 5.8 DATE: 18/01/2013

Test Results: Complies.

Test Data: See attached plots.

Requirement: Attenuation of $43 + 10 \log (P)$ dB, (-13 dBm)

Method of measurement: TIA-603

Transmitter tuned at 854.0, 861.5 and 869.0 MHz

In IM tests two adjacent channels tested as follows:

854.0 MHz and 854.6 MHz / 861.5 MHz and 862.1 MHz / 868.4 MHz and 869.0 MHz.

Highest results:

Channel 854.0 MHz				Channel 861.5 MHz				Channel 869.0 MHz			
Freq (MHz)	Level (dBm)	Offset (dB)	Result (dBm)	Freq (MHz)	Level (dBm)	Offset (dB)	Result (dBm)	Freq (MHz)	Level (dBm)	Offset (dB)	Result (dBm)
6998	-65.46	24.51	-40.35	2591	-68.28	22.44	-45.84	1714	-68.86	22.63	-46.23
-	-	-	-	4305	-67.52	23.61	-43.91	2605	-64.68	22.45	-42.23
-	-	-	-	-	-	-	-	4348	-67.34	23.91	-43.44

Spurious emissions:

Below 1.5 GHz 20 dB attenuator used, offset calculated in the above table.

Above 1.5 GHz 20 dB attenuator and high pass filter used, offset calculated in the above table.

IM tests:

50 dB attenuator used, Offset was set to measuring device.

Equipment used: 566, 567, 572, 729, 375, X4, X5

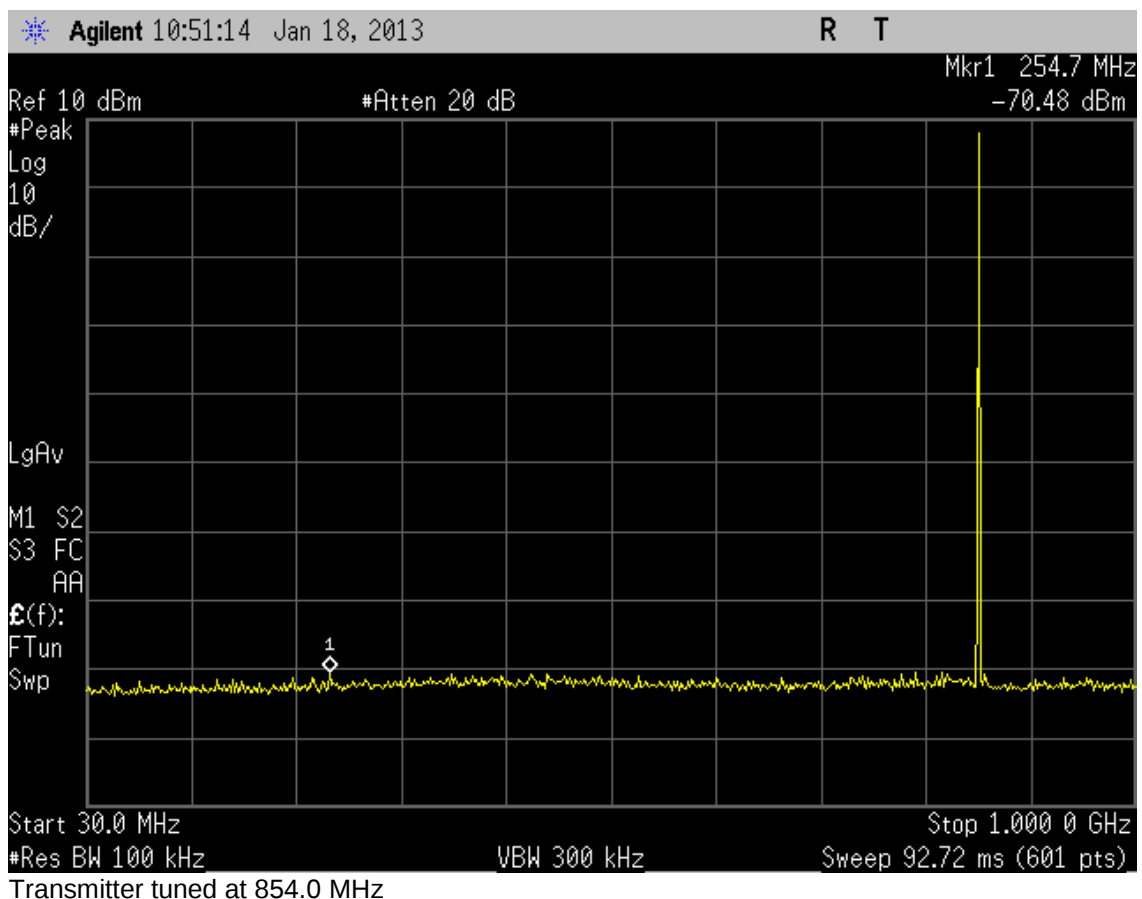
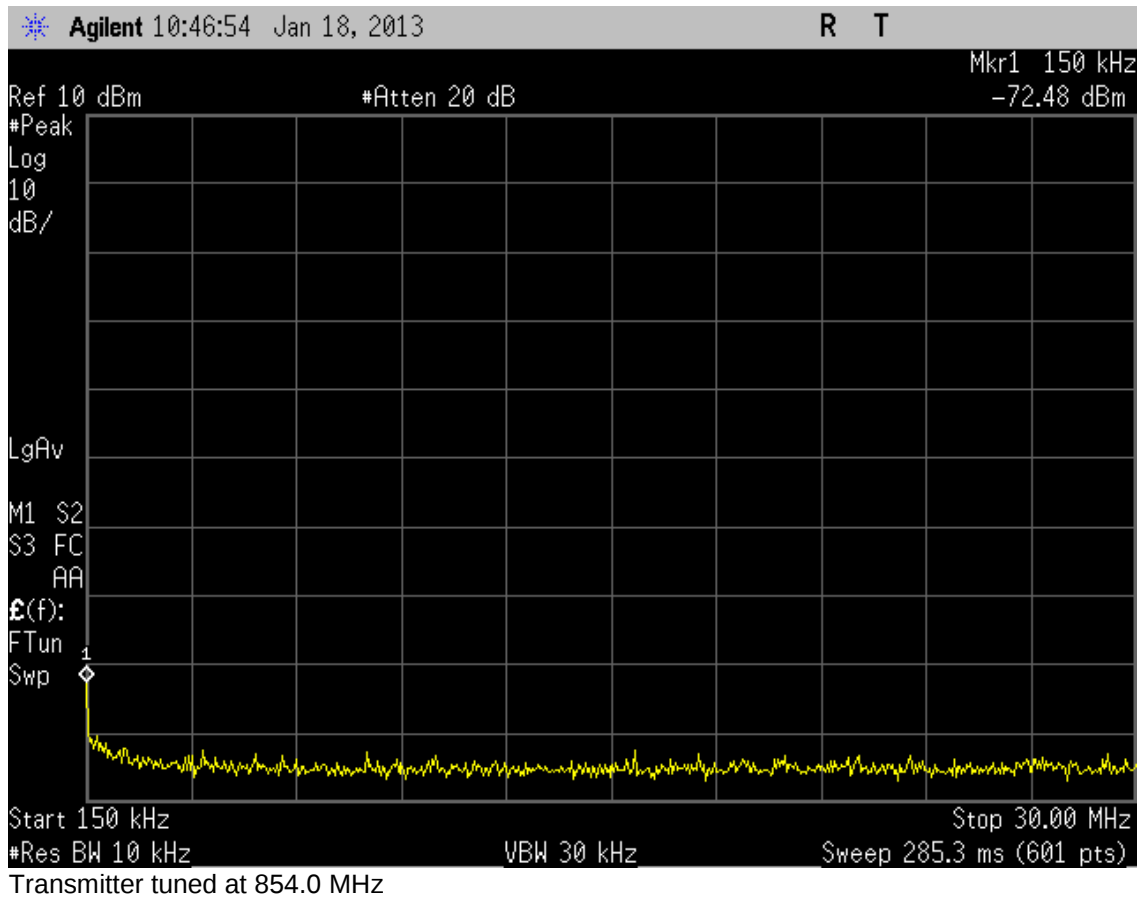
Measurement Uncertainty: ± 1.8 dB.

