

Date: ESPOO 14.09.2009Page: 1 (45)Appendices -Number:
No. 1 / 1**129599A**Date of handing in: 17.06.2009

Tested by:



Pekka Kälviäinen, Test Engineer

Reviewed by:



Timo Leismala, Testing Manager

SORT OF EQUIPMENT:

Transceiver

MARKETING NAME:

TYPE:

MANUFACTURER:

SATELLINE® 3ASd Epic Pro 35 W
Satel Oy, Finland

SERIAL NUMBER:

-

CLIENT:

Satel Oy

ADDRESS:

Meriniitynkatu 17, FIN-24100 Salo, Finland

TELEPHONE:

+358 2 777 7800 / Marita Latovehmas

TEST LABORATORY

Nemko Oy

FCC REG. NO.

359859 November 26, 2008

IC FILE NO.

2040F-1 December 15, 2008

REMARKS:

Tested to FCC Part 90 and RSS-119 Issue 9.

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:	SATELLINE® 3ASd Epic Pro 35 W		
Alignment range:	400.0 – 470.0 MHz		
Switching range:	One channel		
Measurement	Equipment 1 Serial no. -	Equipment 2 Serial no. -	Equipment 3 Serial no.
Frequencies:	1) 408.0 MHz / 12.5 kHz 2) 452.0 MHz / 12.5 kHz 3) 428.0 MHz / 25 kHz	4) 468.0 MHz / 25 kHz 5) 402.0 MHz / 25 kHz 6) 432.0 MHz / 25 kHz	)
Voltages:	Normal 13.2 VDC	Minimum 11.2 VDC	Maximum 15.2 VDC
Temperatures:	+23,0°	-30,0°	+60,0°
Humidity:	35 %		
Effective radiated power:	35 W	Antenna:	50 ohm
Number of channels:	1	Production model:	Pre-production model
Channel separation:	12.5 and 25 kHz	Modulation:	Multilevel State FM (4FSK) (12,5 kHz: 9600 bps 25 kHz: 19200 bps)

The transmitter was tested in a standalone configuration.

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	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)	PASS
90.213 & 2.1055	5.3	Frequency stability	PASS
90.210 & 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	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
TESTED BY: Pekka Kälviäinen	RSS119: 5.4
	DATE: 31/08/2009

Test Results: Complies.

Rated power: highest 35W = 45.4 dBm.
lowest 5W = 37.0 dBm

Limit: ± 1.0 dB from rated power.

Measurement Data:

Modulation Type	Frequency (MHz)	Measured Output	
		Power (dBm)	Power (W)
FM	408.0	45.01	31.70
FM	428.0	45.41	34.75
FM	452.0	44.94	31.19
FM	468.0	45.12	32.51
FM	408.0	37.11	5.14
FM	428.0	36.86	4.85
FM	452.0	37.14	5.18
FM	468.0	36.83	4.82

Equipment used: 337, 284

**Measurement
Uncertainty:** ± 0.7 dB.

Temperature: 23 °C.

**Relative
Humidity:** 45 %.

Antenna terminal:

The power at antenna terminal is measured by using the modulation analyzer.

4. 99% Occupied Bandwidth

NAME OF TEST: Occupied Bandwidth	PARA.NO.: 2.1049
TESTED BY: Timo Hietala	RSS119: 5.5
	DATE: 31/08/2009

Test Results: Complies.

Test Data: See attached plot(s).

Channel spacing	Frequency (MHz)	Measured 99% Occupied Bandwidth (kHz)
25 kHz	428.0	14.4
25 kHz	468.0	14.4
12.5 kHz	408.0	8.0
12.5 kHz	452.0	8.4

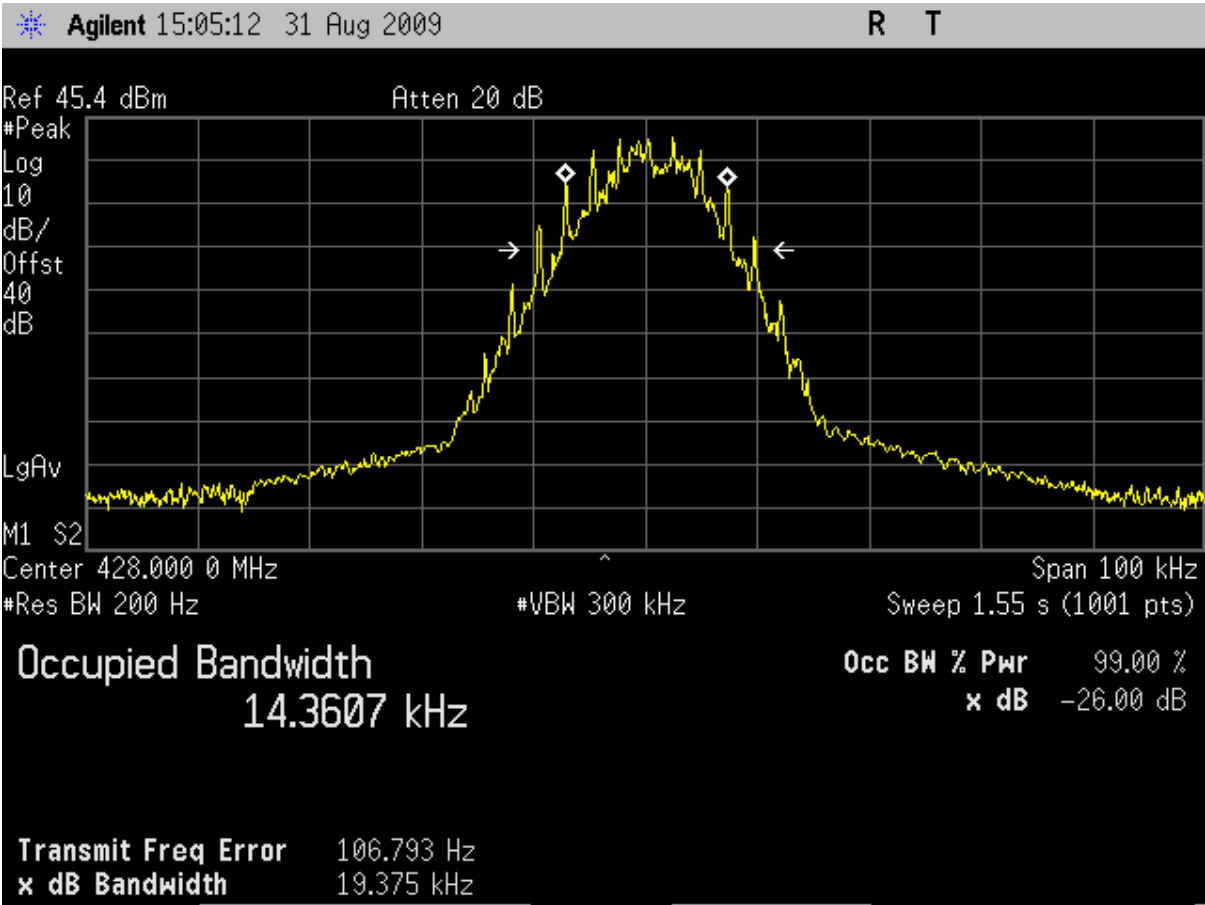
Equipment used: 566, 322

**Measurement
Uncertainty:** ± 0.7 dB.

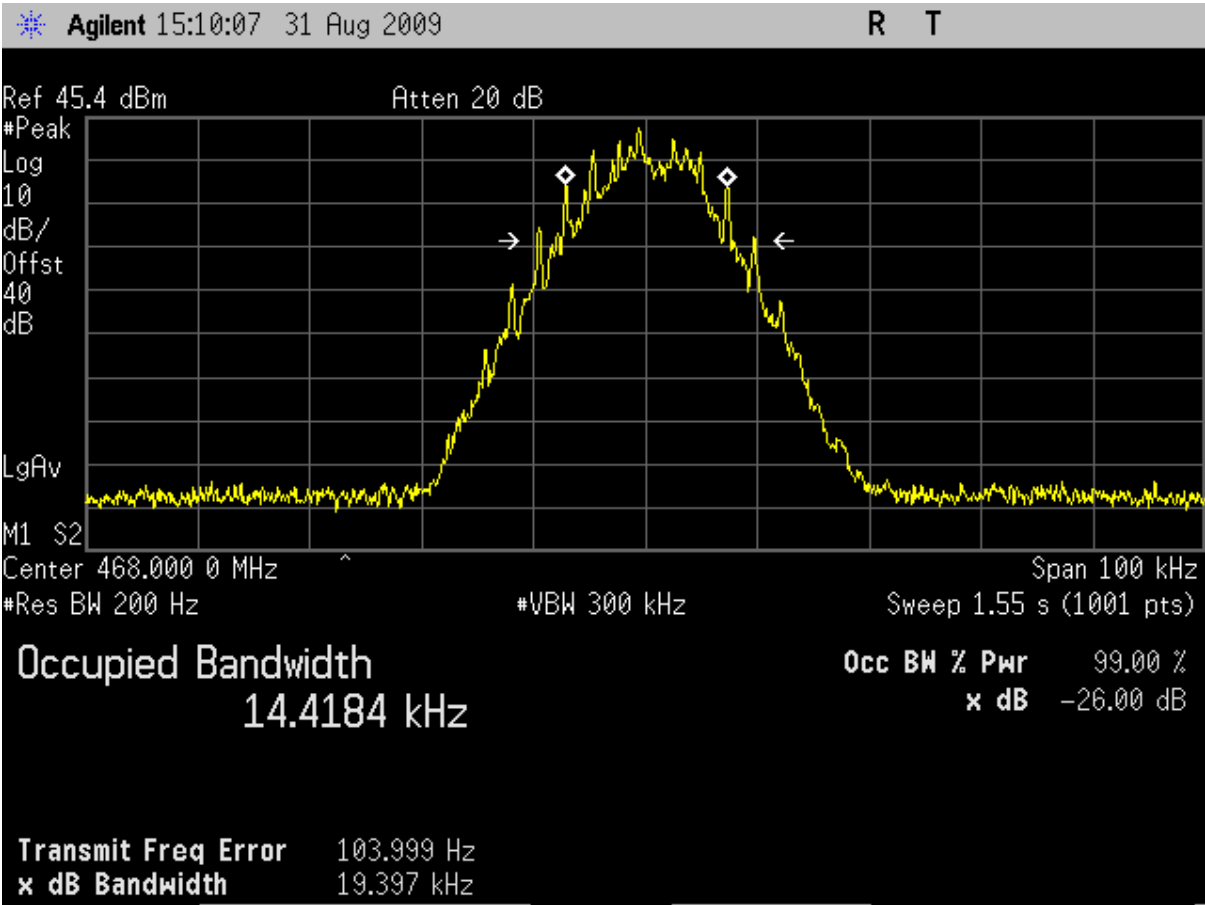
Temperature: 23 °C.

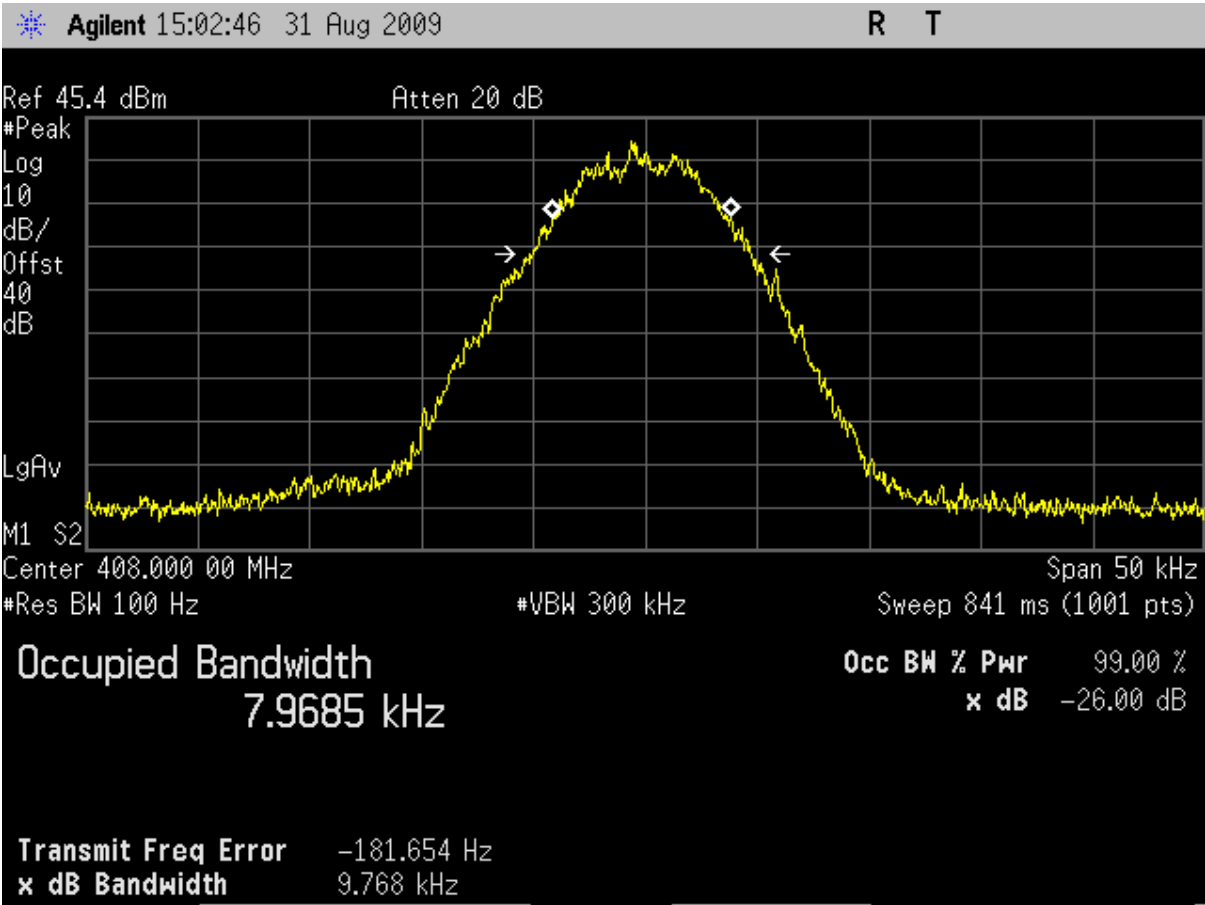
**Relative
Humidity:** 35 %.

The 99% occupied bandwidth of the carrier emission is measured using a spectrum analyzer with Resolution Bandwidth set to 1% of the necessary bandwidth of the transmitted carrier. Transmitter was set to transmit random data file 19200 bps 25kHz channel and 9600 bps 12.5kHz channel.

