CETECOM ICT Services GmbH
Laboratory for Short Range Devices
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Recognized by the
Federal Communications Commission
Anechoic chamber registration no.: 90462 (FCC)
Anechoic chamber registration no.: IC 3463A-1
TCB ID: DE 0001

Accredited by the
German Accreditation Council
DAR–Registration Number
DAT-P-176/94-D1

Accredited Bluetooth® Test Facility (BQTF)

Test report no.: 1-0412-1-2/08
FCC Part 15.247
FCC ID: --
IC: --

Table of contents

1. Administrative data

1.1. Administrative data of the test facility

1.1.1 Identification of the testing laboratory

Company name:	Cetecom ICT Services GmbH
Address:	Untertürkheimerstr. 6-10 D-66117 Saarbruecken Germany
Laboratory accreditation:	DAR-Registration No. DAT-P-176/94-D1 Bluetooth Qualification Test Facility (BQTF)
Responsible for testing laboratory:	Nicolas Stamber, Karsten Geraldy Phone: +49 681 598 0 Fax: +49 681 598 9075 email: info@ict.cetecom.de

N. Stamber / Geraldy Karsten

Responsible for testing laboratory
(Nicolas Stamber, Karsten Geraldy)

1.1.2 Organizational items

Reference No.:	
Order No.:	
Responsible for test report and project leader:	Nicolas Stamber, Karsten Geraldy
Receipt of EUT:	2008-03-10
Date(s) of test:	2008-04-29 to 2008-05-06
Date of report:	2008-05-06
Number of report pages:	60
Version of template:	1.6

N. Stamber / Geraldy Karsten

Responsible for test report
(Nicolas Stamber, Karsten Geraldy)

Note:
The test results of this test report relate exclusively to the item tested as specified in this report. The CETECOM ICT Services 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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During the test no hardware and software changes are allowed to be performed at the EUT.

1.1.3 Applicant's details

Applicant's name:	Toshiba TEC Corporation
Address:	570 Ohito, Ohito-Cho, Tagata-Gun Shizuoka-ken 410-2392 Japan
Tel:	+81-558-76-9512
Fax:	+81-558-76-9844
Contact person:	Mr. Makoto Sugiyama
Tel:	+81-558-76-9512
Fax:	+81-558-76-9844
Email:	Makoto_Sugiyama@toshibatec.co.jp

1.2 Administrative data of manufacturer / member

Manufacturer's name:	Toshiba TEC Corporation
Address:	570 Ohito, Ohito-Cho, Tagata-Gun Shizuoka-ken 410-2392 Japan

1.3 Description of the Equipment under test (EUT)

1.3.1 EUT: Type, S/N etc.

Product name	Product ID	Description	S/N serial number	HW hardware status	SW software status
TRW-USM-01	--	RFID Module	07118020	--	--
Frequency Band [MHz]	**Type of Modulation**	**Number of channels**	**Antenna**	**Power Supply**	**Temperature Range**
902 - 928	FHSS / ASK	99	External Antenna	5 V DC	-20°C - +55°C

1.3.2 If RF component testing only, description of additional used HW/SW

	Product name	Product ID	Description	S/N serial number	HW hardware status	SW software status
1	--					
2	--					

1.3.3 Additional EUT information

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1.3.4 EUT operating modes

EUT operating mode no.*)	Description of operating modes	Additional information
Op. 0	Normal mode	normal temperature and power source conditions
Op. 1		low temperature, low power source conditions
Op. 3		low temperature, high power source conditions
Op. 4		high temperature, low power source conditions
Op. 5		high temperature, high power source conditions

*) EUT operating mode no. is used to simplify the test report.

1.3.5 Extreme conditions testing values

Description	Shortcut	Unit	Value
Nominal Temperature / humidity	T_{nom}	°C / %	22°C / 33%
Low Temperature	T_{low}	°C	-20°C
High Temperature	T_{high}	°C	+55°C
Nominal Power Source	V_{nom}	V	5.0
Low Power Source	V_{low}	V	4.5
High Power Source	V_{high}	V	5.5

Type of power source: External DC power supply from our house

2 Test standard & summary list of all performed test cases

TC identifier	Description	verdict	date	Remark
RF-Testing	FCC Part 15 §15.247	pass	2008-05-06	--