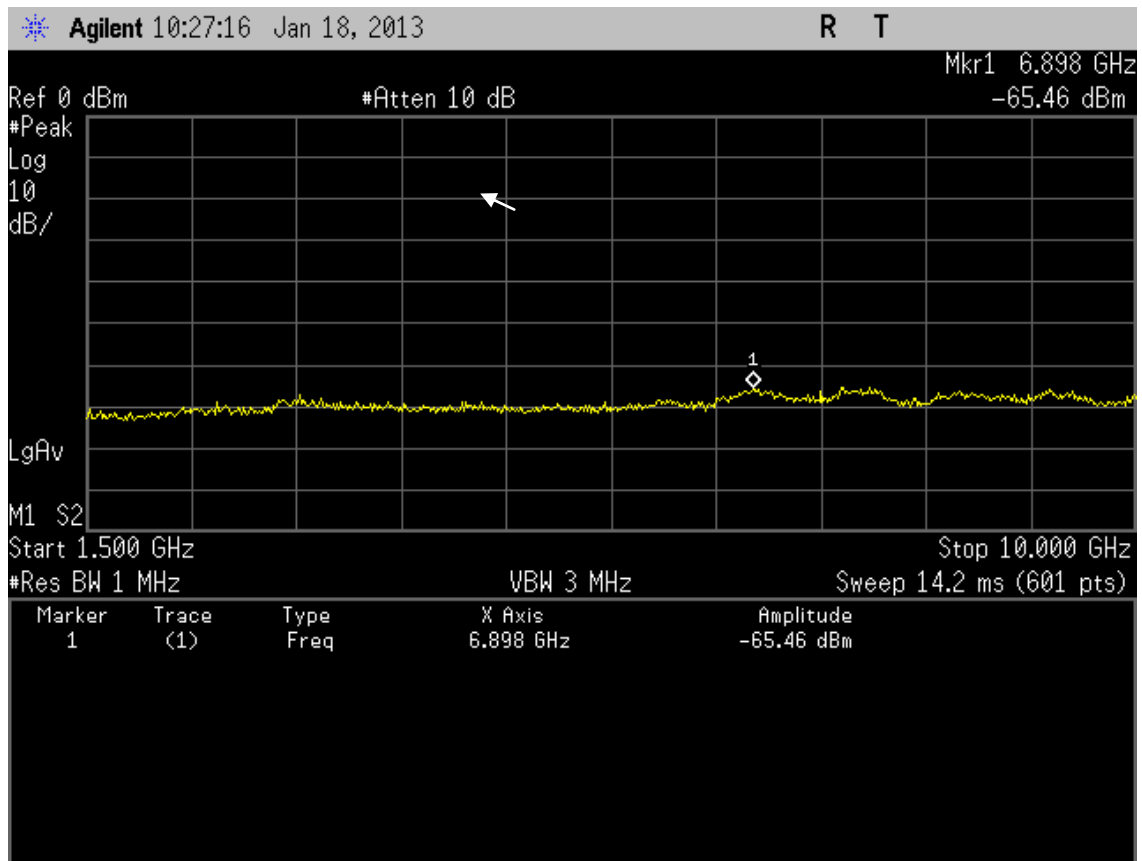
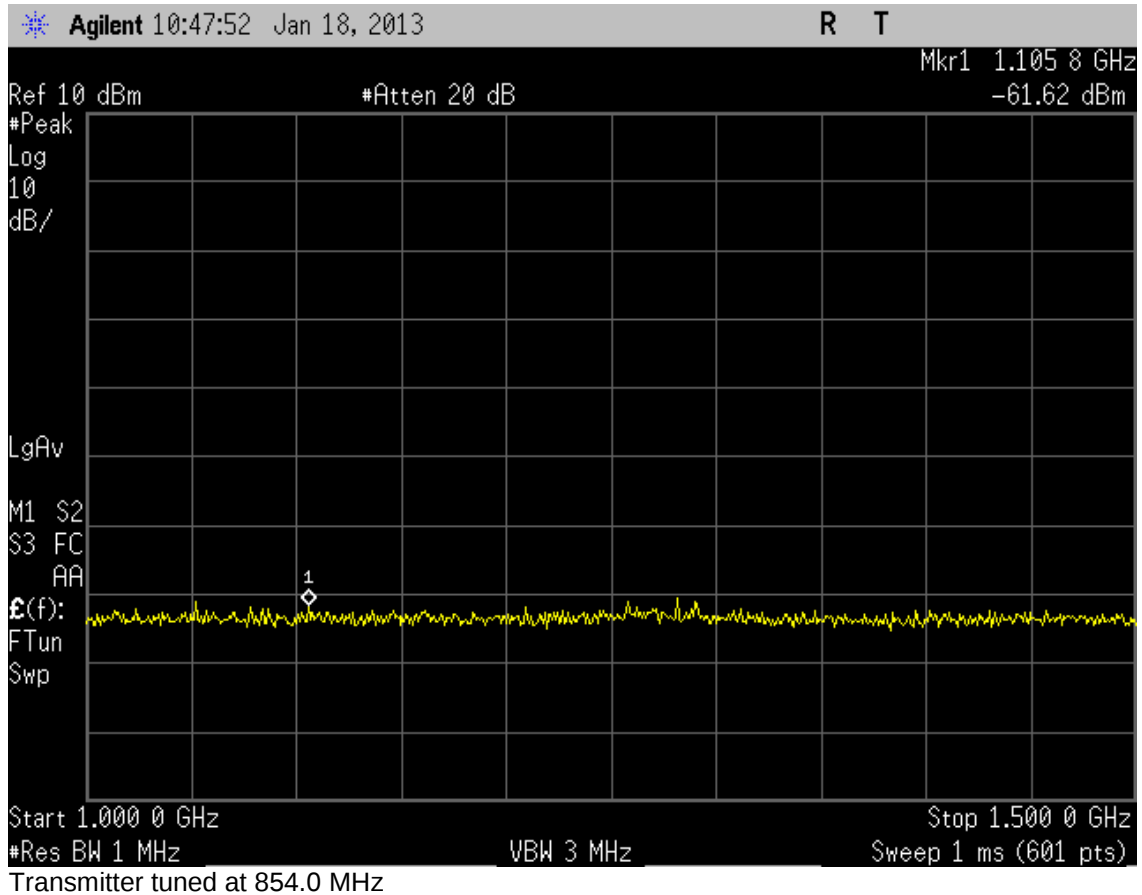
Temperature: 23 °C.