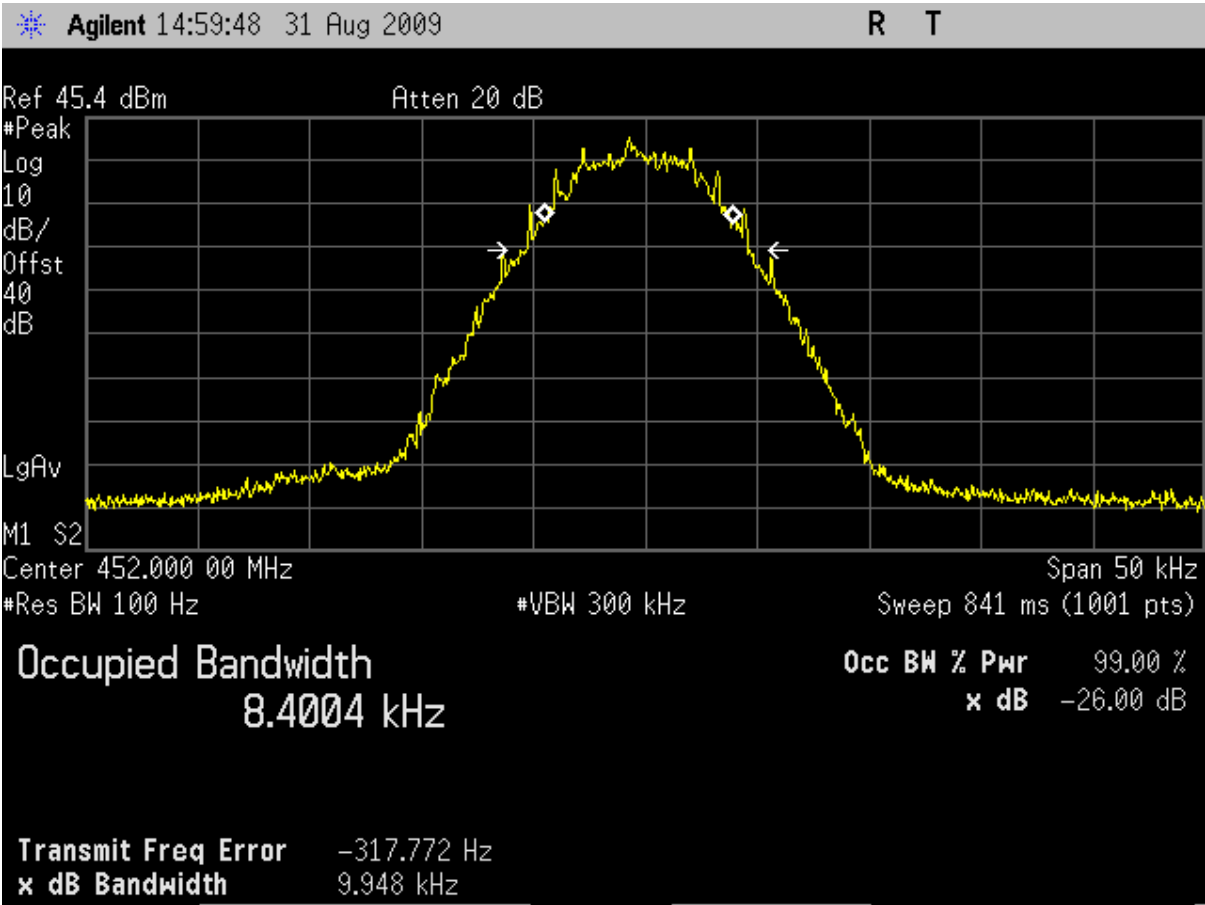


25kHz channel spacing, 428 MHz





12.5kHz channel spacing, 408.0 MHz



12.5kHz channel spacing, 452 MHz

5. Spectrum Emission mask

NAME OF TEST: Spectrum emission mask	PARA.NO.: 2.1049
TESTED BY: Timo Hietala	RSS119: 5.5
	DATE: 31/08/2009

Test Results: Complies.

Test Data: See attached plot(s).

Limit: Mask C for 25kHz channel bandwidth and mask D for 12.5kHz channel bandwidth.

Equipment used: 566, 322

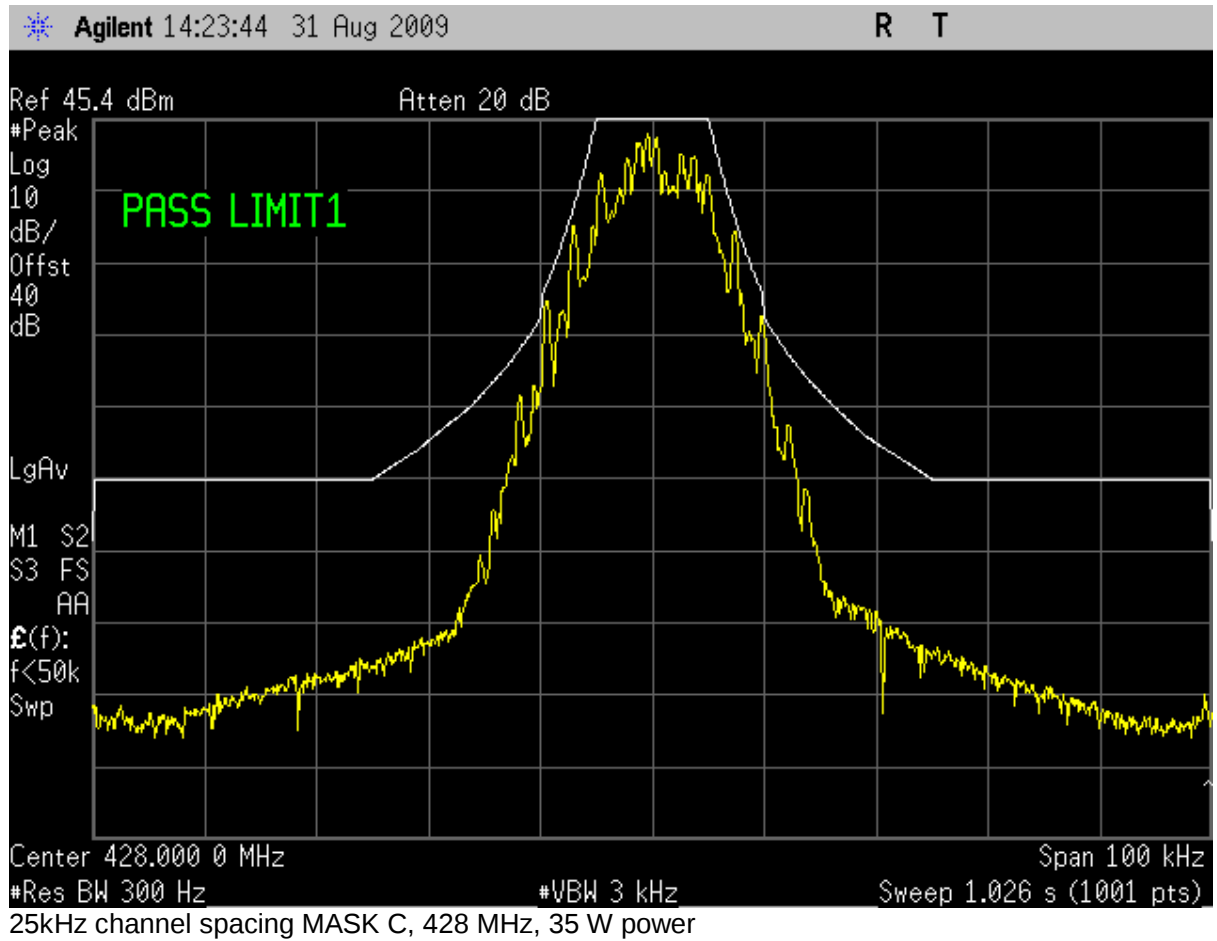
Measurement Uncertainty: ± 0.7 dB.

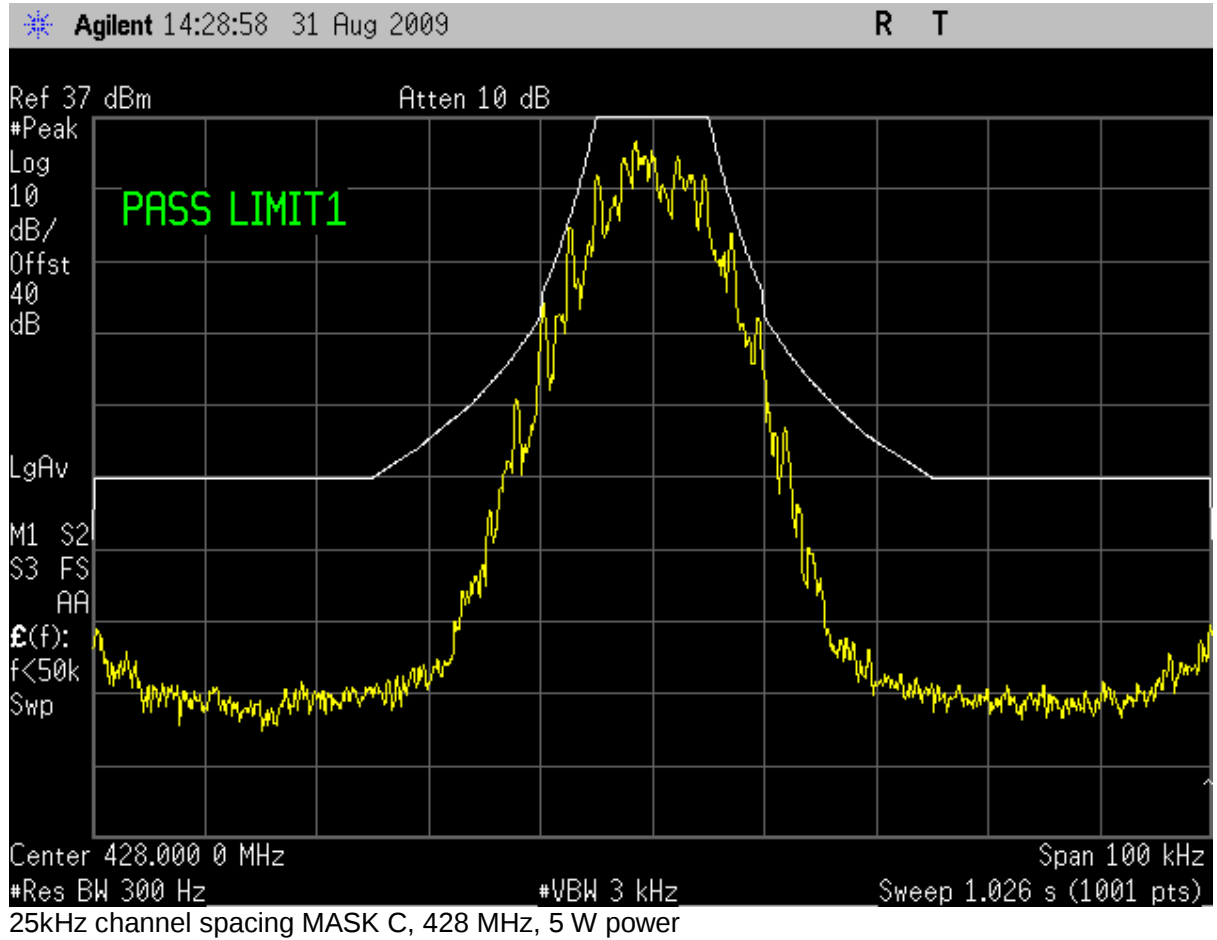
Temperature: 23 °C.

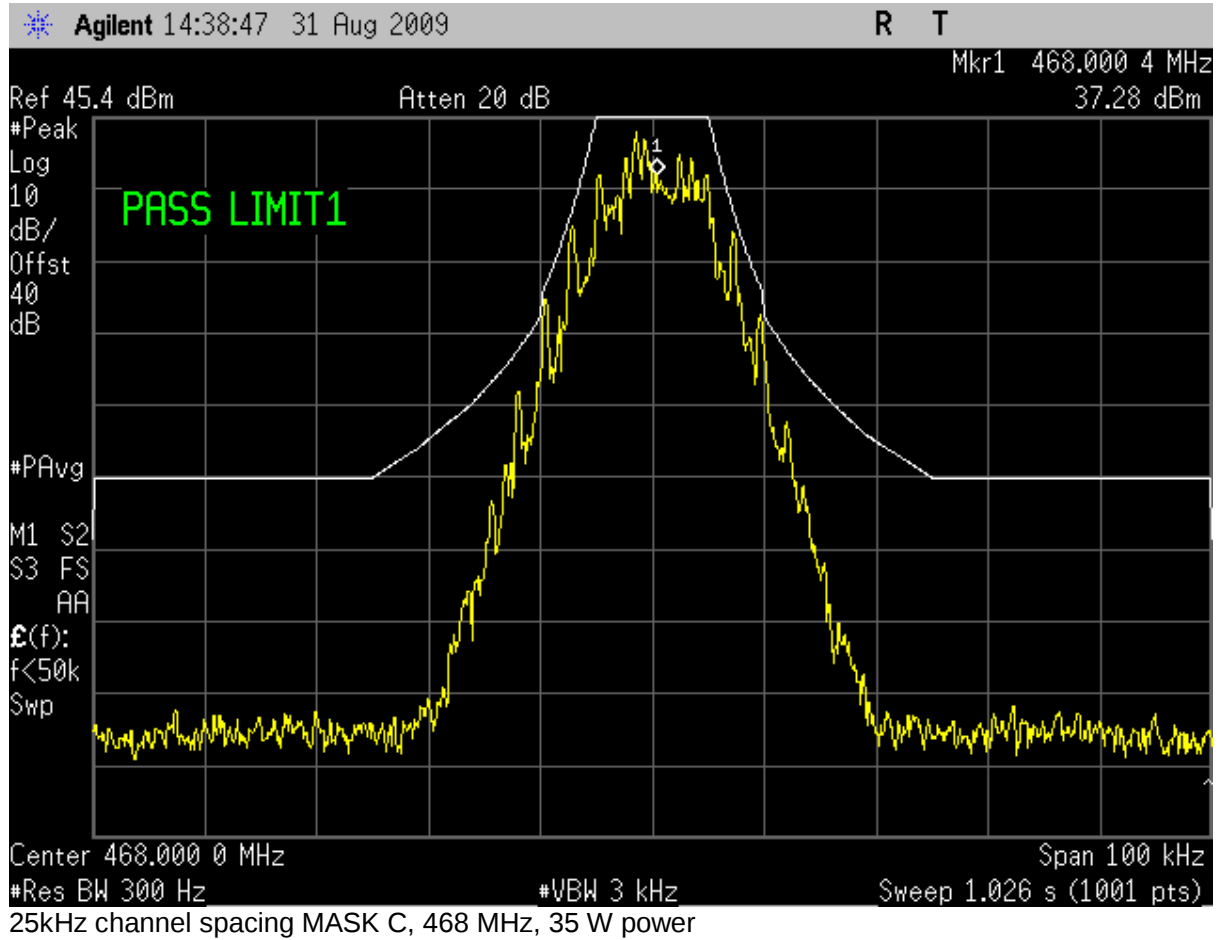
Relative Humidity: 35 %.