Test Specification Clause	Test Case	Pass	Fail	Not applicable	Not performed
§15.247(a)(1)(i)	Spectrum Bandwidth of a FHSS System 20dB BW	Yes			
§ 15.247 (b) (2)	Maximum output power (conducted)	Yes			
§ 15.247 (b) (2)	Max. peak output power (radiated)	Yes			
§15.247 (d)	Spurious Emissions - conducted (Transmitter)	Yes			
§ 15.209	Spurious Emissions - radiated (Transmitter)	Yes			
§ 15.109/209	Spurious Emissions - radiated (Receiver)	Yes			
§ 15.107/207	Conducted Emissions <30 MHz	Yes			
--	Frequency Stability	Yes			

3 RF measurement testing

3.1 Description of test set-up

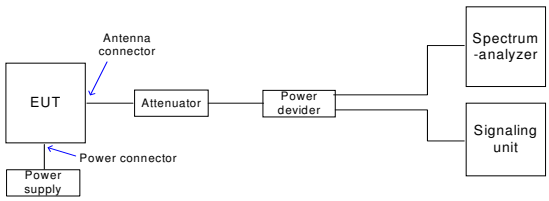
3.1.1 Radiated measurements

The radiated measurements are performed in vertical and horizontal plane in the frequency range from 9 kHz to 12 GHz in anechoic chambers. The EUT is positioned on a non-conductive support with a height of 0.80 m above a conductive ground plane that covers the whole chamber. The receiving antennas are conform with specifications ANSI C63.2-1996 clause 15 and ANSI C63.4-2003 clause 4.1.5. These antennas can be moved over the height range between 1.0 m and 4.0 m in order to search for maximum field strength emitted from EUT. The measurement distances between EUT and receiving antennas are indicated in the test setups for the various frequency ranges. For each measurement, the EUT is rotated in all three axes until the maximum field strength is received. The wanted and unwanted emissions are received by spectrum analysers where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63-4-2003 clause 4.2.

Antennas are conform with ANSI C63.2-1996 item 15.
150 kHz - 30 MHz: Quasi Peak measurement, 9kHz Bandwidth, passive loop antenna.
30 MHz - 200 MHz: Quasi Peak measurement, 120KHz Bandwidth, biconical antenna
200MHz - 1GHz: Quasi Peak measurement, 120KHz Bandwidth, log periodic antenna
>1GHz: Average, RBW 1MHz, VBW 10 MHz, waveguide horn with lownoise preamp

3.1.2 Conducted measurements

The EUT's RF signal is coupled out by the antenna connector which is supplied by the manufacturer. The signal is connected to the spectrum analyzer. The specific losses for signal paths is first checked within a calibration. The measurement readings on the spectrum analyzer is corrected by the specific test set-up loss. The attenuator, power divider, signaling unit and the spectrum analyzer are impedance matched on 50 Ohm.