Relative Humidity: 45 %.

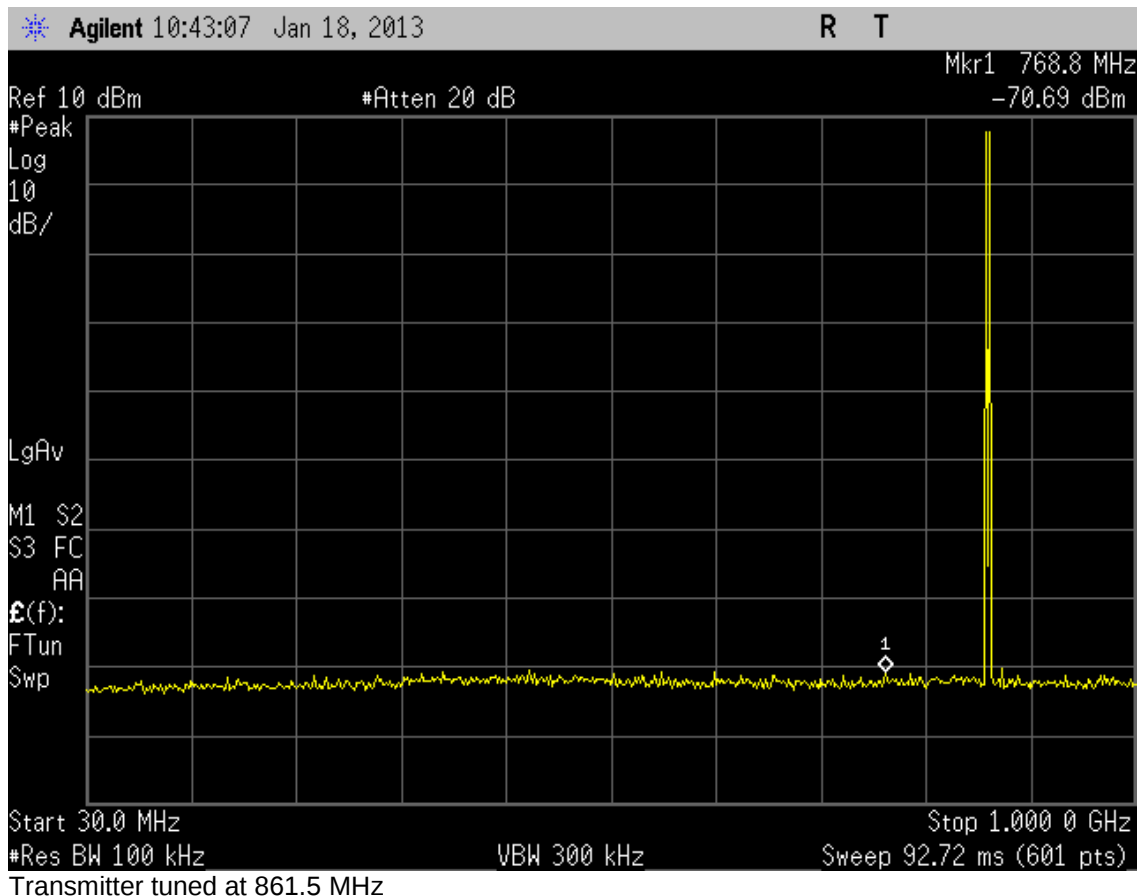
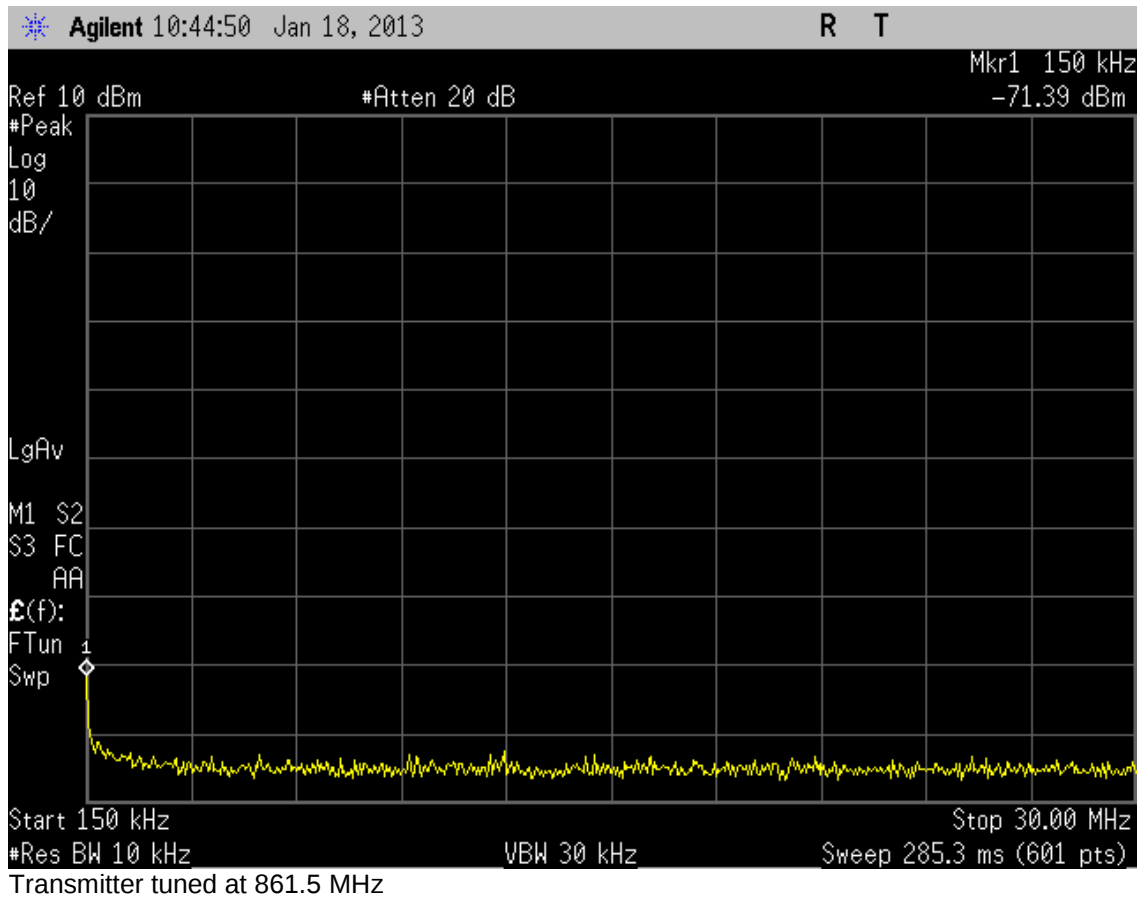
The spectrum was searched from 30 MHz to the 10th harmonic of the carrier (10 GHz).