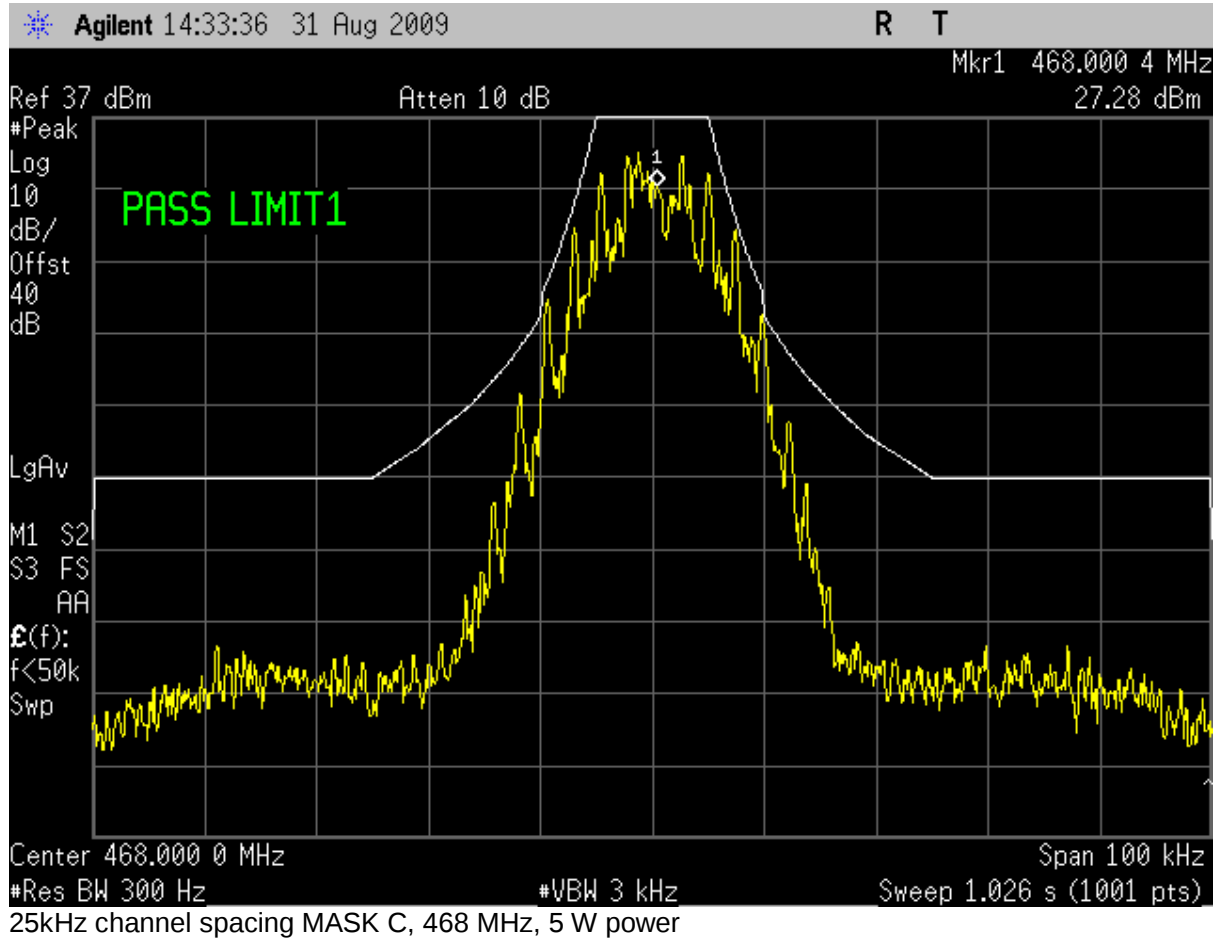
The emission mask of the modulated carrier is measured by using a spectrum analyzer with resolution bandwidth set to 300 Hz for emission mask C (25kHz bandwidth) and 100 Hz for emission mask D (12.5kHz bandwidth).

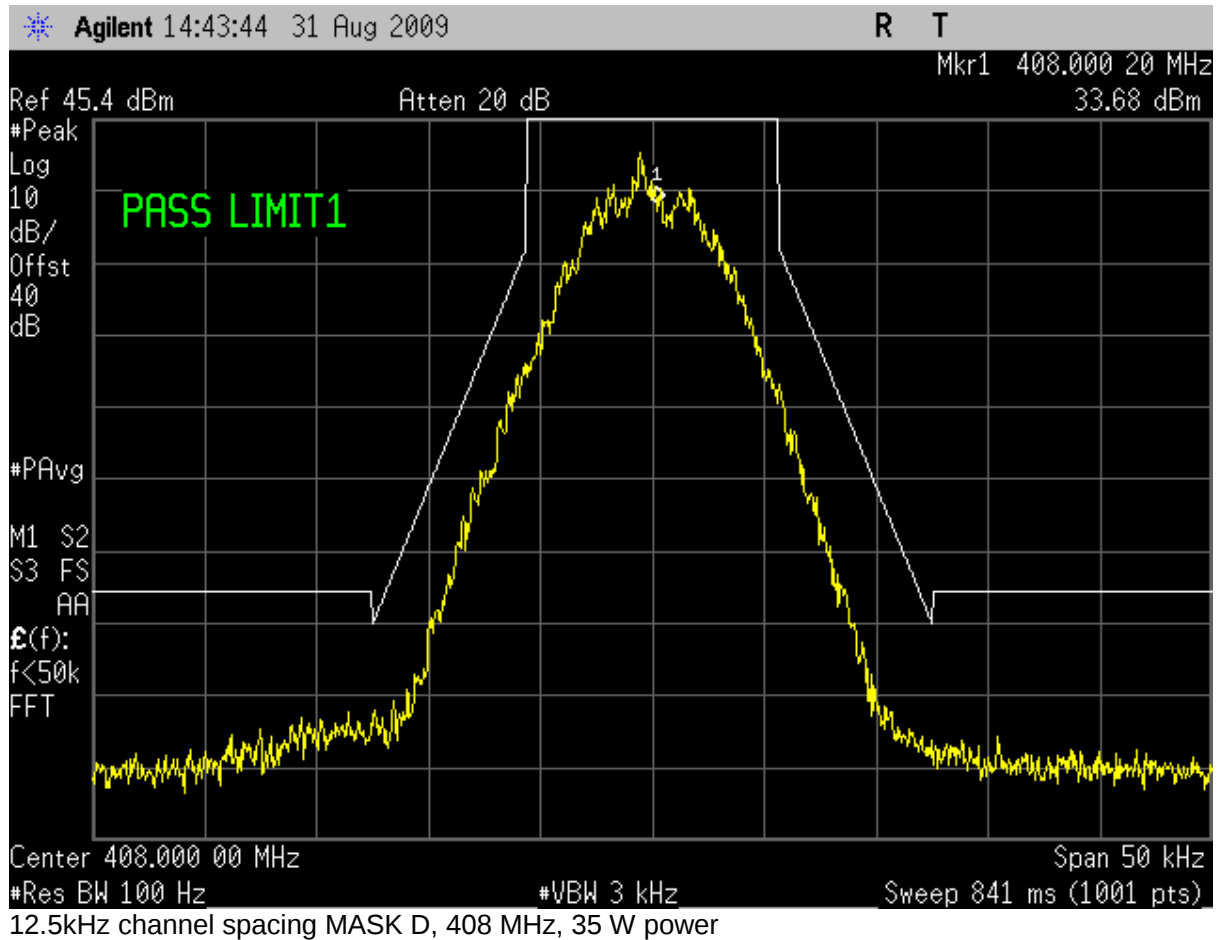
Transmitter was set to transmit random data file 19200 bps 25kHz channel and 9600 bps 12.5kHz channel.