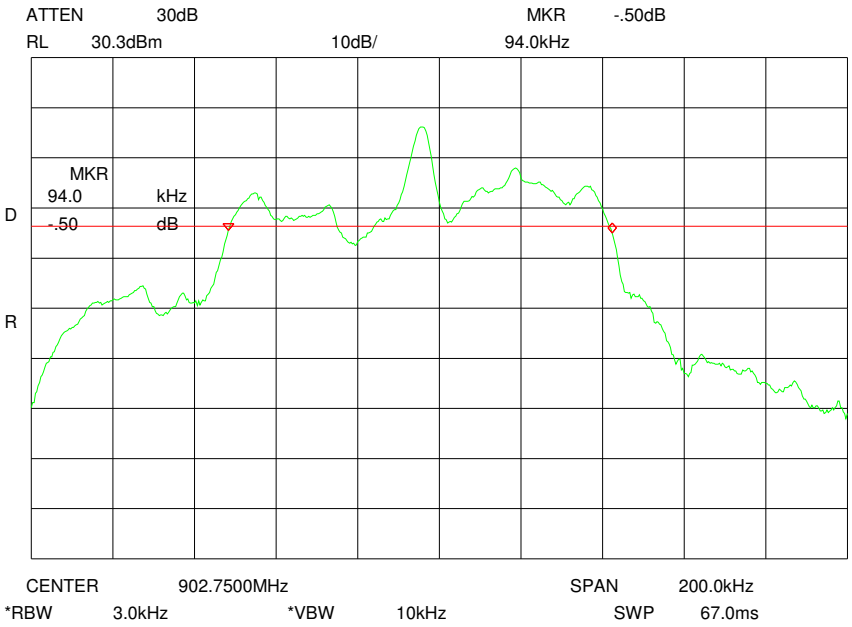


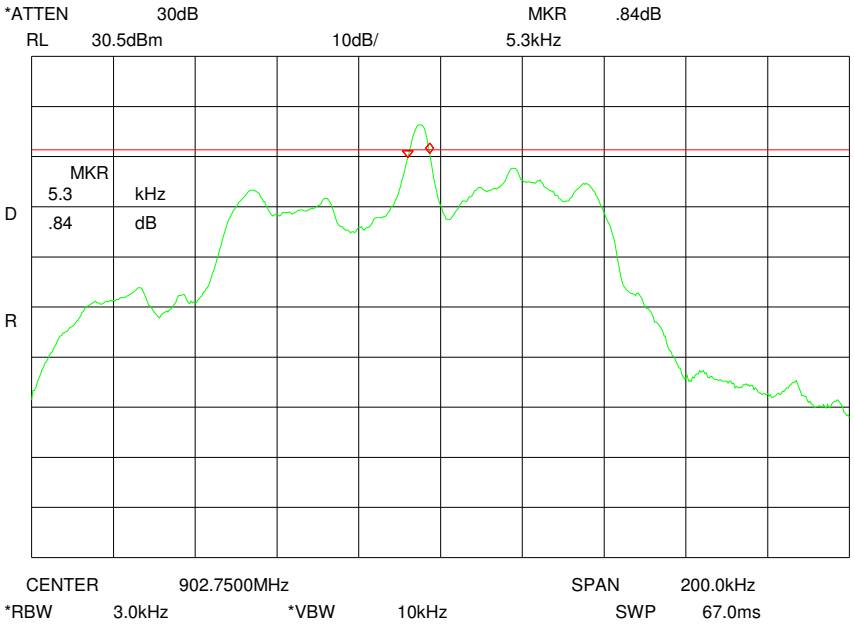
3.1.3 AC-conducted measurements

As the product is sold without any power supply, we used a power supply from our company to show compliance with AC-conducted requirements.

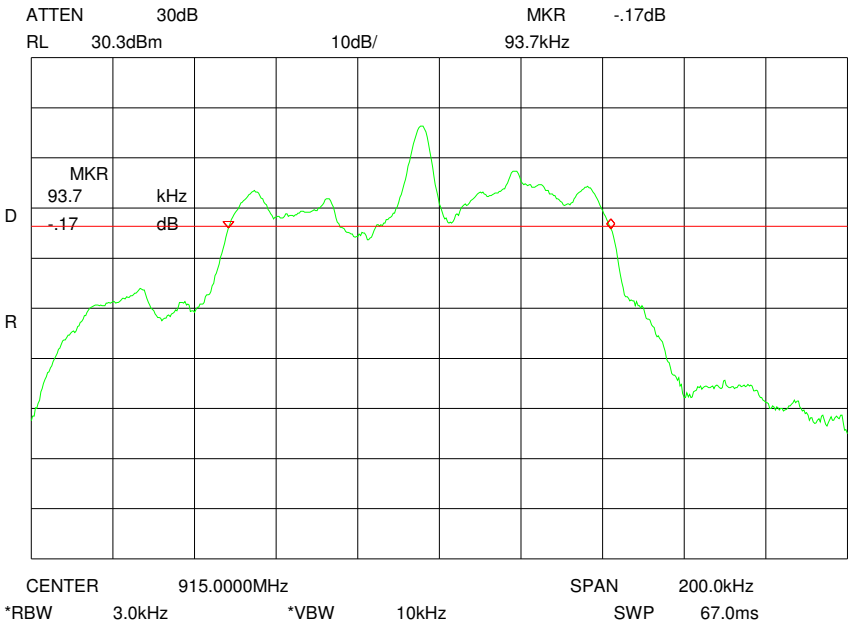
3.2 Spectrum Bandwidth of a FHSS System / 6/20 dB Bandwidth §15.247(a)(1)(i)