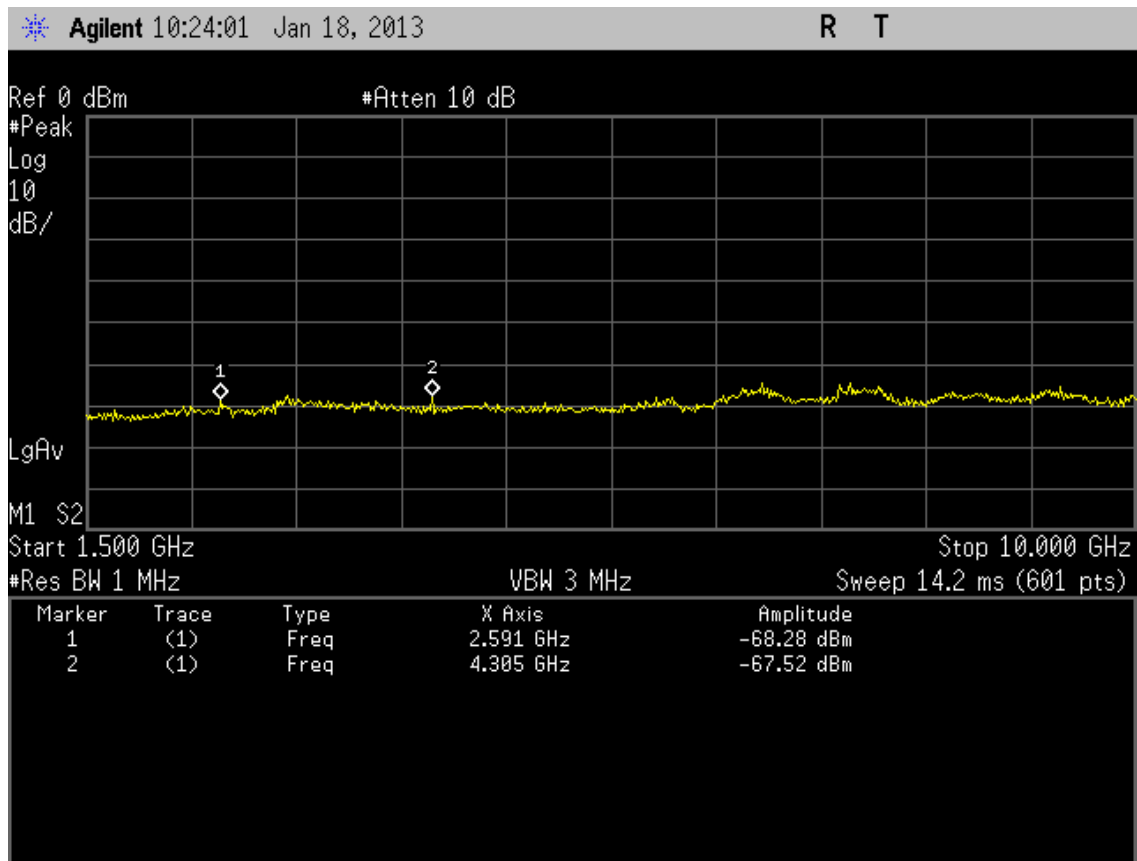
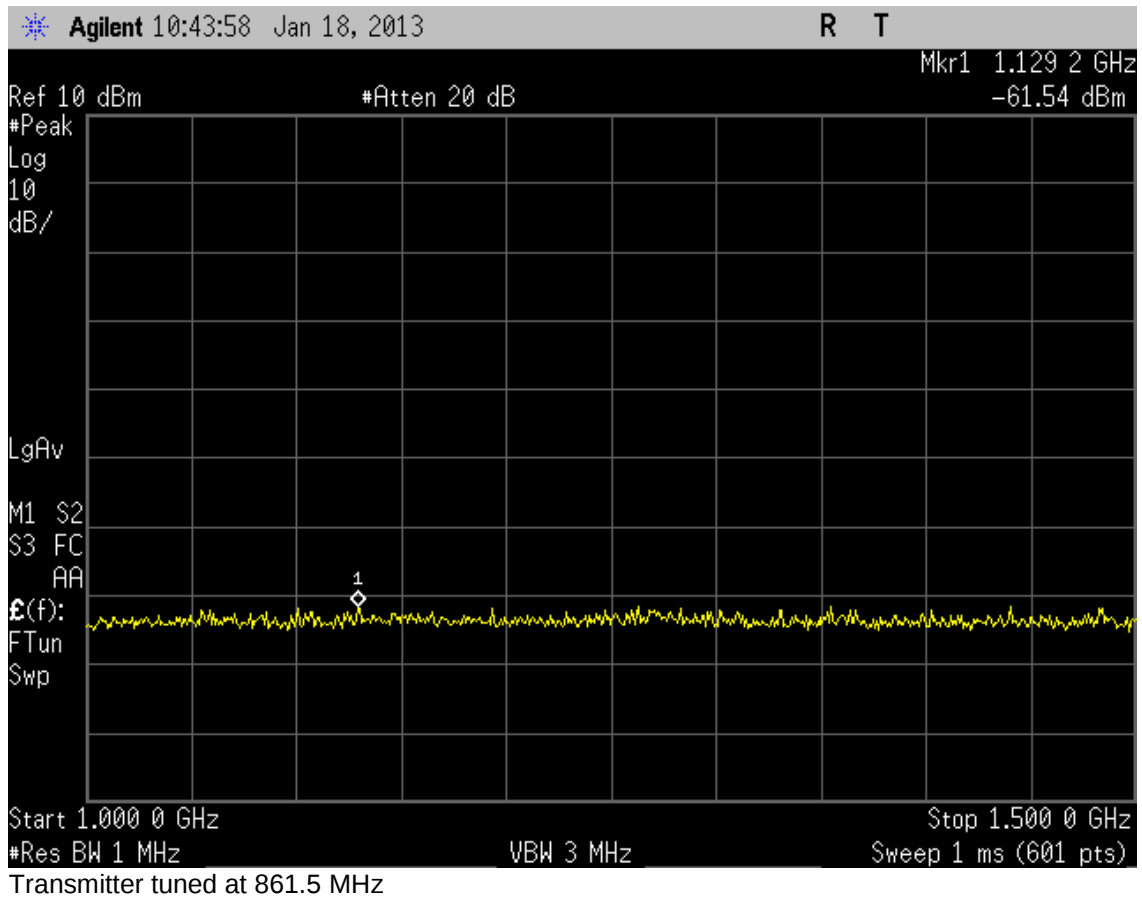
Rated output power: 25W