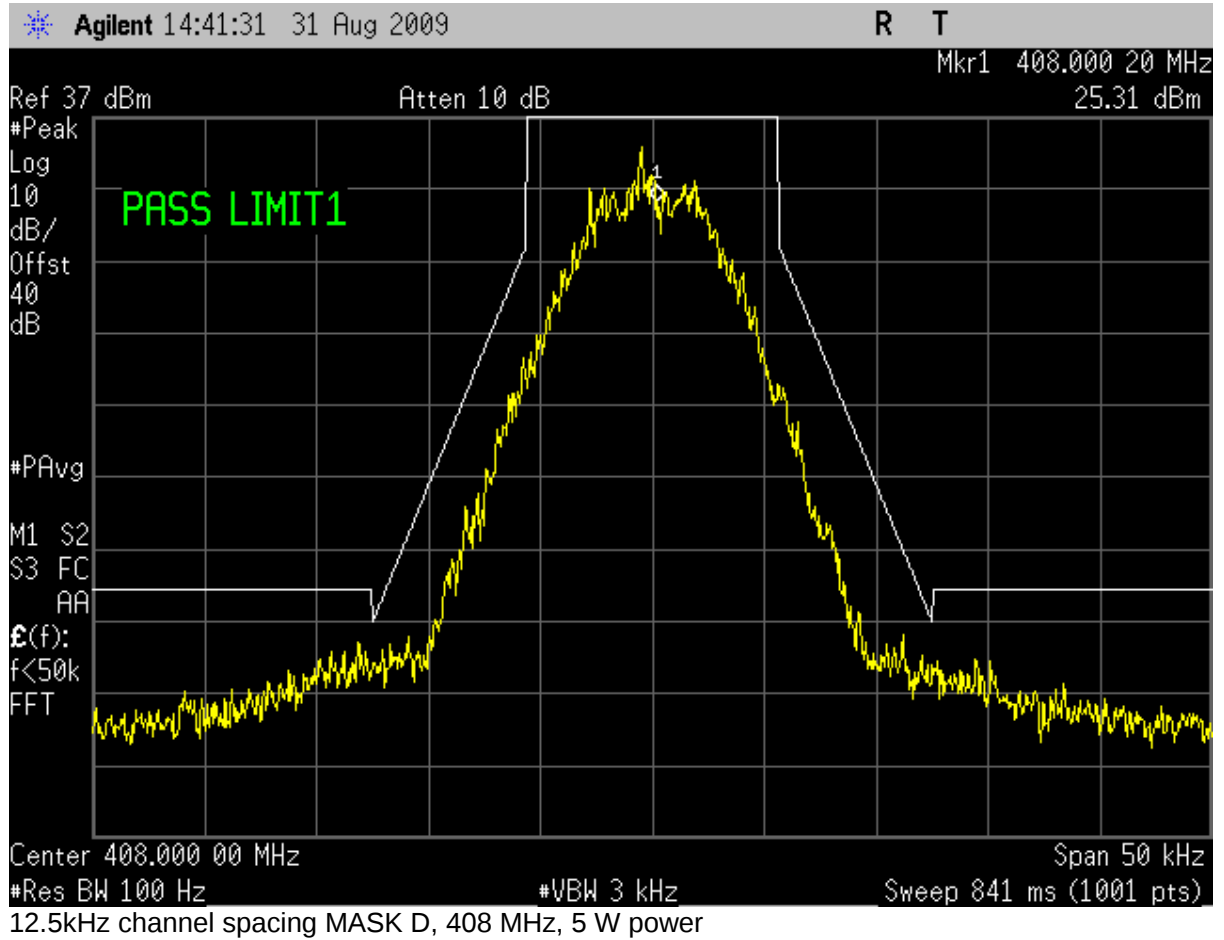


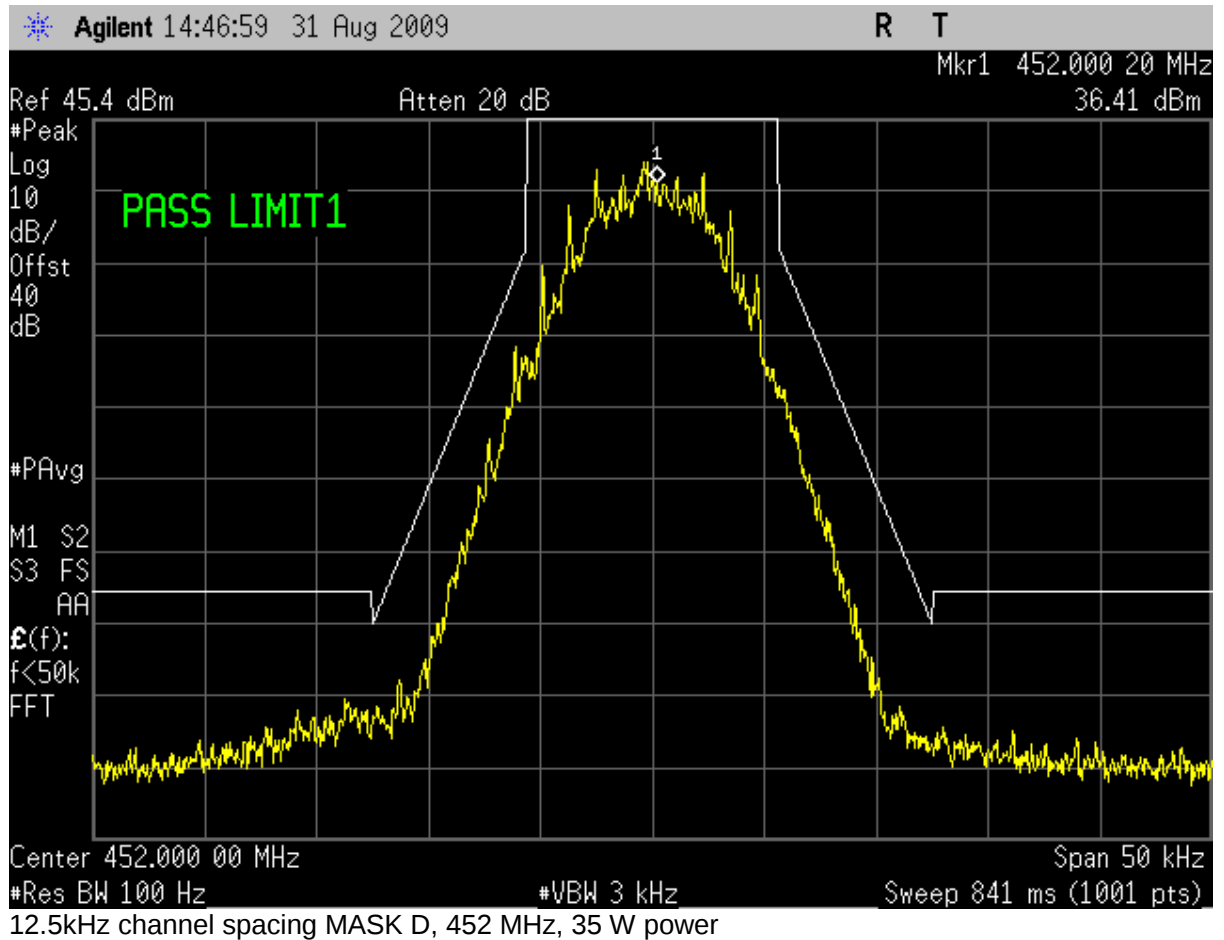


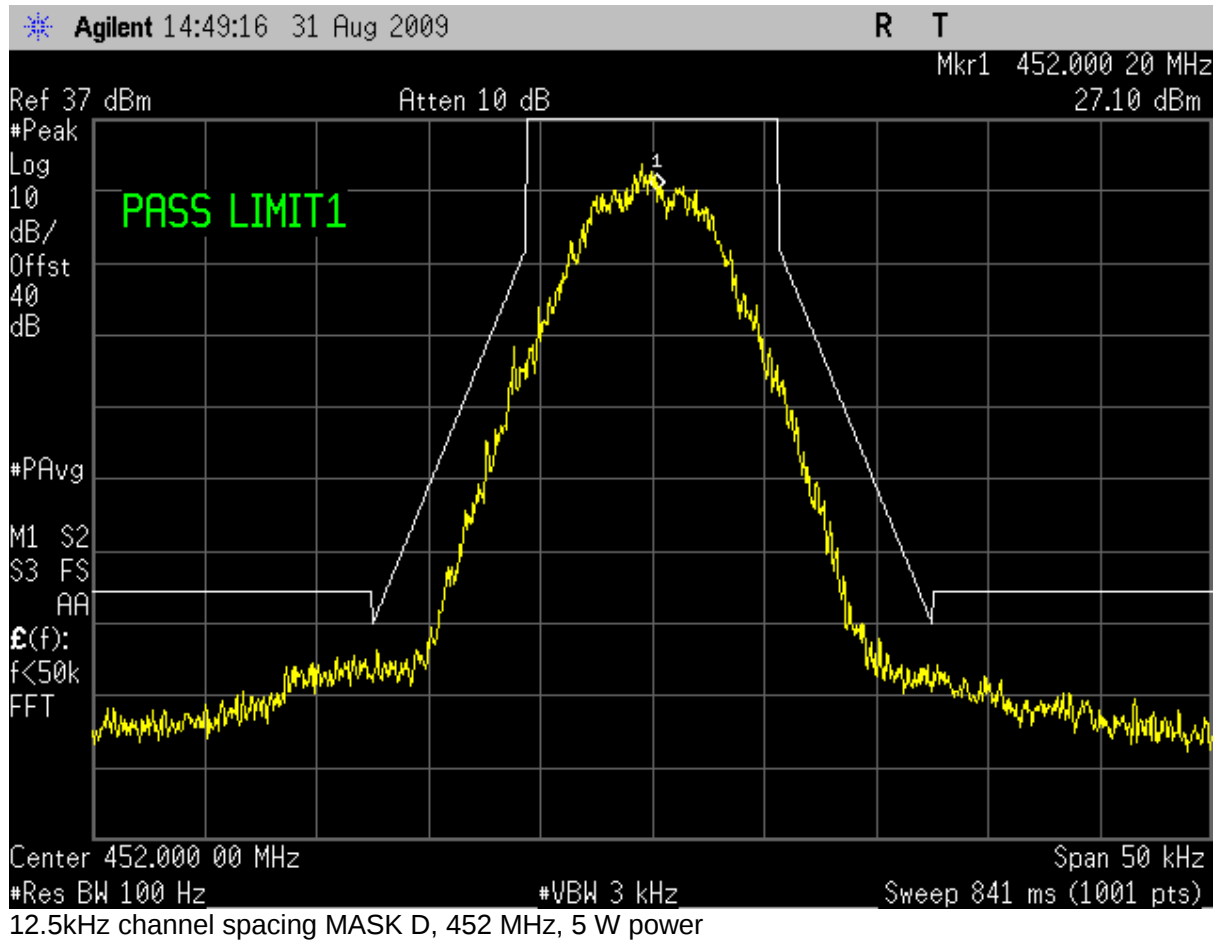












6. Transmitter Spurious Emissions (Conducted)

NAME OF TEST: Spurious Emissions conducted	PARA.NO.: 2.1051
TESTED BY: Pekka Kälviäinen	RSS119: 5.8
	DATE: 02/09/2009

Test Results: Complies.

Test Data: See attached plots.

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

Method of measurement: TIA-603

Transmitter tuned at 408, 428 and 468 MHz

Highest results:

Channel 408.0 MHz		Channel 428.0 MHz		Channel 468.0 MHz	
Frequency (MHz)	Level (dBm)	Frequency (MHz)	Level (dBm)	Frequency (MHz)	Level (dBm)
433.82	-26.6	505.57	-33.5	442.17	-25.5

Equipment used: 566, 328, 571, 145, 316, 341

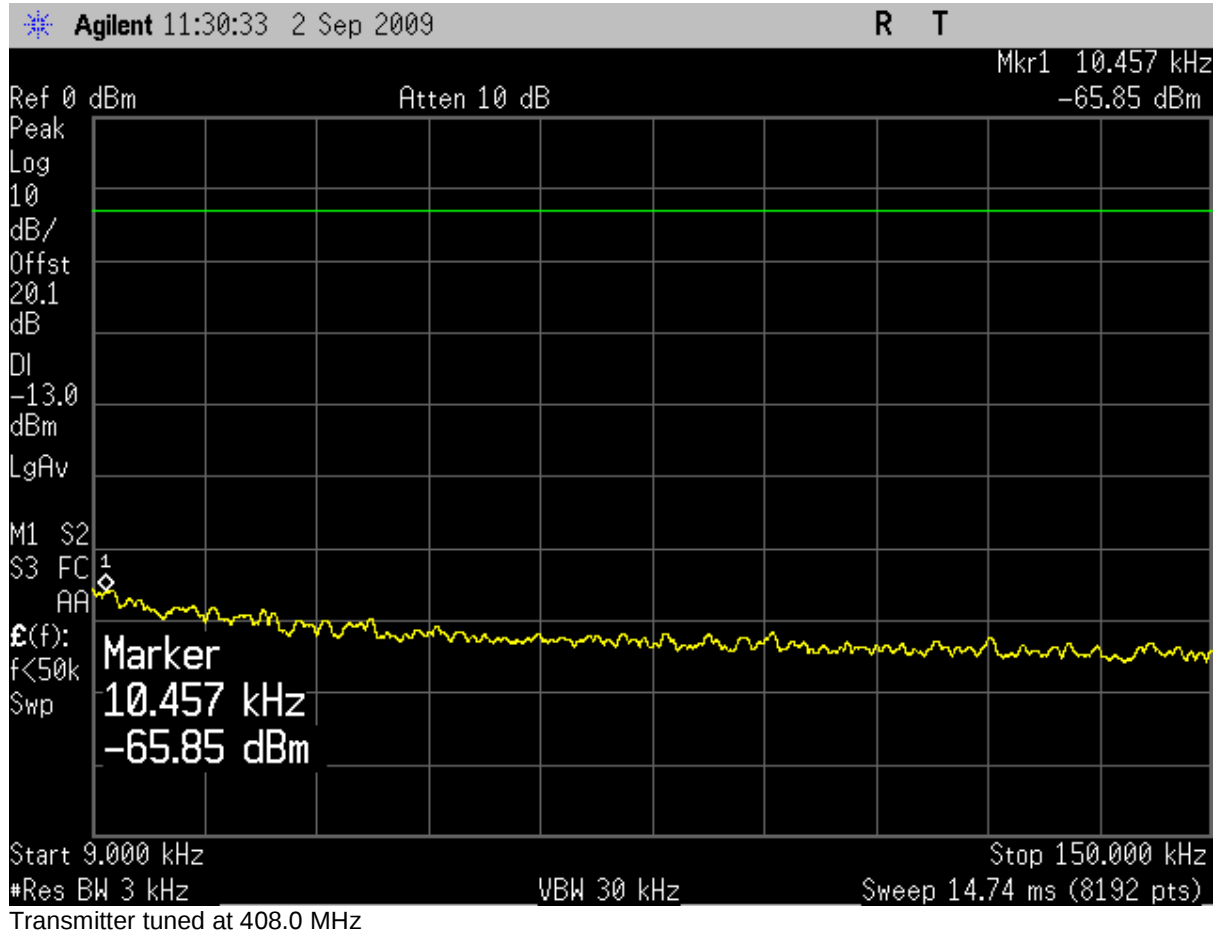
Measurement Uncertainty: ± 1.8 dB.

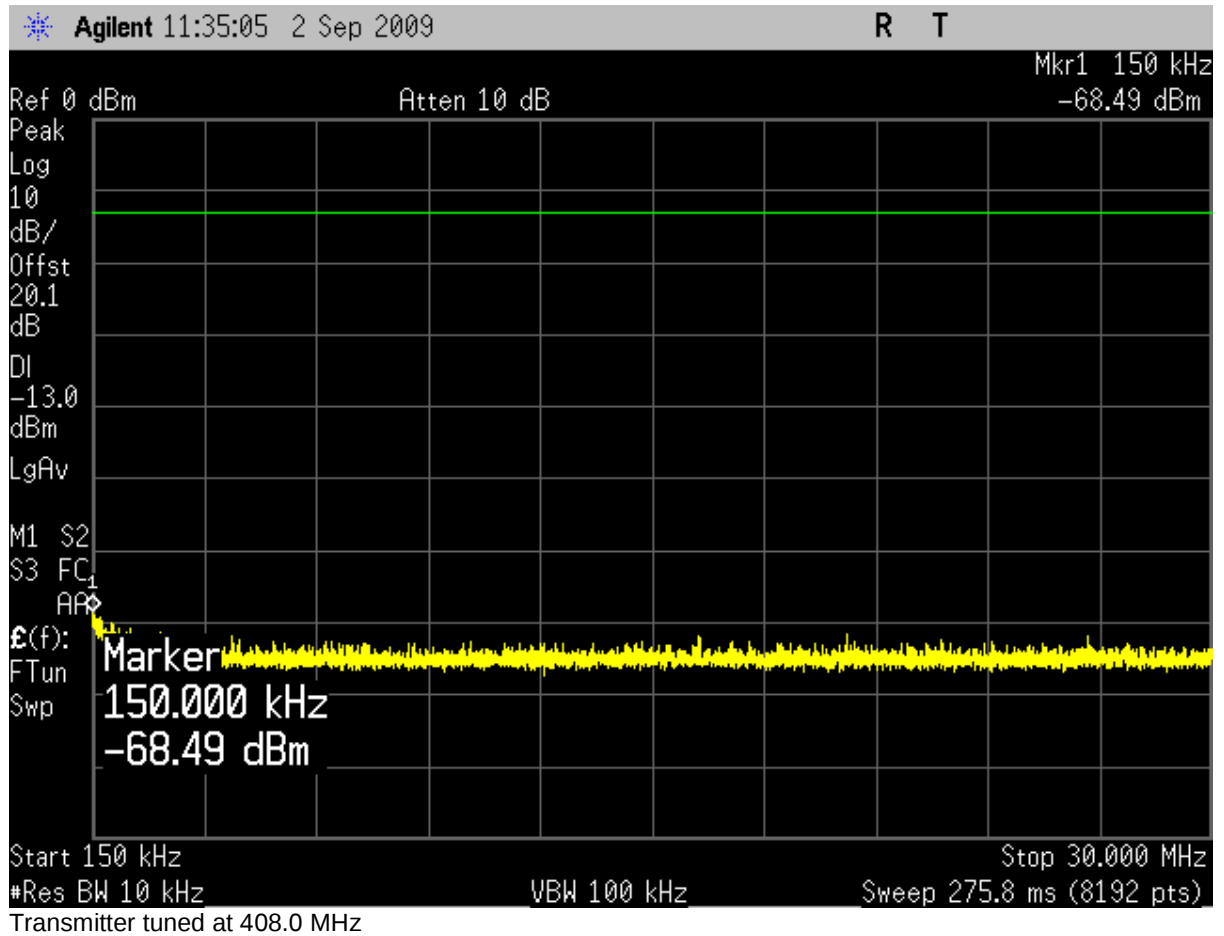
Temperature: 23 °C.

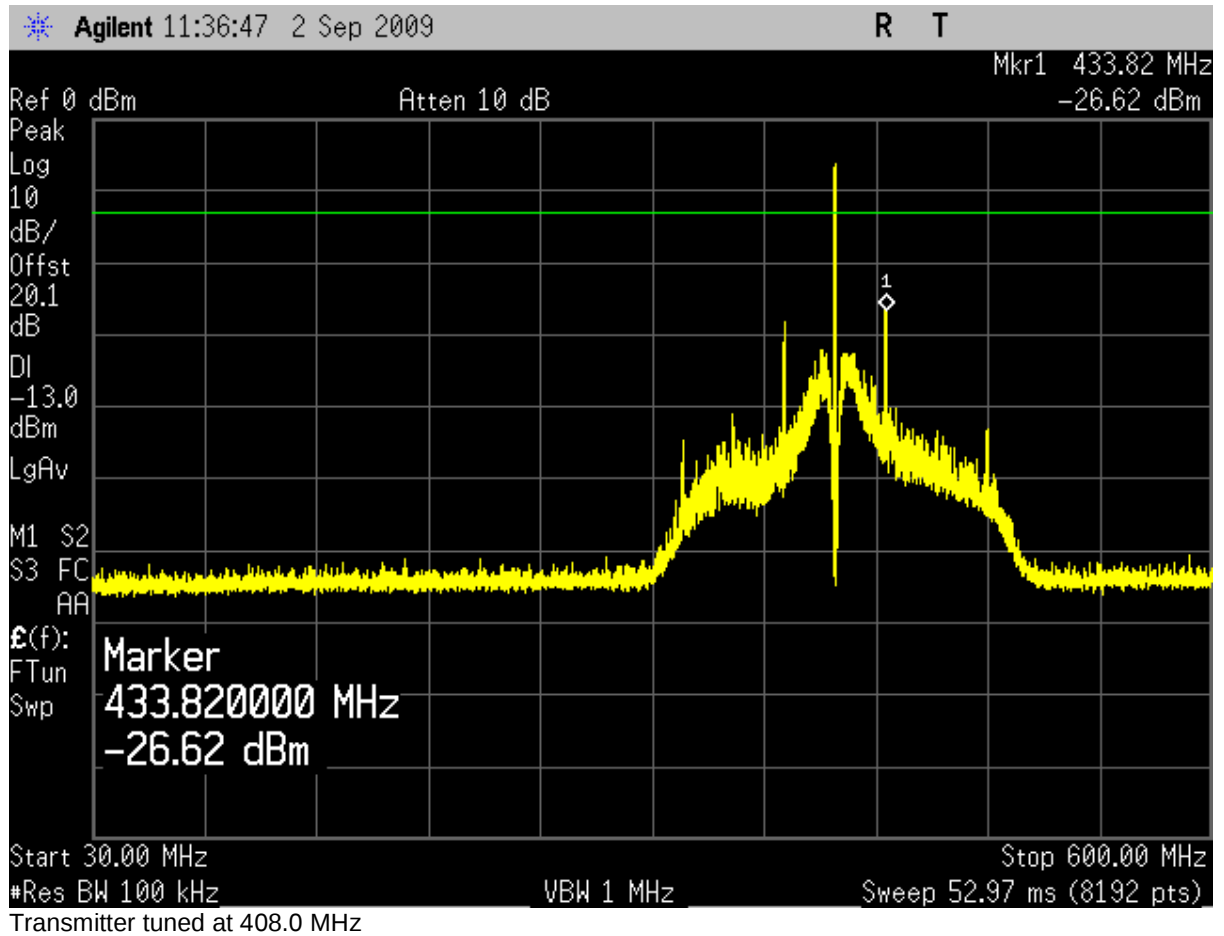
Relative Humidity: 45 %.