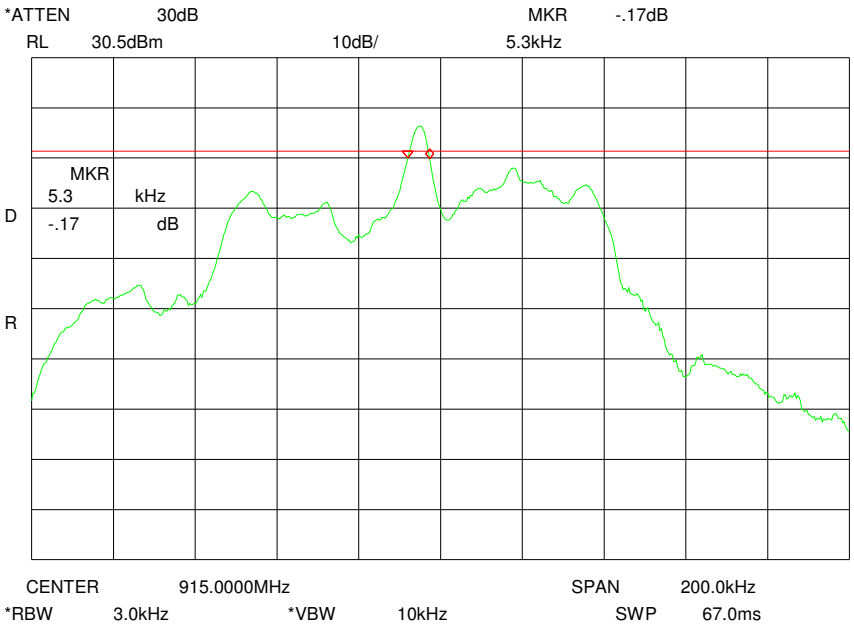
Plot 1/2: low channel 902.75 MHz



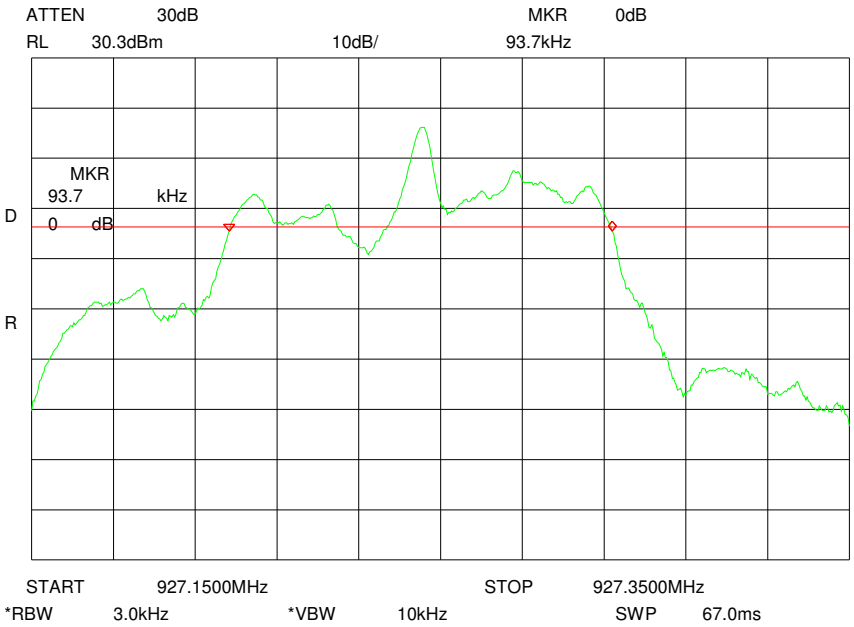


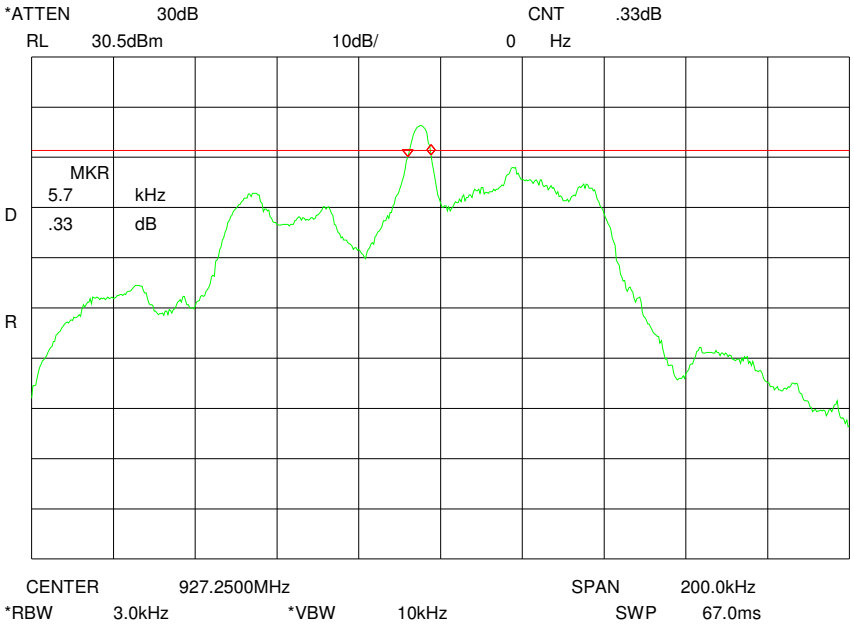
Plot 3/4: mid channel 915.00 MHz





Plot 5/6: high channel 927.25 MHz





Results:

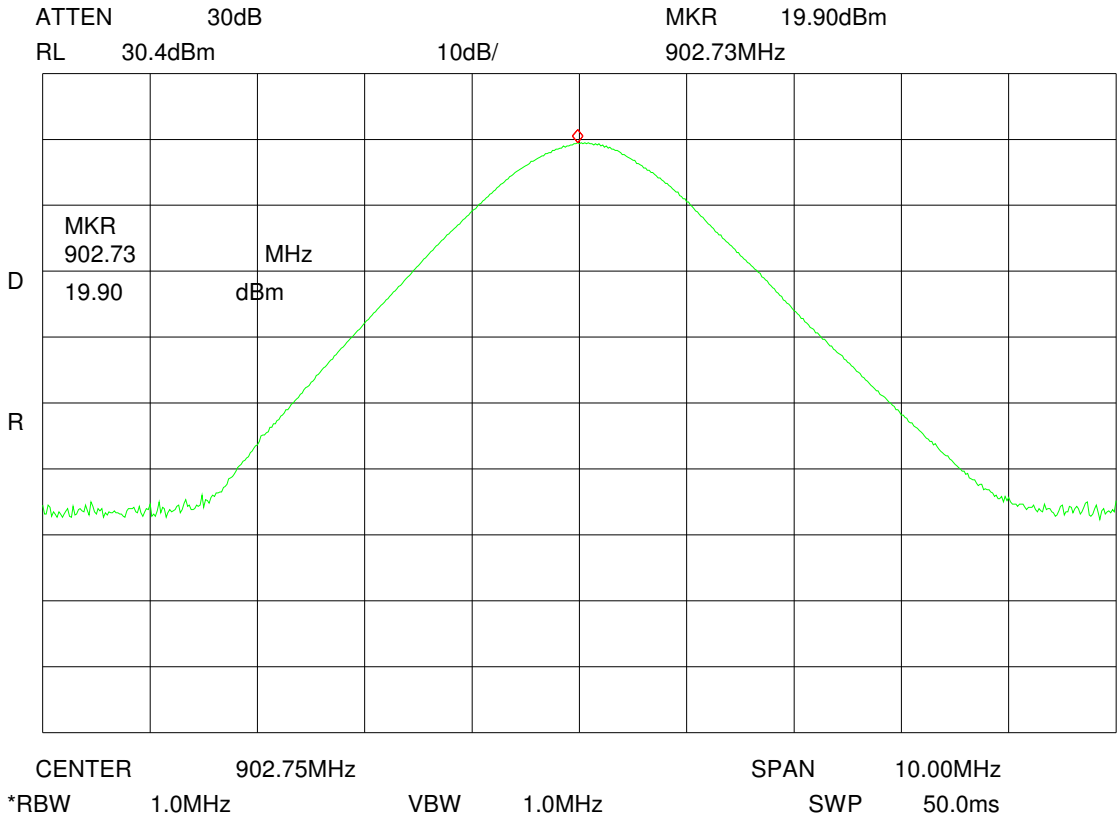
Test conditions	BANDWIDTH [kHz]		
Frequency [MHz]	902.75	915.00	927.25
6 dB Bandwidth	5.3	5.3	5.3
20 dB Bandwidth	94.0	93.7	93.7
Measurement uncertainty	±1kHz		

RBW: 100 kHz / VBW 100 kHz
Limits:

Under normal test conditions only	< 500 kHz

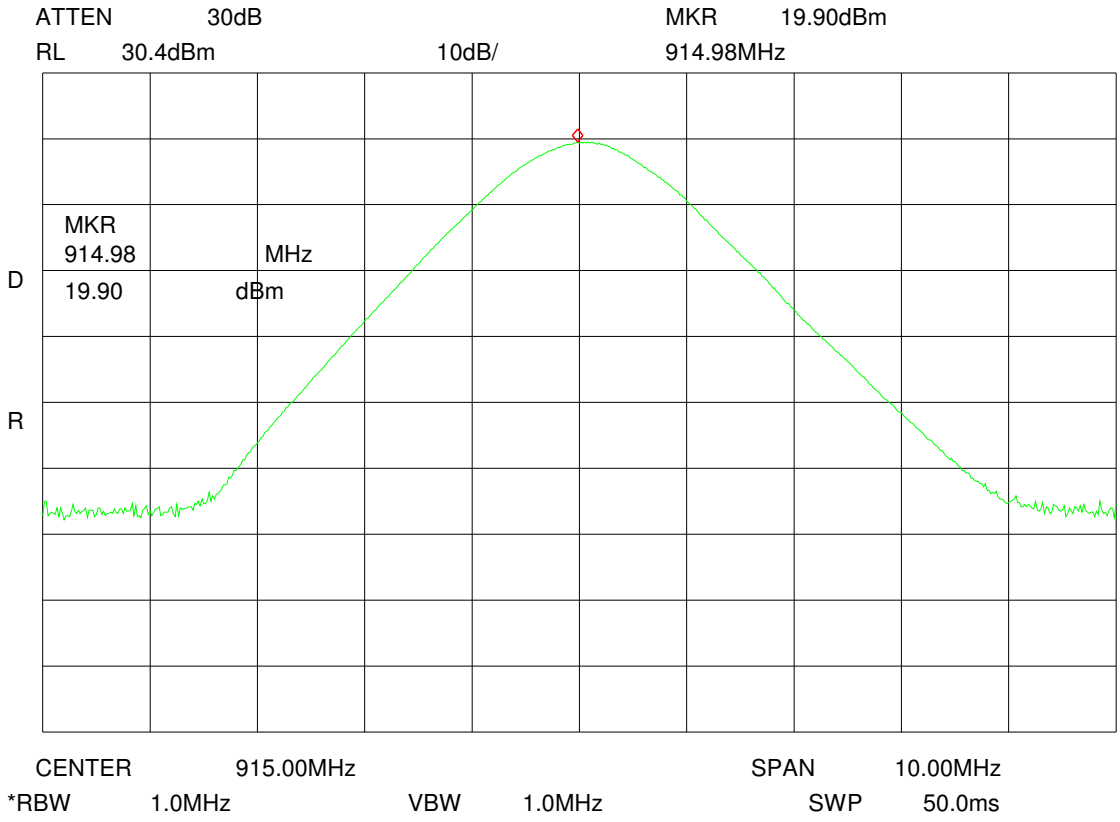
3.3 Maximum output power (conducted) (FHSS) §15.247 (b) (2)