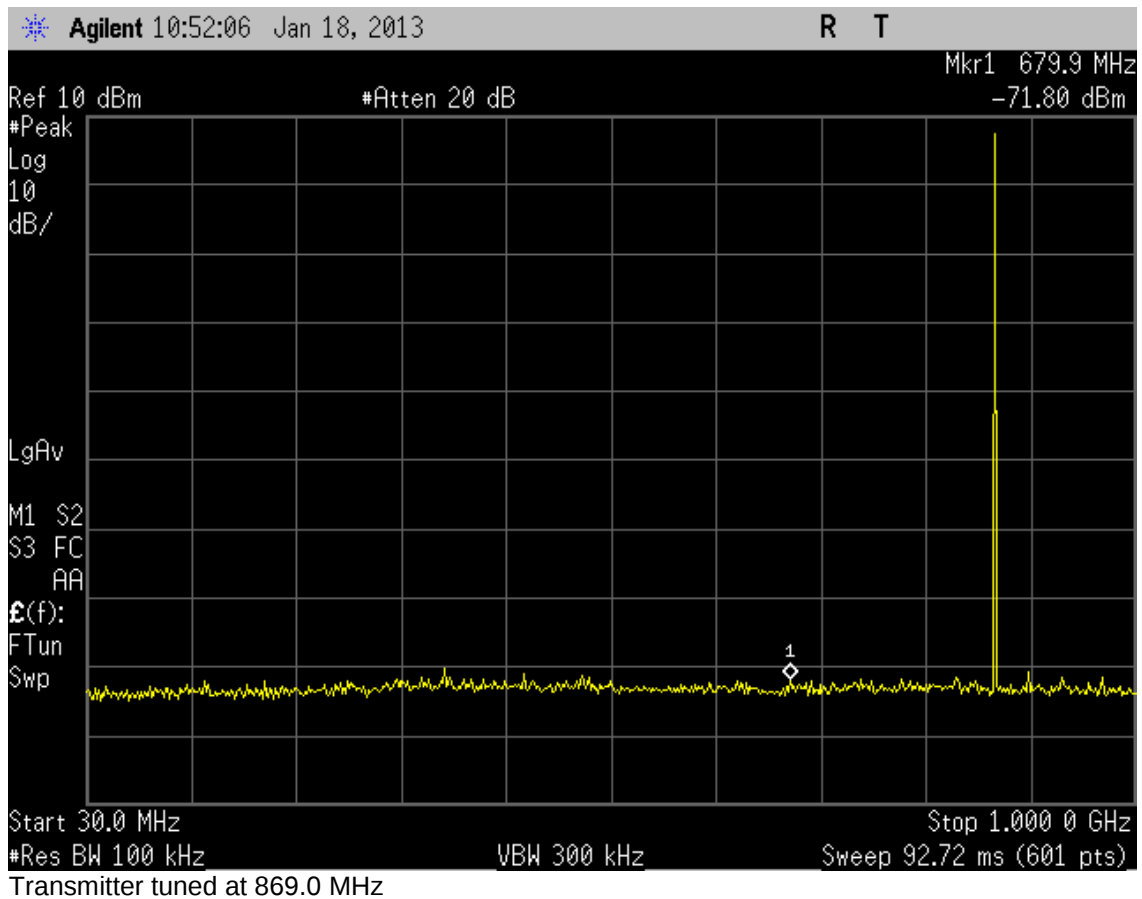
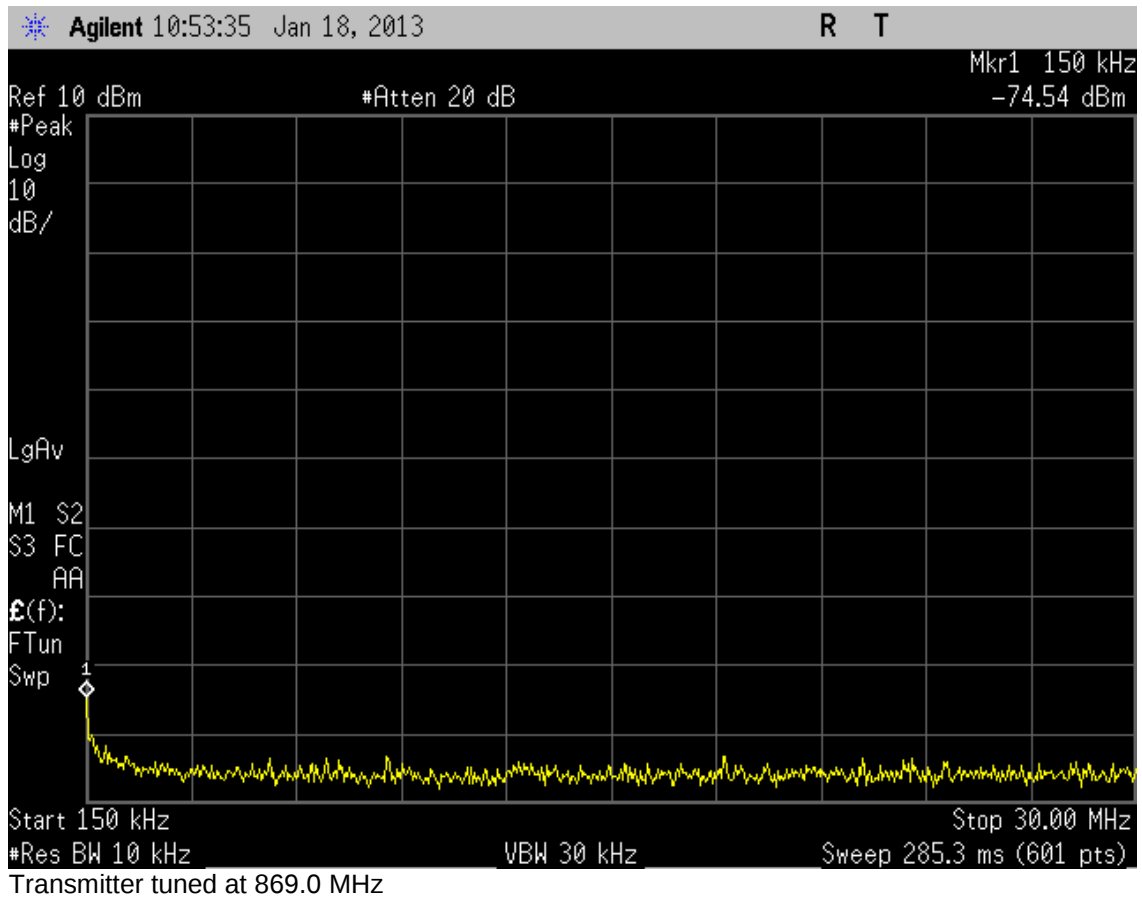