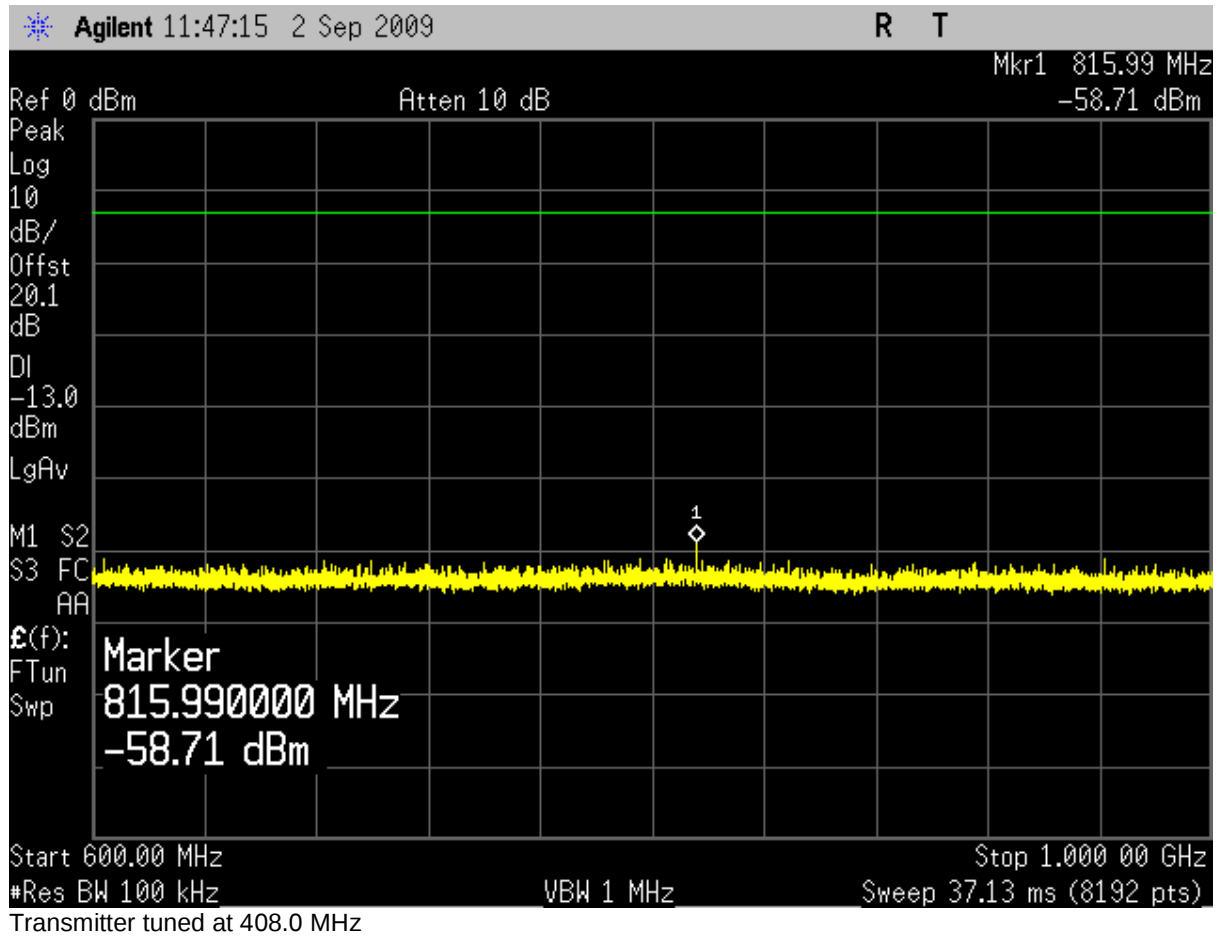
The spectrum was searched from 30 MHz to the 10th harmonic of the carrier (5GHz).