Plot 1: low channel 902.75 MHz



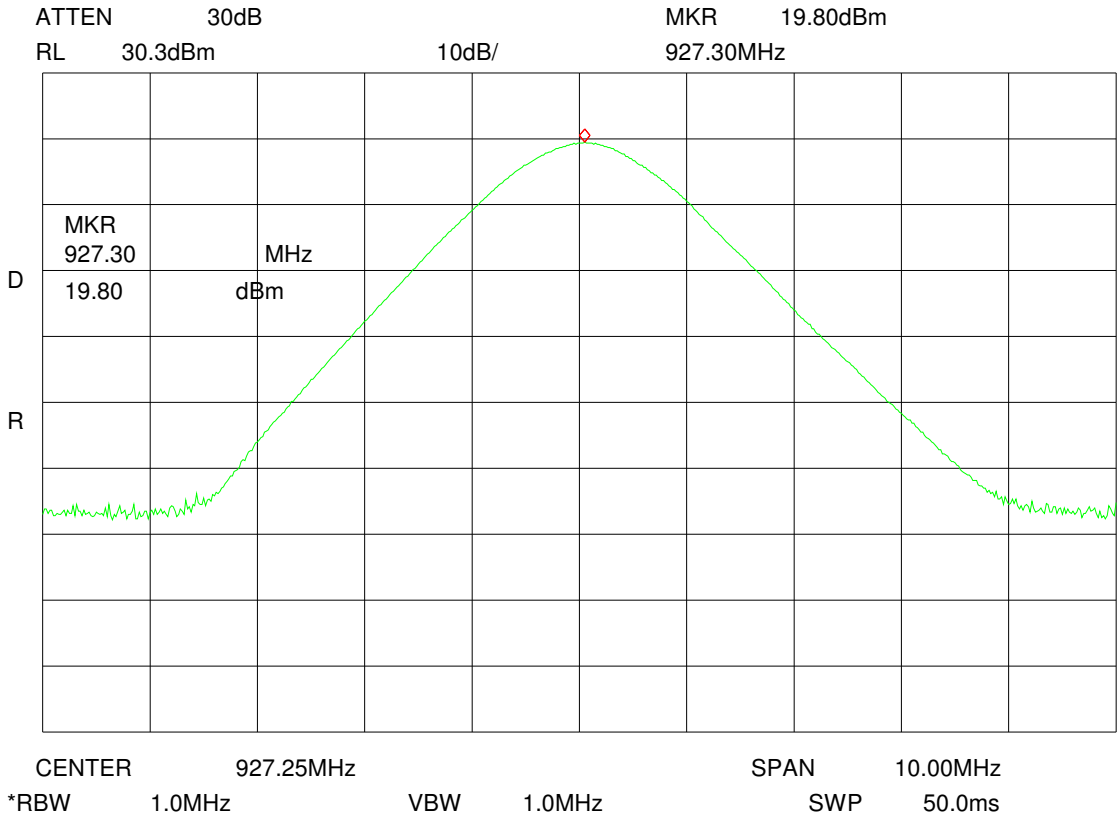
RBW / VBW: 1 MHz

Plot 2: mid channel 915.00 MHz



RBW / VBW: 1 MHz

Plot 3: high channel 927.25 MHz



RBW / VBW: 1 MHz

Results:

Test conditions		Max. output power [dBm]		
Frequency [MHz]		902.75	915.00	927.25
T_{nom}	V_{nom}	19.9	19.9	19.8
Measurement uncertainty		±3 dB		

Limits:

Under normal test conditions only, for frequency range 902 - 928 MHz	Max. 1.0 Watt / 30 dBm

3.4 Max. peak output power (radiated) §15.247 (b) (2)

Results:

Test conditions		Max. peak output power EIRP [dBm]		
Frequency [MHz]		902.75	915.00	927.25
T_{nom}	V_{nom}	19.9 cond 10.7 rad	19.9 cond 7.5 rad	19.8 cond 8.0 rad
Measurement uncertainty		±3 dB		

RBW / VBW: 1 MHz

Limits:

Under normal test conditions only, for frequency range 902 - 928 MHz	Max. 1.0 Watt / 30 dBm