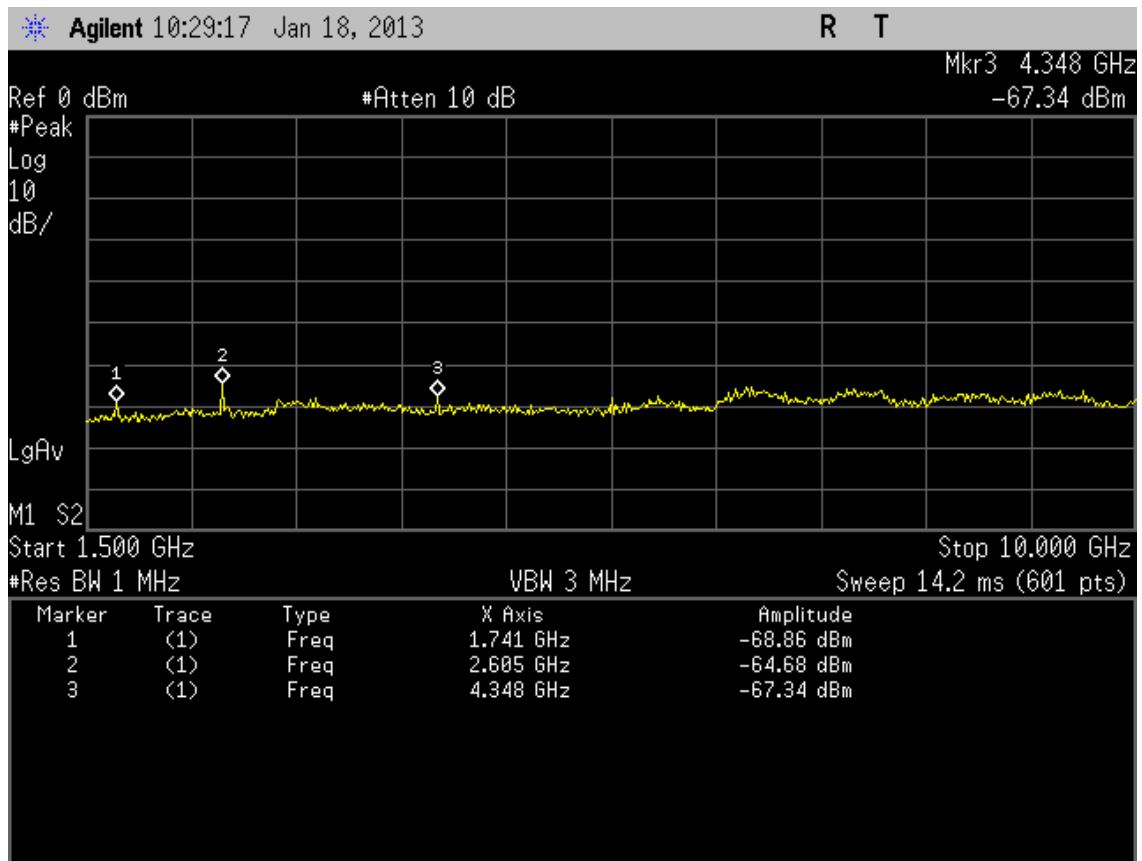
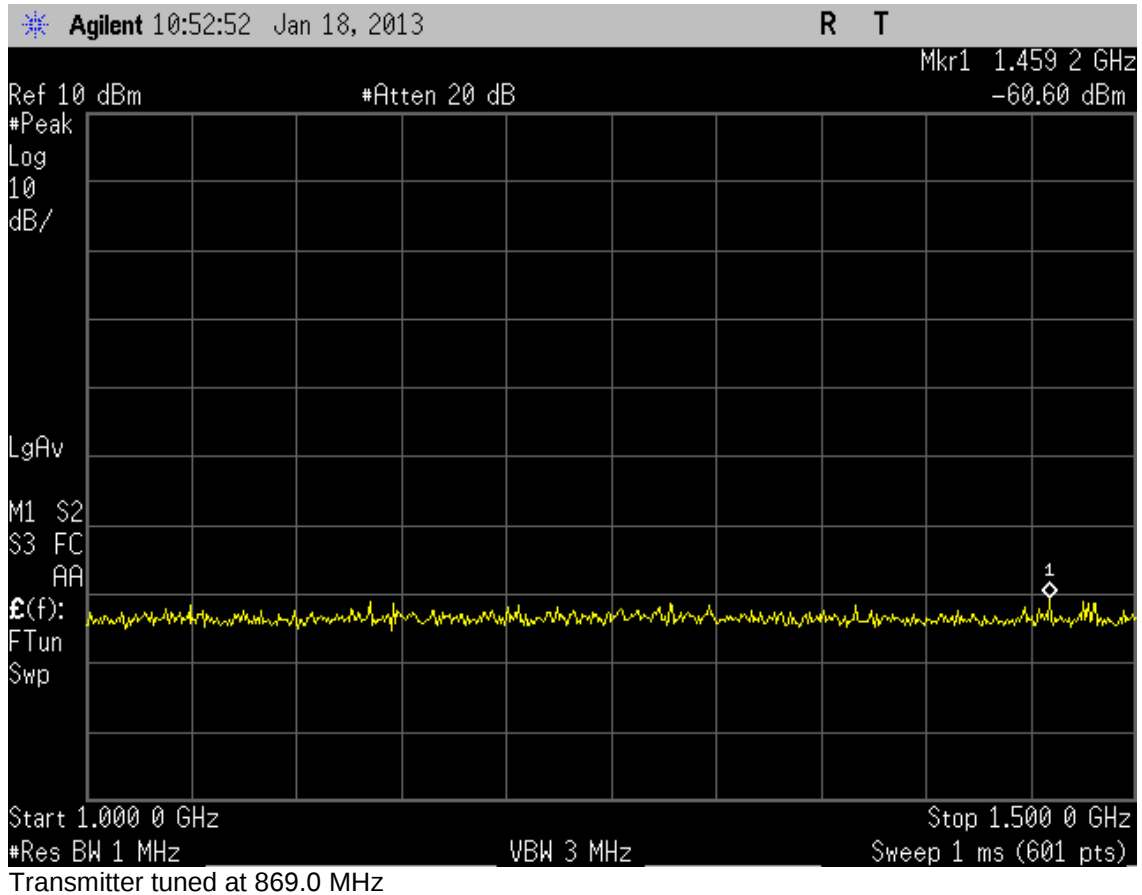
Transmitter tuned at 854.0.0 MHz