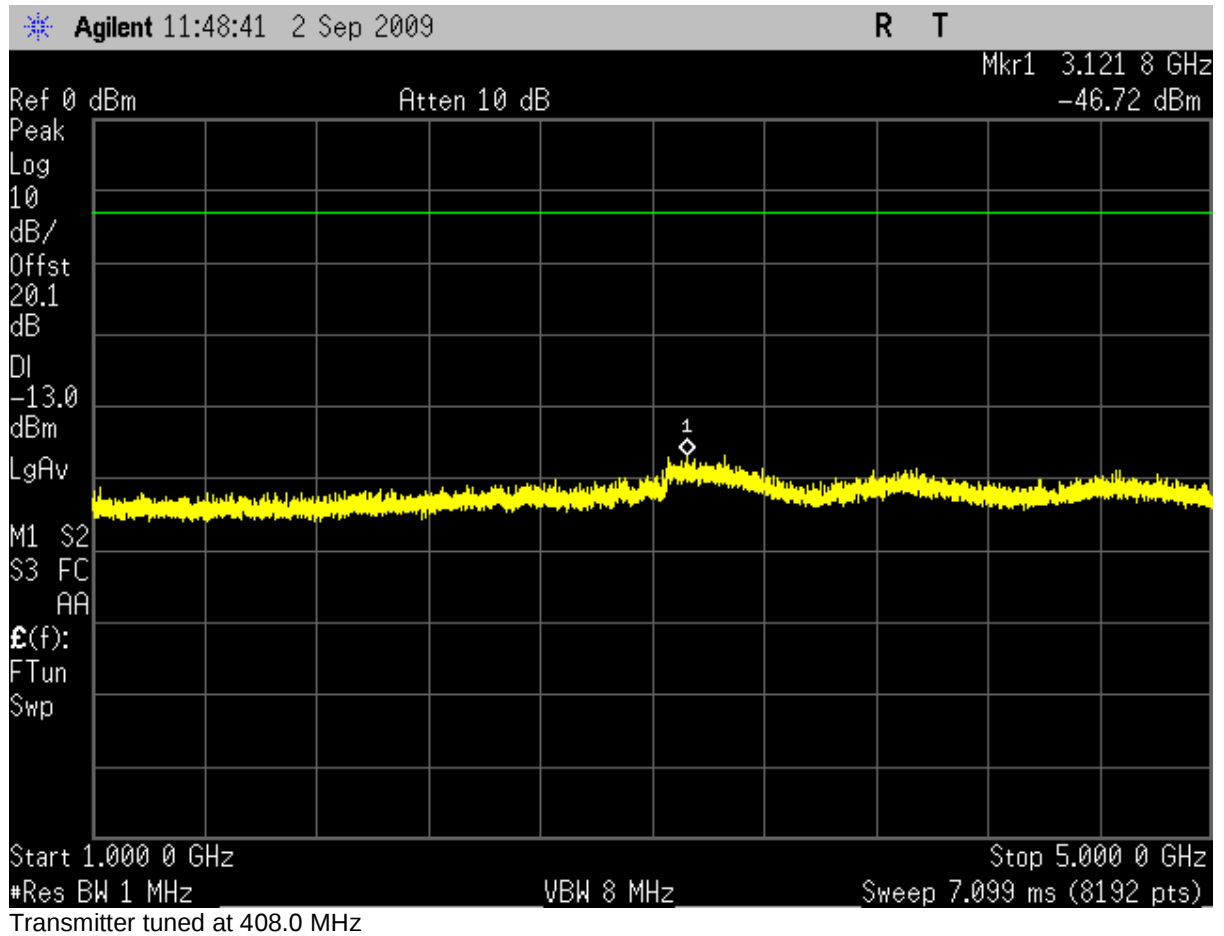
Rated output power: 35W

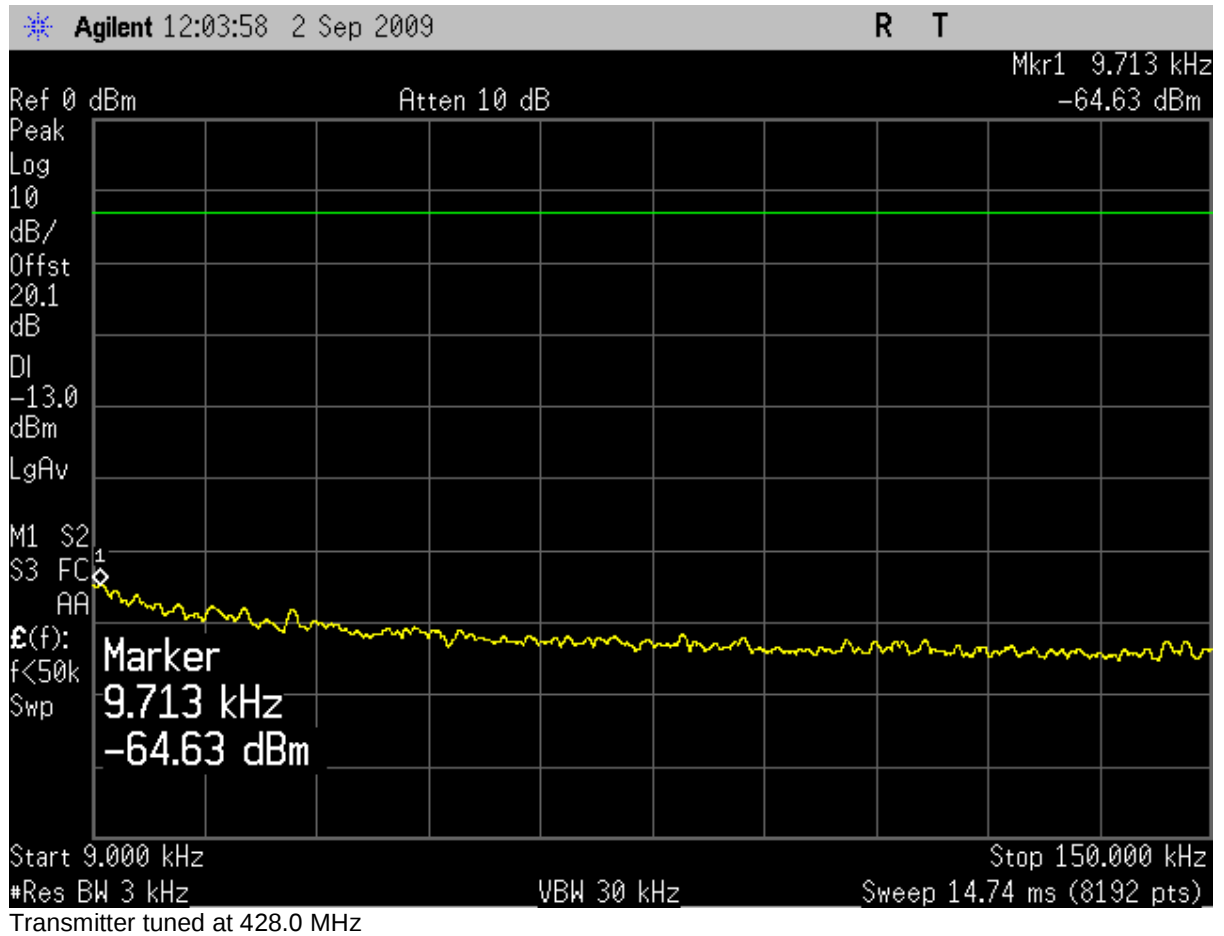


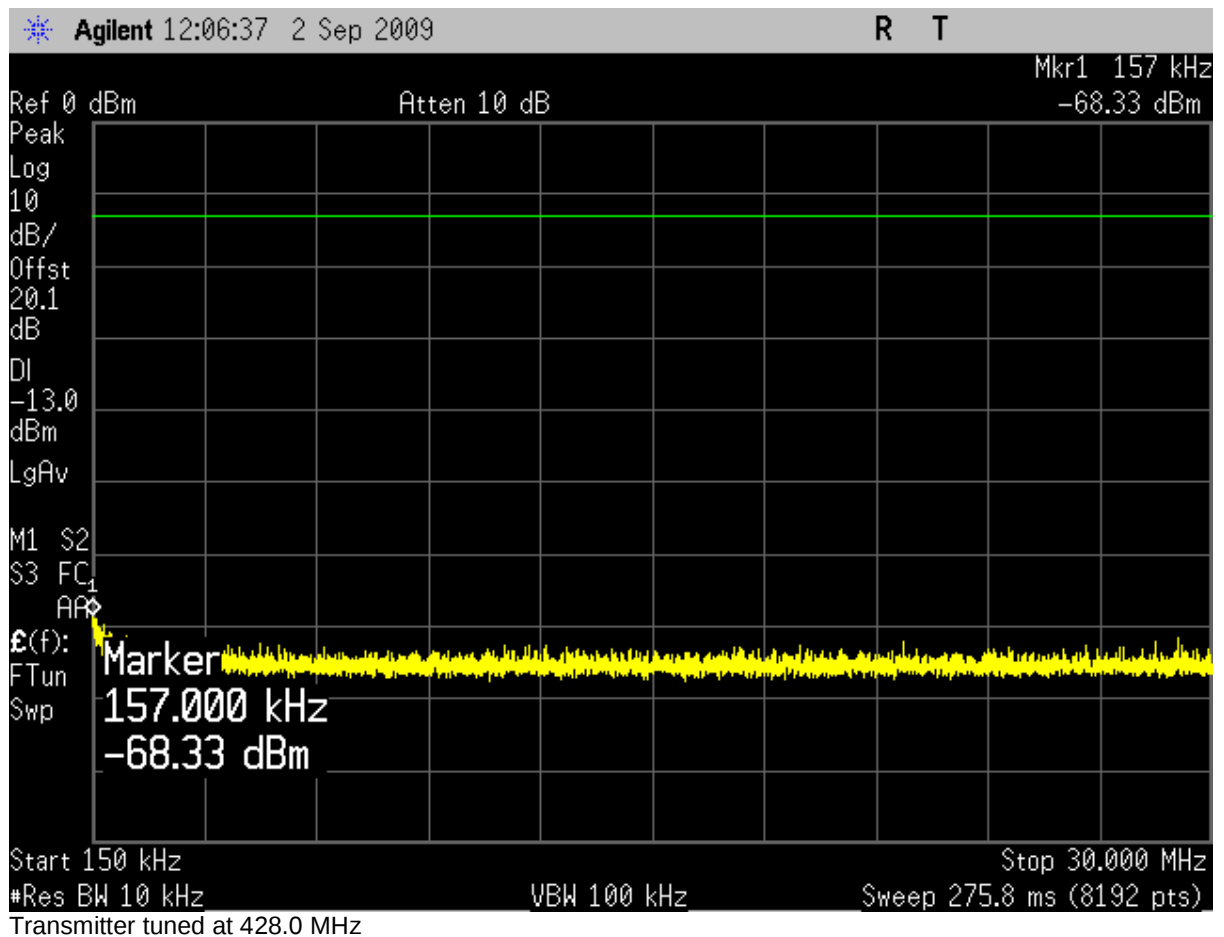


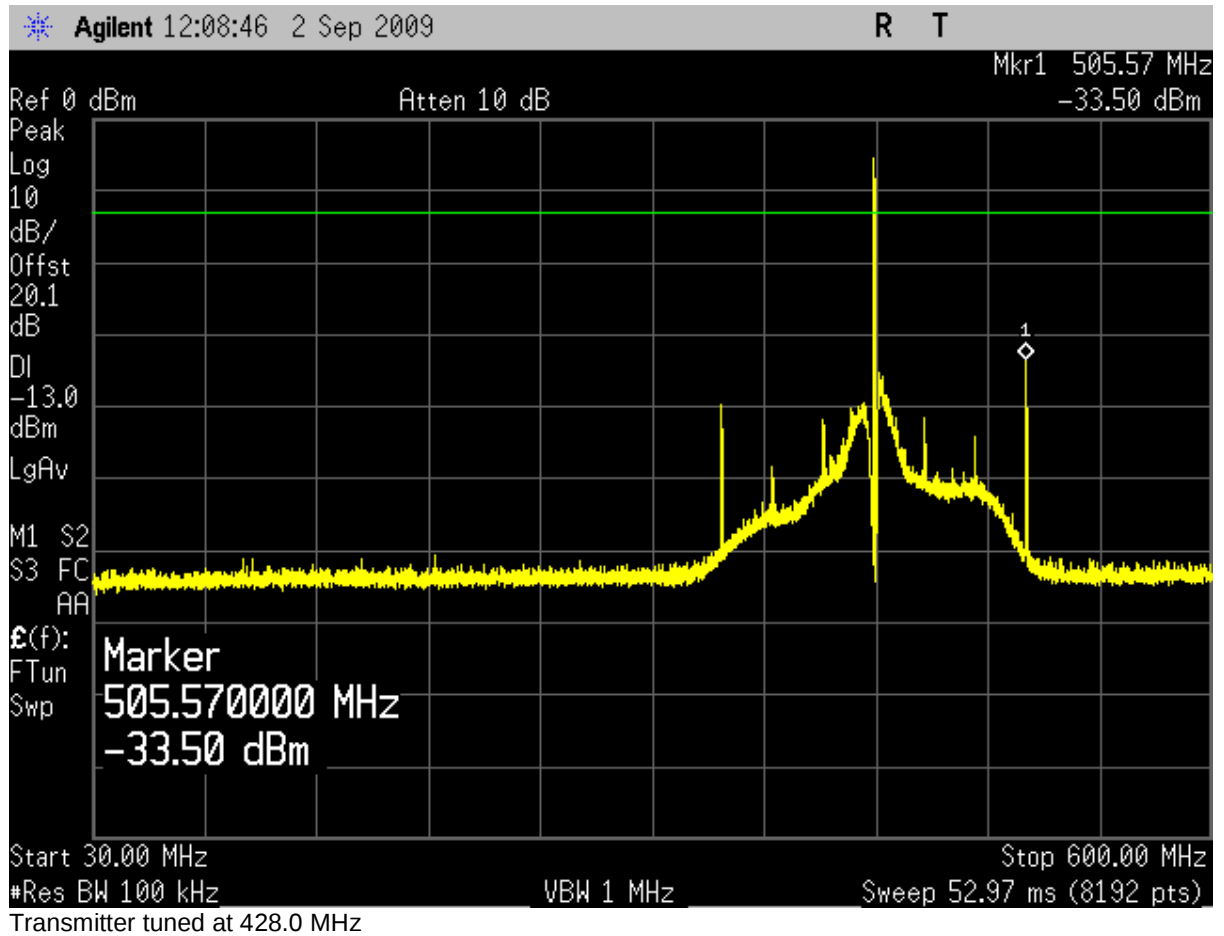


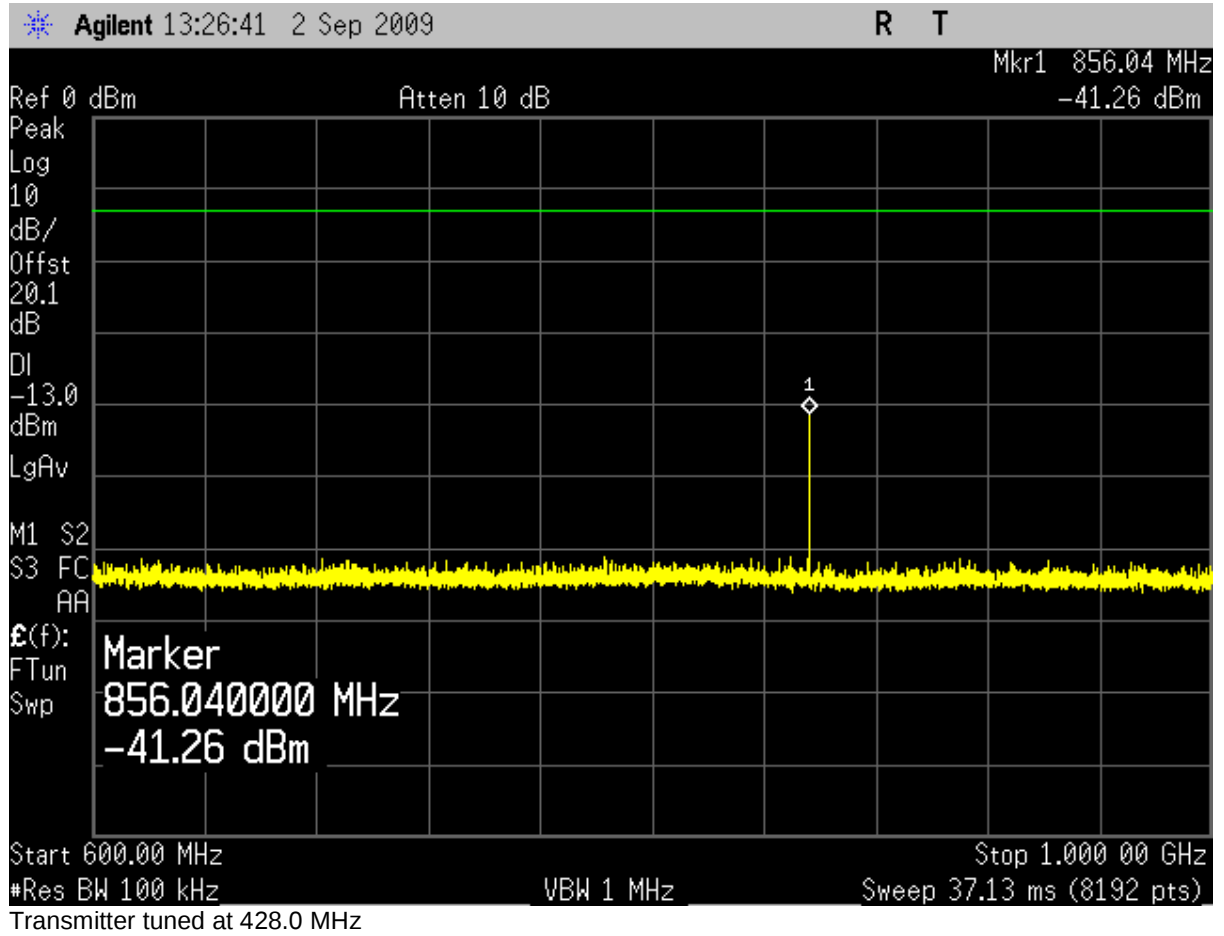


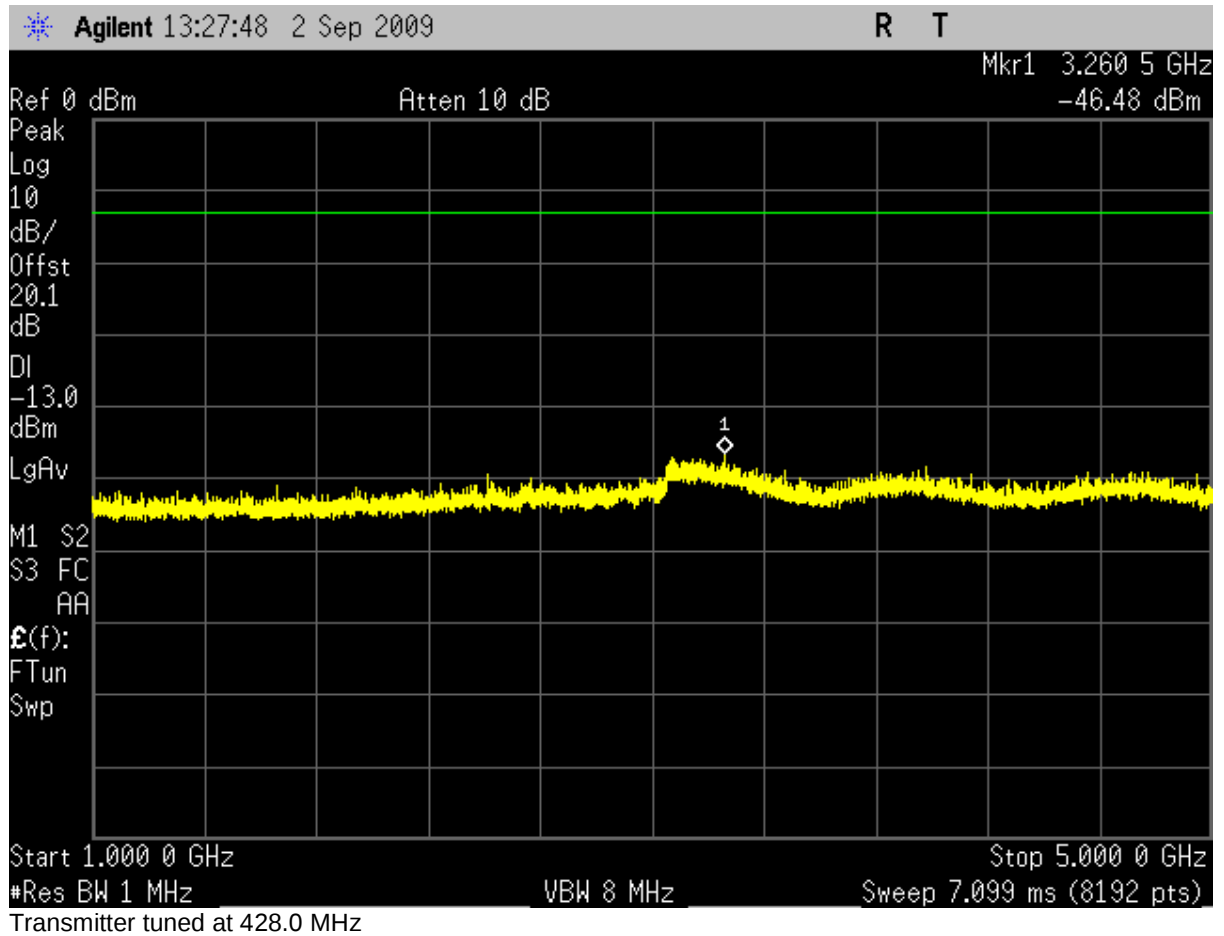


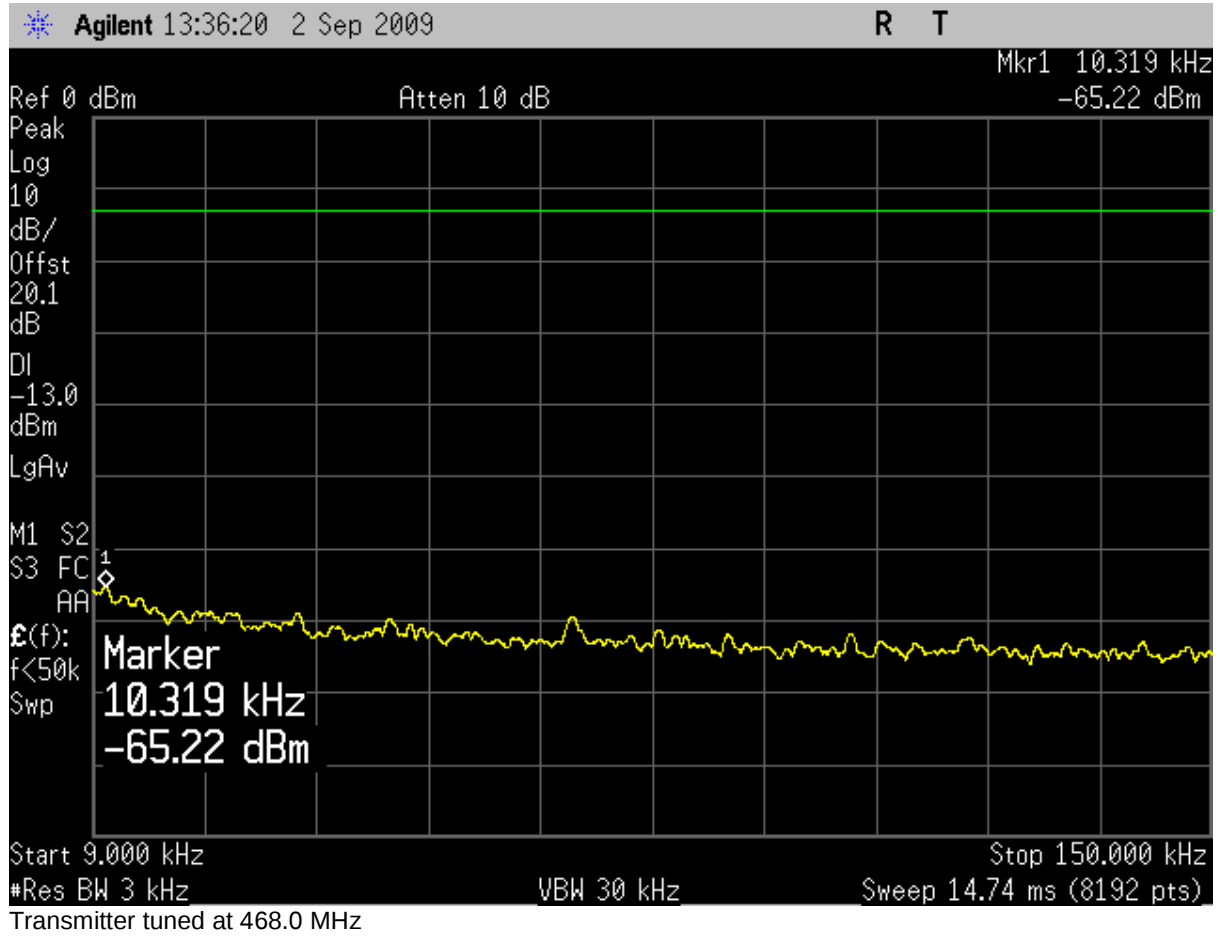


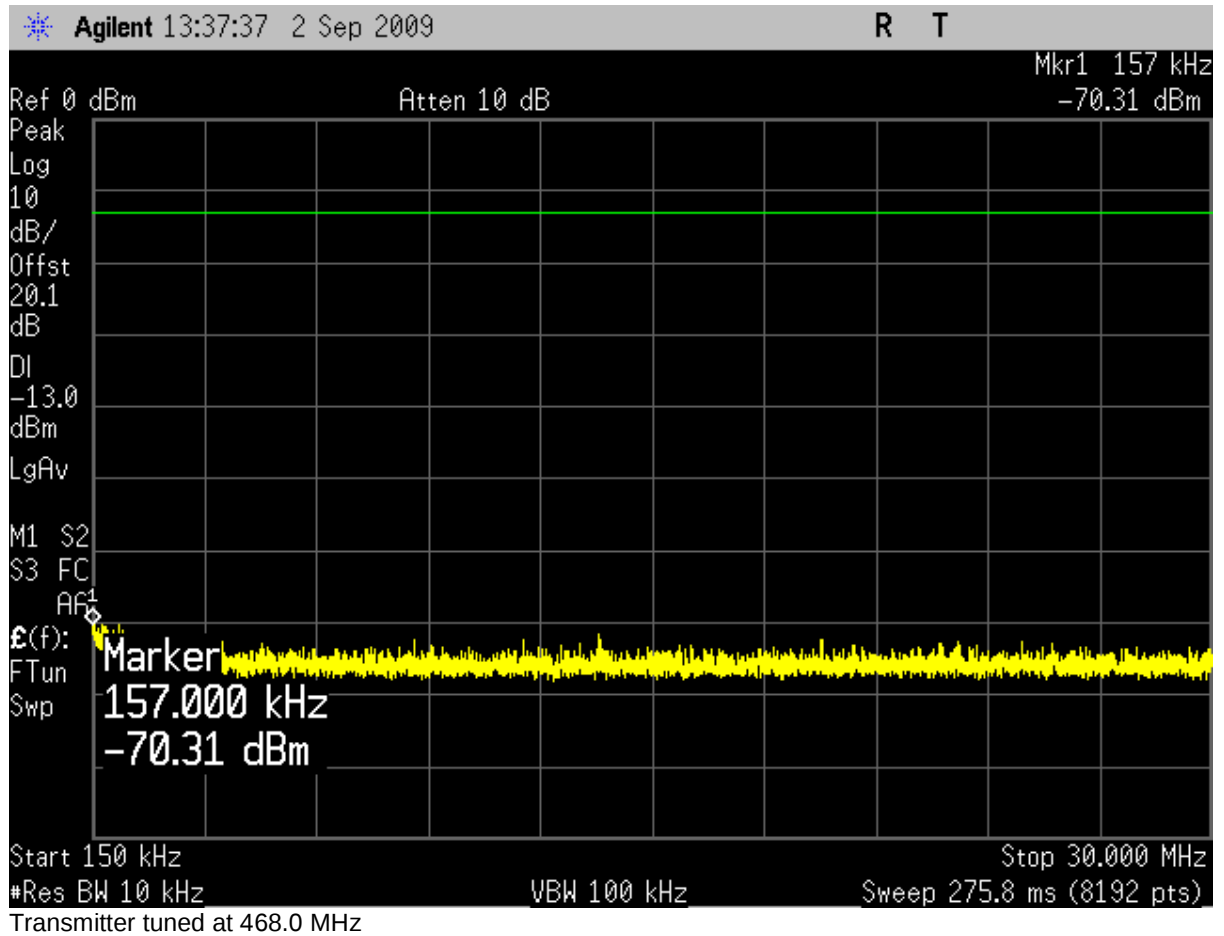


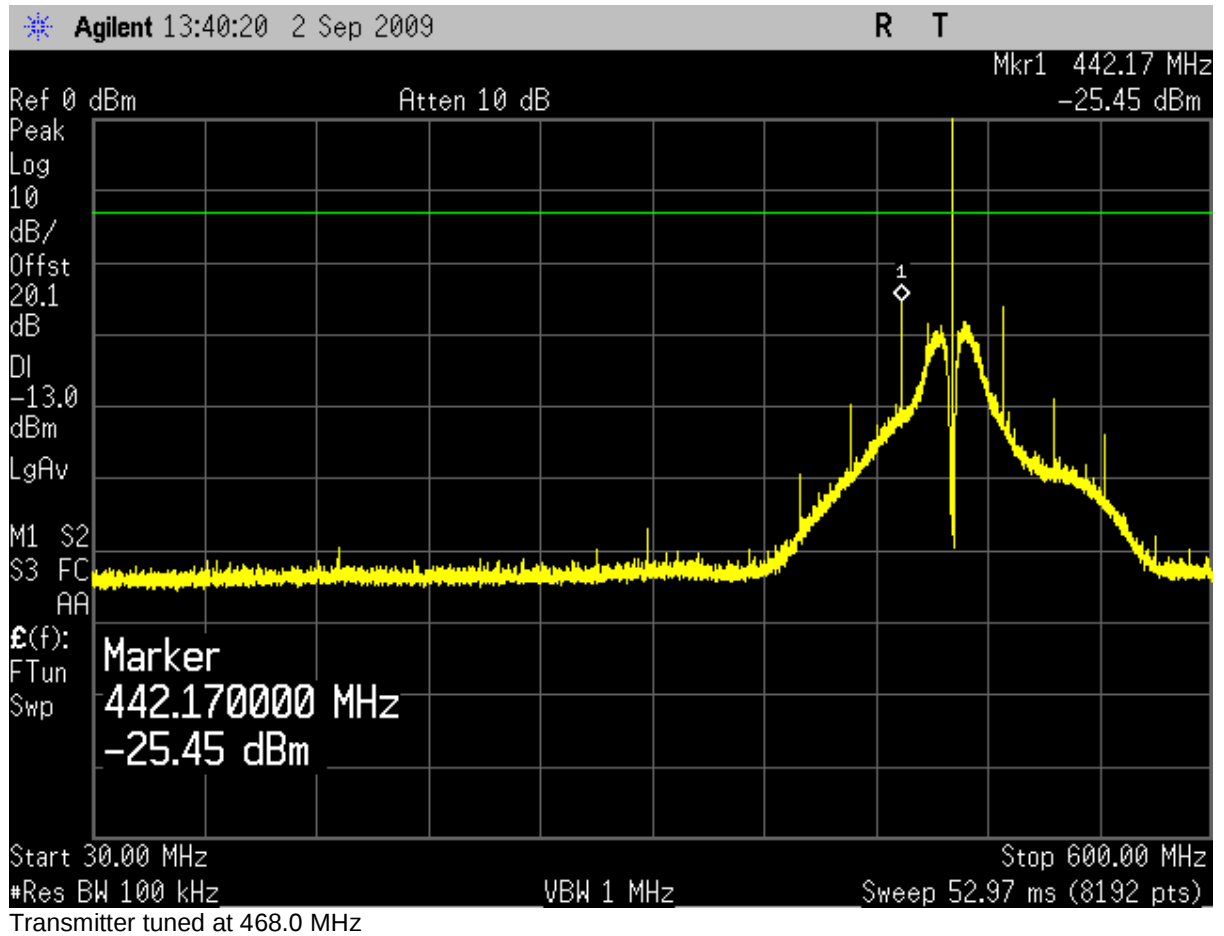


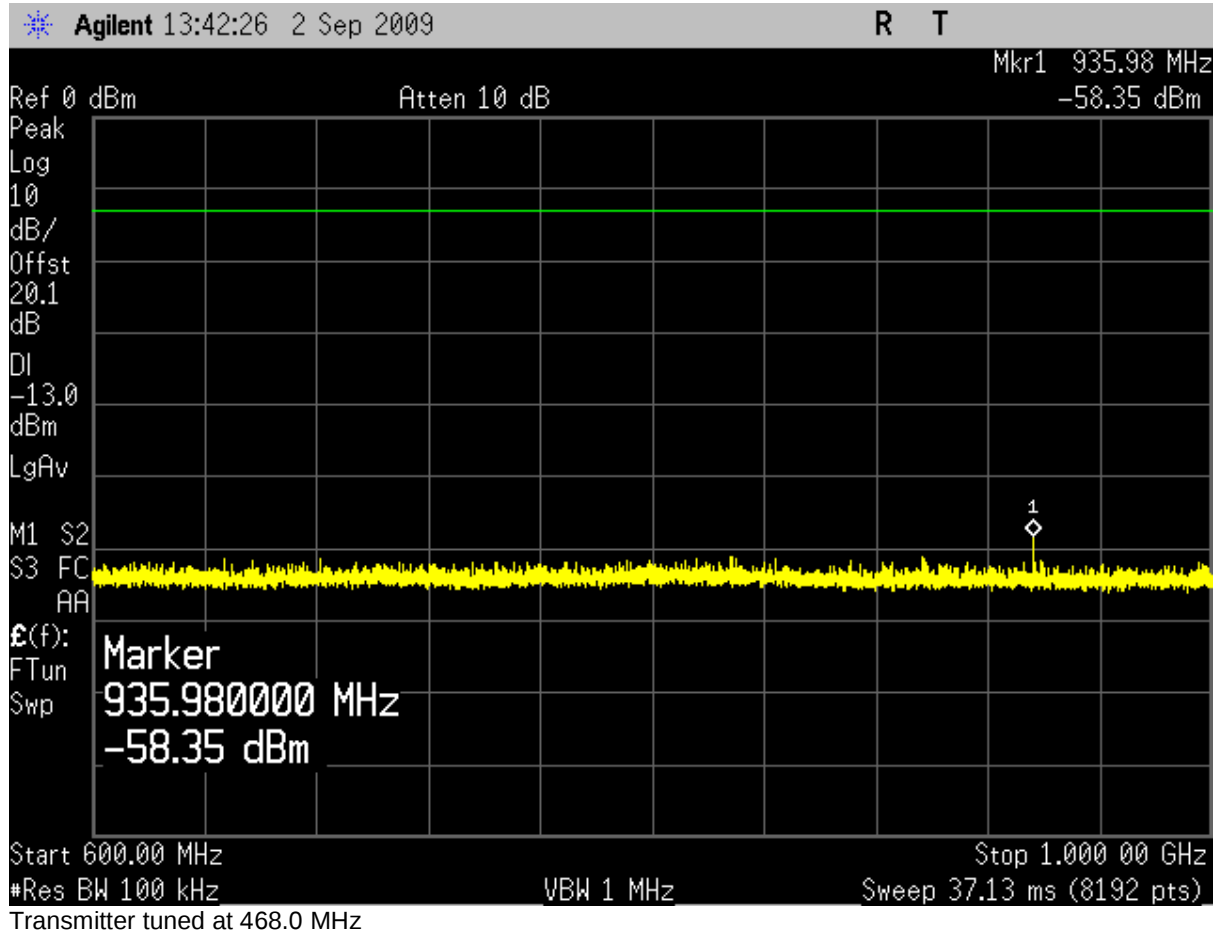


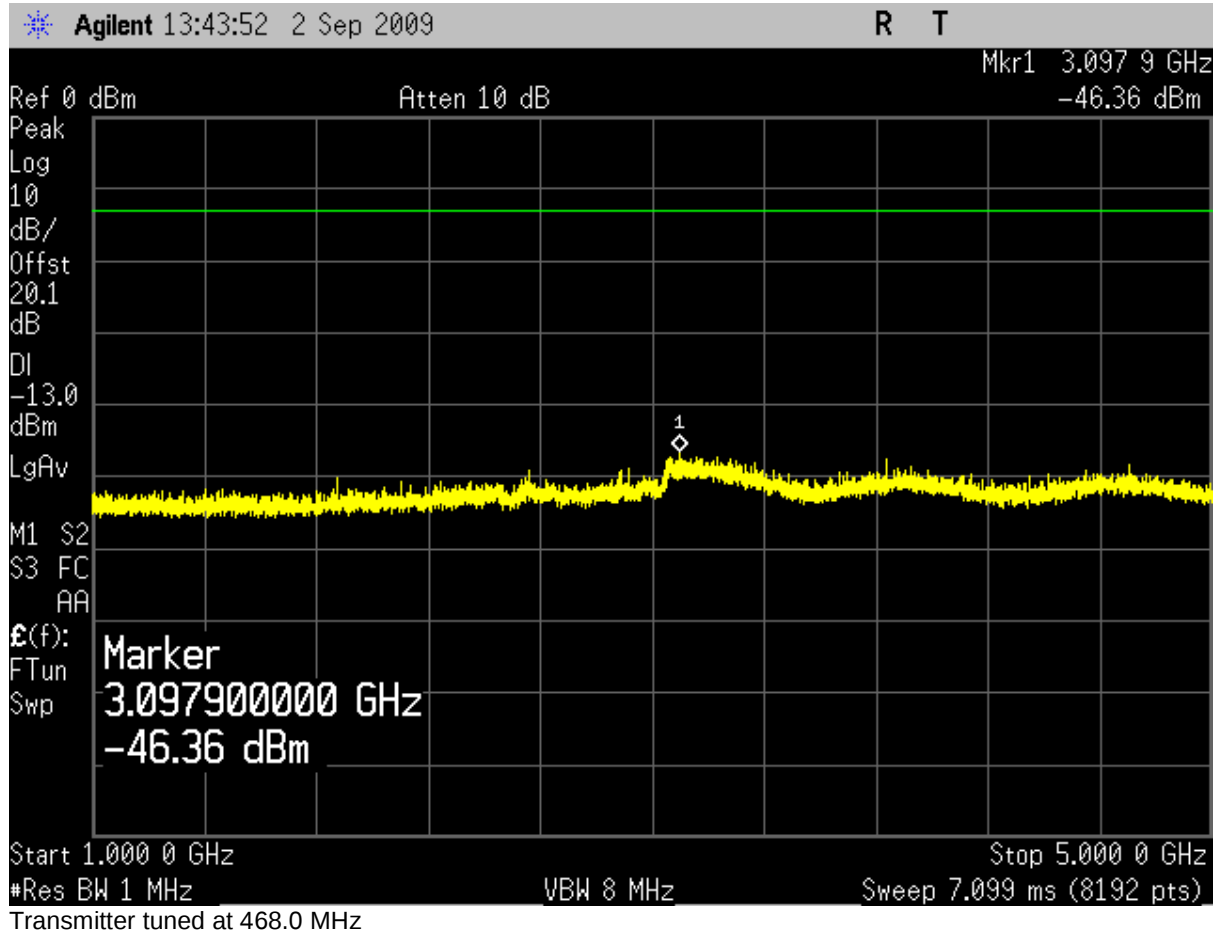












7. Transmitter Spurious Emissions (Radiated)

NAME OF TEST: Field Strength of Spurious Emissions	PARA.NO.: 2.1053
TESTED BY: Pekka Kälviäinen	RSS119: 5.8
	DATE: 03/09/2009

Test Results: Complies.

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

Transmitter tuned at 408, 428 and 468 MHz

Test Data:

Channel 408.0 MHz		Channel 428.0 MHz		Channel 468.0 MHz	
Frequency (MHz)	Level (dBm)	Frequency (MHz)	Level (dBm)	Frequency (MHz)	Level (dBm)
816.0	-37.8	856.0	-42.1	936.0	-46.2
1224.0	-55.3	1284.0	-55.5	1404.0	-51.1