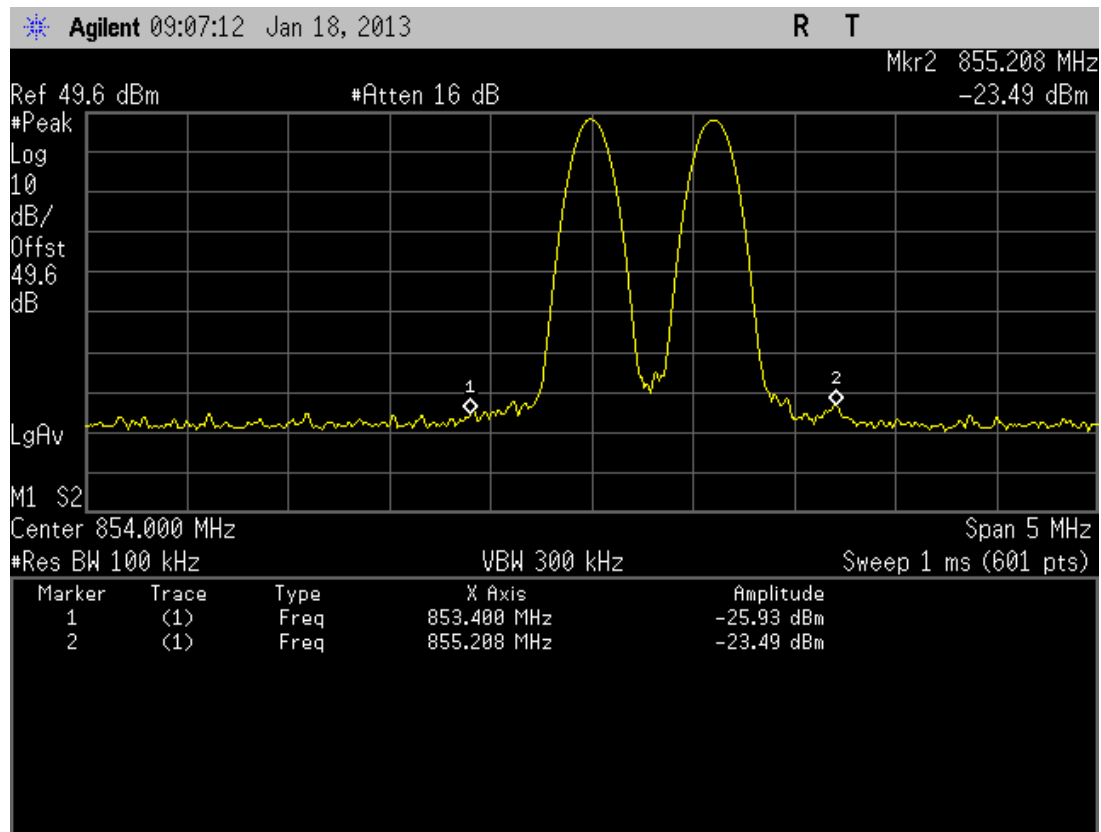
Transmitter tuned at 861.5 MHz



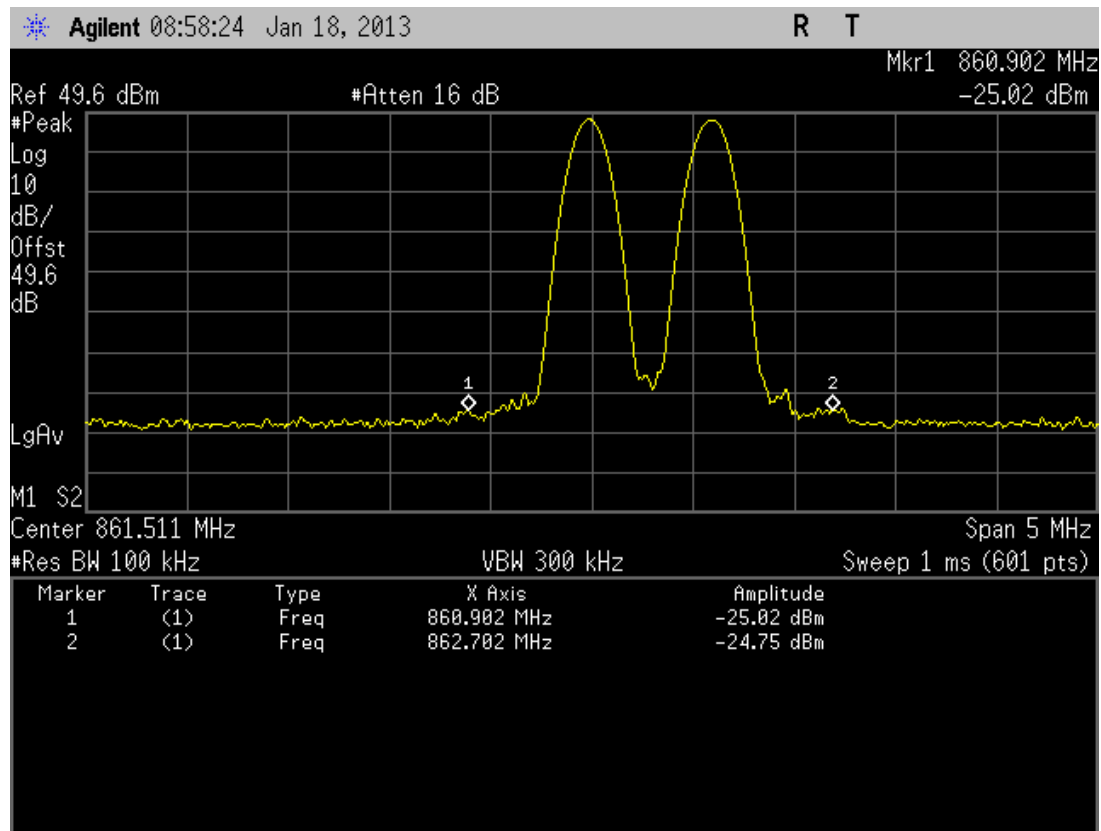


Transmitter tuned at 869.0 MHz

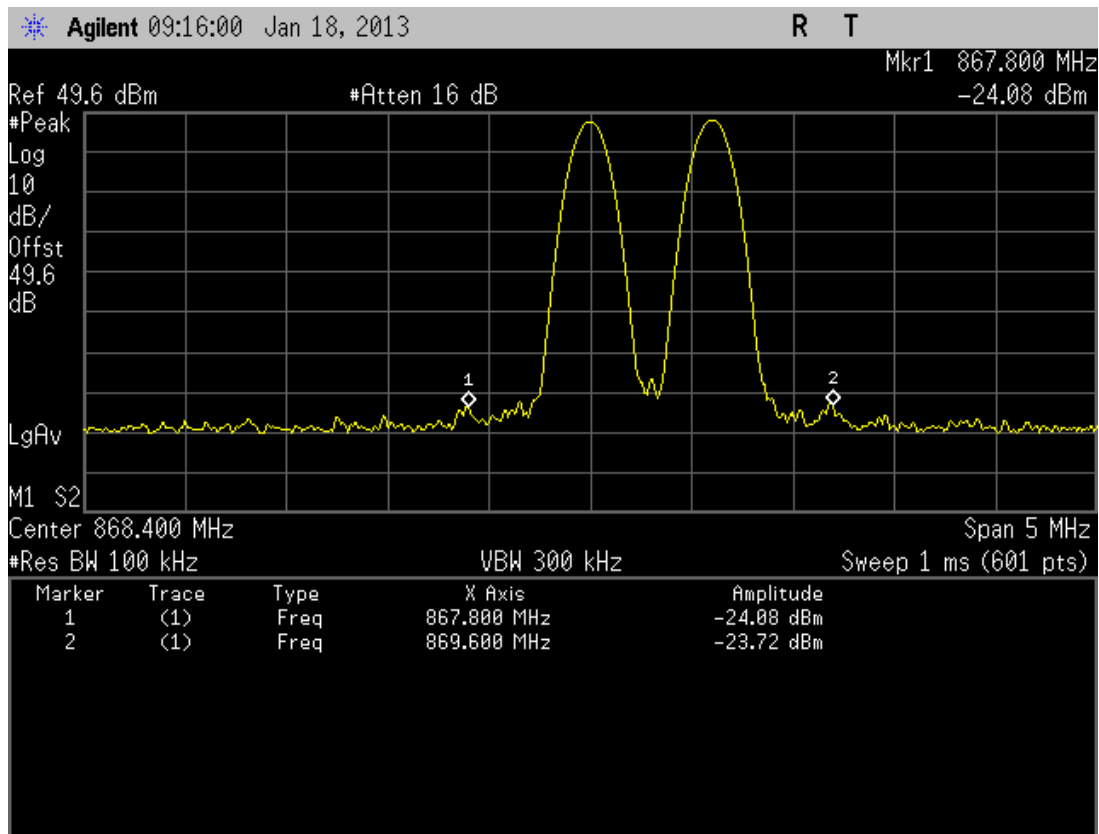
IM tests with two adjacent channels



Low channels: 854.0 MHz and 854.6 MHz.



Mid channels: 861.5 MHz and 862.1 MHz.



High channels: 868.4 MHz and 869.0 MHz.

8. Transmitter Spurious Emissions (Radiated)

NAME OF TEST:	Field Strength of Spurious Emissions	FCC PARA.NO.:	2.1053 90.210
		RSS119:	5.8
TESTED BY:	Pekka Kälviäinen	DATE:	15-17/01/2013

Test Results: Complies.

Requirement: Attenuation of $43 + 10 \log (P)$ dB, (-13 dBm)

Transmitter tuned at the mid channels 861.5 MHz and 862.1 MHz (two carriers)

Test Data:

Channels 861.5 MHz and 862.1 MHz		Limit (dBm)	Margin (dB)
Frequency (MHz)	Level (dBm)		
30-1000	< -60	-13	> 47
1000-9000	< -43	-13	> 30

Equipment used: 566, 564, 571, 525, 417, 544, 145, 350

**Measurement
Uncertainty:** ± 5.2 dB.

Temperature: 23 °C.

Relative Humidity: 35 %.

The spectrum was searched from 30 MHz to the 10th harmonic of the carrier (9 GHz).

The test was performed in a semi-anechoic shielded room. The EUT was placed on a non-conductive 0.8 m high table standing on the turntable. During the test in the frequency range 30-9000 MHz the distance from the EUT to the measuring antenna was 3 m. In order to find the maximum levels of the disturbance radiation the angle of the turntable, the height of the measuring antenna were varied during the tests. The test was performed with the measuring antenna being both in horizontal and vertical polarizations. Spectrum analyzer settings were: 30MHz-1000MHz RBW 100kHz, 1000-9000MHz RBW 1MHz.

Vertical and horizontal polarizations in the frequency range 30 – 9000 MHz was first measured by using the peak detector. During the peak detector scan the turntable was rotated from 0° to 360° with 30° step with the antenna heights 1.0 m and 2.5 m.

The limit of -13 dBm has been calculated to correspond 84.4 dB(μV/m).
Spurious emissions closer than 20 dB to the limit were measured with average detector.

The antenna substitution method was used to determine the equivalent radiated power at spurious frequencies. The EUT was replaced with a reference substitution antenna with a known gain referenced to an isotropic radiator $G_{Antenna[dBi]}$. This antenna was fed with a signal at the spurious frequency $P_{Gen[dBm]}$. The level of the signal was adjusted to repeat the previously measured level. The resulting EIRP is the signal level fed to the reference antenna corrected for gain referenced to an isotropic.

The formula below was used to calculate the EIRP of the EUT.

$$P_{EIRP[dbm]} = P_{Gen[dbm]} - L_{Cable[db]} + G_{Antenna[dBi]}$$

9. Frequency stability

NAME OF TEST: Frequency Stability**PARA.NO.:** 2.1055**TESTED BY:** Pekka Kälviäinen**RSS119:** 5.3**DATE:** 14/01/2013**Test Results:** Complies.**Limit:** FCC Part 90.xx: ± 1.5 ppm.
RSS119, Issue 11: ± 0.1 ppm

Test performed at transmitter frequency 861.5 MHz.

Test Data:**a) Frequency stability vs. voltage variations**

Temperature °C	Voltage V	Frequency MHz	Error ppm
20	40.8	861.4999993	-0.0008
20	48.0 (nom)	861.4999987	-0.002
20	55.2	861.4999993	-0.0008

b) Frequency stability vs. temperature variations

Temperature °C	Voltage V	Frequency MHz	Error ppm
50	48.0	861.4999973	-0.003
40	48.0	861.4999972	-0.003
30	48.0	861.4999975	-0.003
20	48.0	861.4999987	-0.002
10	48.0	861.5000019	0.002
0	48.0	861.5000049	0.006
-10	48.0	861.5000045	0.005
-20	48.0	861.5000046	0.005
-30	48.0	861.5000044	0.005

Equipment used: 2085, X1, X2, X3, X4, X5, X6**Measurement
Uncertainty:** ± 0.7 dB.**Temperature:** 23 °C.**Relative
Humidity:** 45 %.Antenna terminal:

The frequency at antenna terminal is measured by using the frequency counter.

10. List of measuring equipment:

No.	Equipment	Type	Manufacturer	Serial Number
10	Oscilloscope	9400A	LeCroy	8878
42	Spectrum analyzer	8566B	Hewlett Packard	2637A04102
62	Audio amplifier	PRL x	Self made	
89	Antenna	3147	EMCO	9202-1078
102	Hybrid	H 9	Anzac	
133	Termination 50Ω	370 BNM	Narda	
145	Notch Filter	TTR - 375 - 3EE	Telonic	3062 - 1
146	Dual directional coupler	778D	Hewlett Packard	1144A02333
157	Temp. test chamber	VMT 04/240	Vötsch	31884
168	Artificial Mains	NSLK 8127	Schwartzbeck	8127162
176	Anechoic chamber	888 cm x 585 cm x 416 cm	length of absorber 66 cm	
185	Antenna	PRL LogPer	Self made	1A93
201	RF-Generator	2042	Marconi	119571/062
205	RF-Amplifier	ZHL-1042J	Mini-Circuits	012288-11
316	Power supply	HP 6032A	Hewlett Packard	2517A-00654
319	Antenna	CBL6112	Chase	2018
328	Power attenuator	765-20	Narda	-
332	IF-filter	10.7MHz/25kHz	Ultracom Oy	-
334	IF-filter	10.7MHz/12.5kHz	Ultracom Oy	-
335	Mixer	ZFM-150	Mini-Circuits	-
337	Modulation analyzer	HP 8901B	Hewlett Packard	3538A05622
341	Multimeter	Fluke 87	Fluke	593100386
350	Semianechoic shielded room	RFD-F-100	Euroshield Oy	1327
375	RF attenuator PAD	757 C - 20 dB	Narda	
386	RF attenuator PAD	WA2-3	Weinschel	3780
390	RF attenuator PAD	WA2-10	Weinschel	3784
392	RF attenuator PAD	1A (6dB)	Weinschel	
394	RF attenuator PAD	1A (20dB)	Weinschel	
417	Antenna, bilog	CBL 6141	Chase	4028
525	Double-Ridged Horn	3115	Emco	6691
544	RF-amplifier	ZFL-1000VH2	Mini-Circuits	QA0749010
563	Thermometer	52 II	Fluke	81210080
564	RF amplifier	CA018-4010	CIAO Wireless	132
566	Spectrum analyzer	E4448A	Agilent	US42510236
567	RF generator	E8257C	Agilent	MY43320736
571	High Pass Filter	WHK0.6/13G-10SS	Wainwright Instruments	1
572	High Pass Filter	WHKX1.5/15G-12SS	Wainwright Instruments	4
729	RF High-Power Attenuator	WA48-20-34-LIM	Weinschel	CB9277
2039	Power sensor	8482A	Hewlett Packard	1925A03475
2040	Power meter	438A	Hewlett Packard	2517U00427
2046	Counter	5351B	Hewlett Packard	2844U00220
2085	Thermometer	Testo 608-H1	Hygrometer	-
X1	Environment Chamber	LK-540/30/HCT-20	Finero	519999
X2	Multimeter	34401A	Hewlett Packard	US36093689
X3	Power supply	AP10090A	Wayne Kerr Electronics	000334
			Testo AG Germany	
X4	Attenuator, 30dB, 200W	BN745396	Spinner	21066
X5	Tetra Signal Analyzer	IFR 2310	Aeroflex	231001/014
X6	Vector Network Analyzer	ZVR	Rohde & Schwartz	828286/011