1632.0	-52.0	1712.0	-45.9	1872.0	-38.8
2040.0	-43.1	2140.0	-50.1	2340.0	-41.7
2448.0	-44.9	2568.0	-50.3	2808.0	-38.5
2856.0	-44.3	2996.0	-44.0	3276.0	-42.6
3264.0	-46.3	3424.0	-46.9	3744.0	-41.8
3672.0	-38.0	3852.0	-43.0	4212.0	-40.6
4080.0	-40.1	4280.0	-39.3	4680.0	-38.9
4488.0	-37.5	4708.0	-38.0		
4896.0	-39.3				

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

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 (5GHz).

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 30-5000 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, 1000-5000MHz RBW 1MHz.

Vertical and horizontal polarizations in the frequency range 30 – 5000 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.

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

8. Transient behaviour of the transmitter

NAME OF TEST: Transient behaviour of the transmitter	PARA.NO.: 90.214
	RSS119: 5.9
TESTED BY: Risto Hietanen	DATE: 18/06/2009

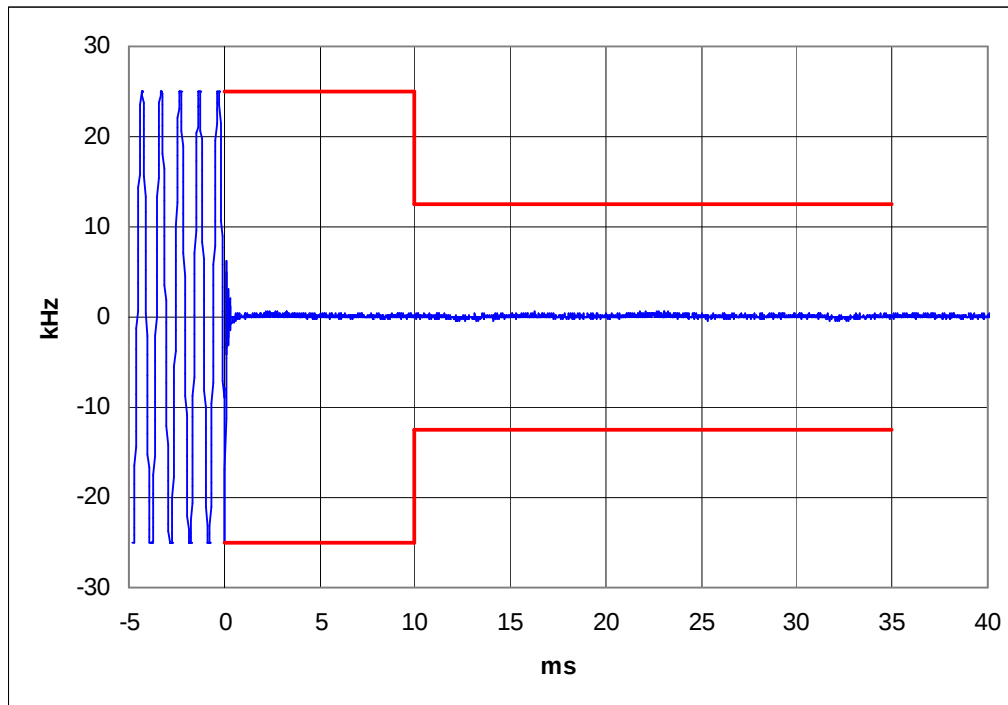
Test Results: Complies.

Test Data: See attached plots

Requirement:

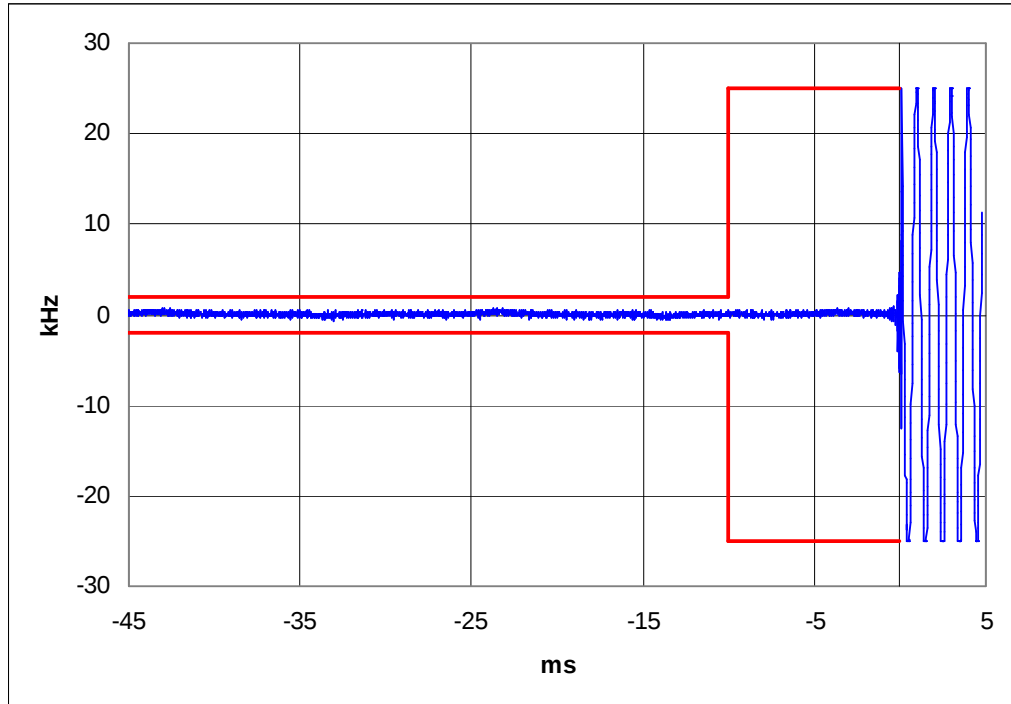
Measurement	Maximum frequency difference (kHz)	Transient duration limit (ms)
T1	± 25	10
T2	± 12.5	25
T3	± 25	10

TEST EQUIPMENT USED: 335, 332, 334, 43, 42, 10, 201, 133, 146, 328, 386, 390, 392, 394, 316, 341

Graphs of the transient behaviour of the transmitter
Rated output power 35 W**Transmitter attack time (402.0 MHz)**
(Transient behaviour of the transmitter switch-on)**Output power: 35 W.**

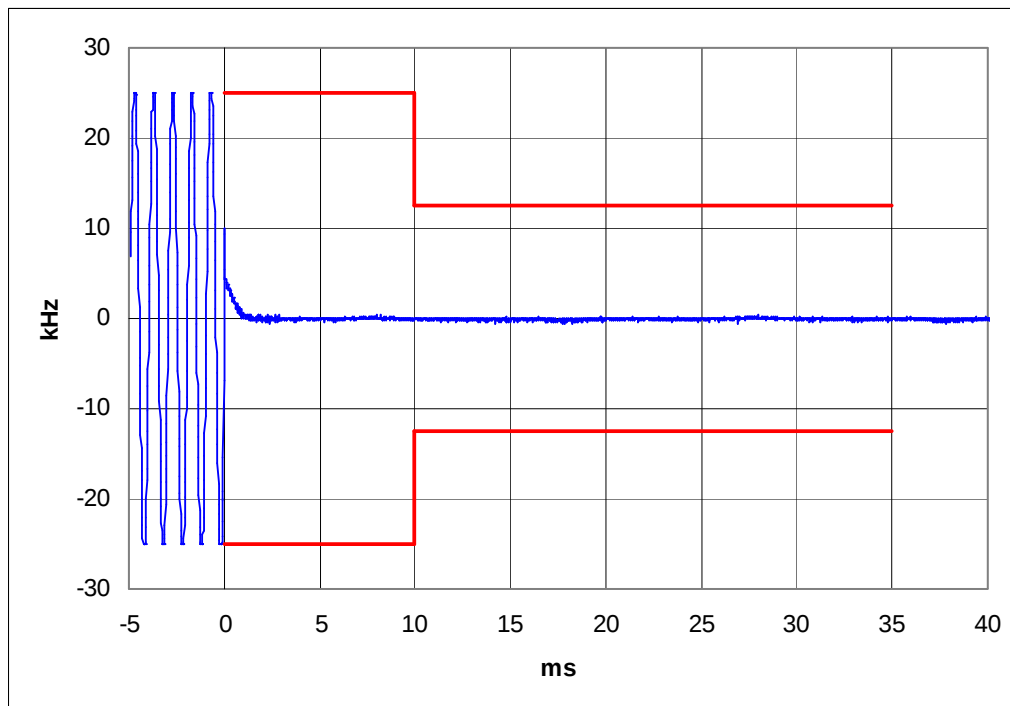
Transmitter release time (402.0 MHz)
(Transient behaviour of the transmitter switch-off)

Output power: 35 W.



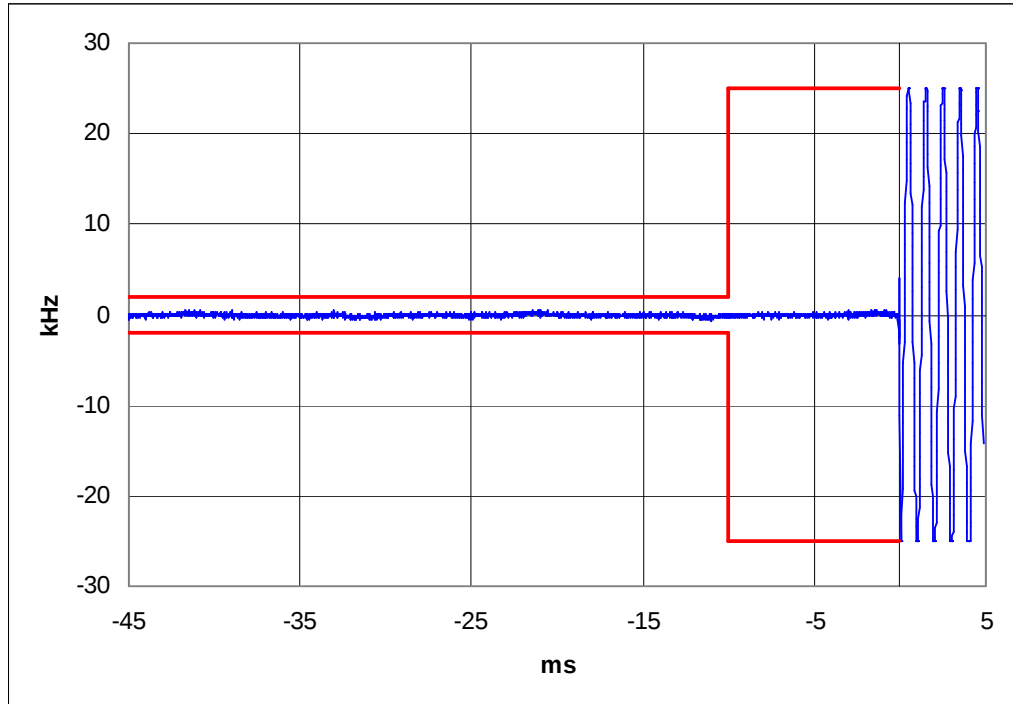
Transmitter attack time (432.0 MHz)
(Transient behaviour of the transmitter switch-on)

Output power: 35 W.



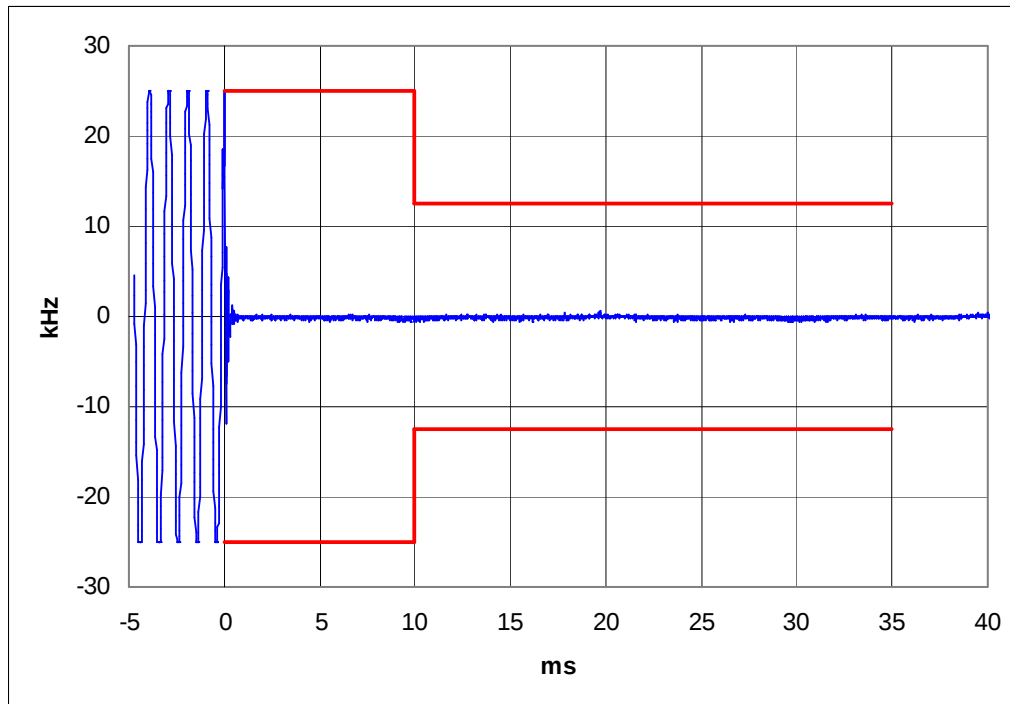
Transmitter release time (432 MHz)
(Transient behaviour of the transmitter switch-off)

Output power: 35 W.



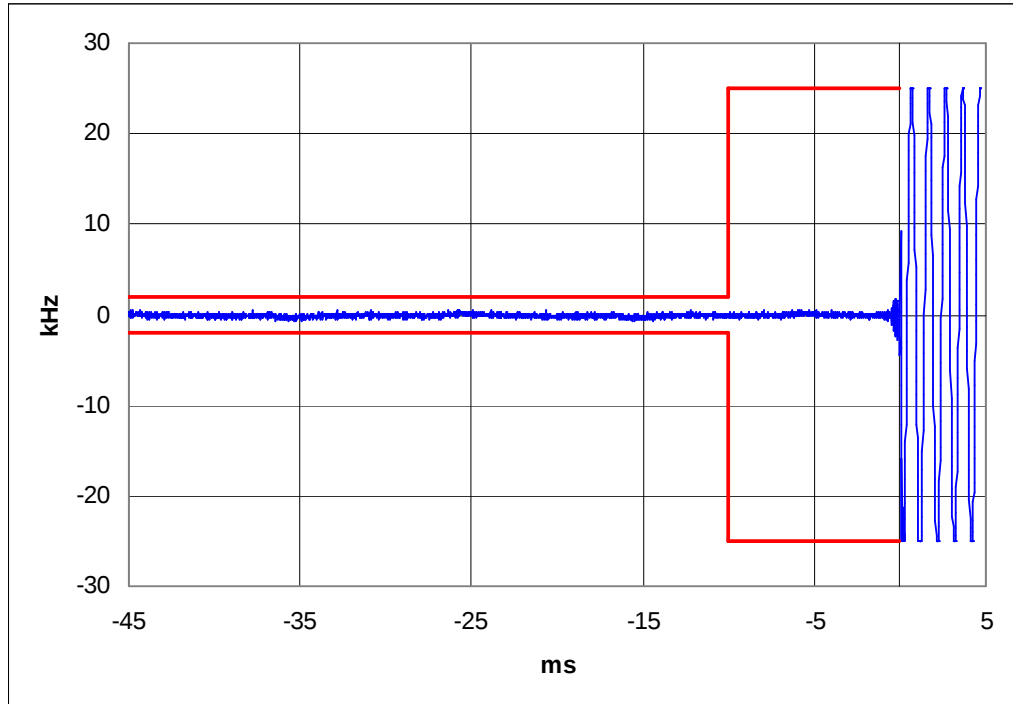
Transmitter attack time (468.0 MHz)
(Transient behaviour of the transmitter switch-on)

Output power: 35 W.



Transmitter release time (468.0 MHz)
(Transient behaviour of the transmitter switch-off)

Output power: 35 W.



8.1 Frequency stability

NAME OF TEST: Frequency Stability	PARA.NO.: 2.1055
TESTED BY: Pekka Kälviäinen	RSS119: 5.3
	DATE: 01/09/2009

Test Results: Complies.

Limit: ± 1.5 ppm.

Test performed at transmitter frequency 452.0 MHz.

Test Data:

a) Frequency stability vs. voltage variations

Temperature °C	Voltage V	Frequency MHz	Error ppm
20	11.2	452.00012	0.27
20	13.2	452.00014	0.31
20	15.2	452.00010	0.22

b) Frequency stability vs. temperature variations

Temperature °C	Voltage V	Frequency MHz	Error ppm
60	13.2	451.99959	-0.91
50	13.2	451.99962	-0.84
40	13.2	451.99971	-0.64
30	13.2	451.99991	-0.20
20	13.2	452.00014	0.31
10	13.2	452.00027	0.60
0	13.2	452.00037	0.82
-10	13.2	452.00047	1.04
-20	13.2	452.00039	0.86
-30	13.2	452.00028	0.62

Equipment used: 2045

**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.

9. List of measuring equipment:

No.	Equipment	Type	Manufacturer	Serial Number
5	Test receiver	ESH-3	Rohde & Schwarz	894718/01510
10	Oscilloscope	9400A	LeCroy	8878
42	Spectrum analyzer	8566B	Hewlett Packard	2637A04102
43	Spectrum analyzer	8568B	Hewlett Packard	2039A01256
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
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	D01080
563	Thermometer	52 II	Fluke	81210080
564	RF amplifier	CA018-4010	CIAO Wireless	101
566	Spectrum analyzer	E4448A	Agilent	US42510236
567	RF generator	E8257C	Agilent	MY43320736
571	High Pass Filter	WHK0.6/13G-10SS	Wainwright Instruments	1
2039	Power sensor	8482A	Hewlett Packard	1925A03475
2040	Power meter	438A	Hewlett Packard	2517U00427
2046	Counter	5351B	Hewlett Packard	2844U00220