3.5 Spurious Emissions - conducted (Transmitter) §15.247 (d)

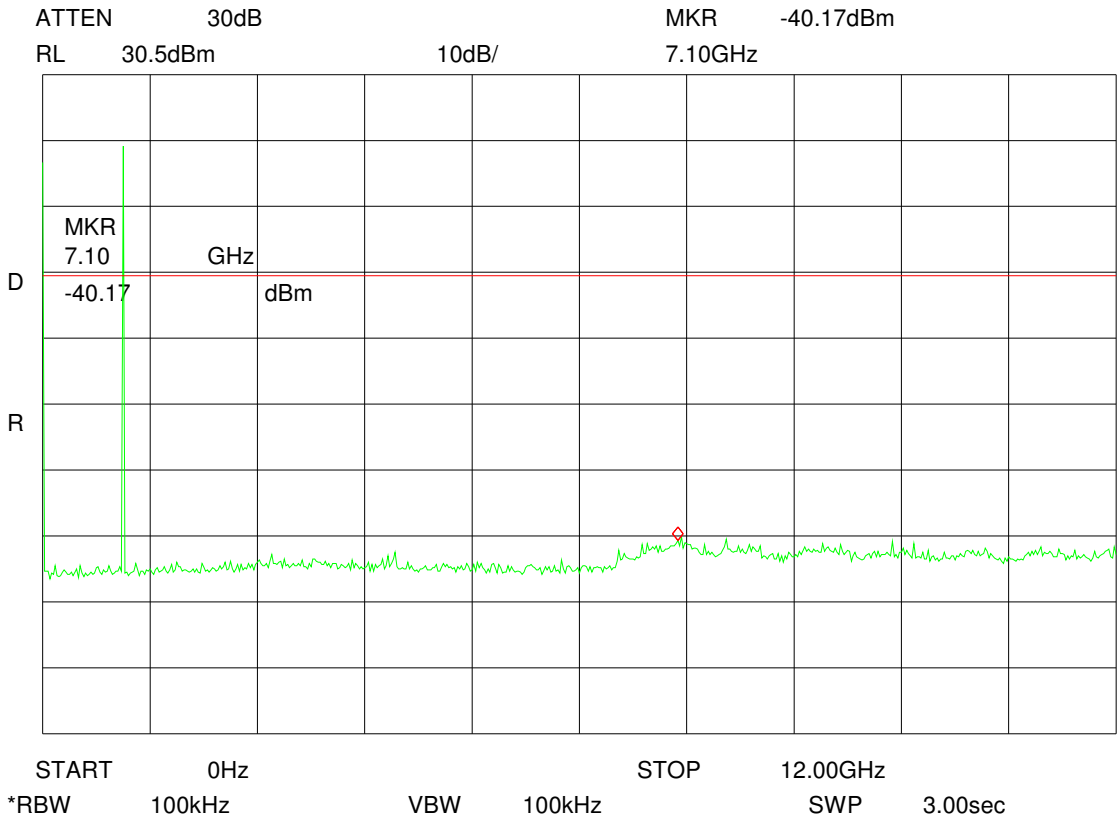
Result & Limits for FHSS

Emission Limitations					
f [MHz]		amplitude of emission [dBm]	limit max. allowed emission power	actual attenuation below frequency of operation [dB]	results
902.75		19.90	30 dBm		Operating frequency
7100		-40.17	-20 dBc	60.07	pass
915.00		19.90	30 dBm		Operating frequency
7080		-41.00	-20 dBc	60.90	pass
927.25		19.80	30 dBm		Operating frequency
7180		-39.50	-20 dBc	59.30	pass
Measurement uncertainty		± 3dB			

RBW: 100 kHz VBW: 100 kHz

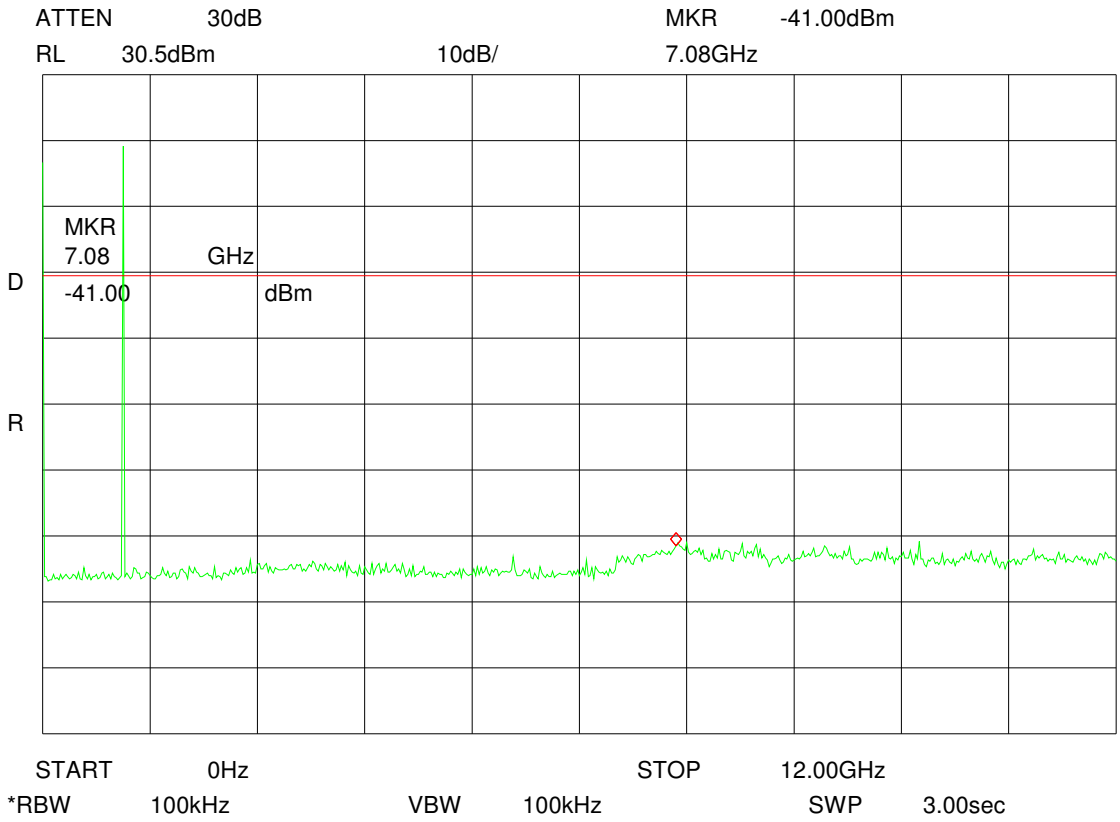
Under normal test conditions only	In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

902.75 MHz



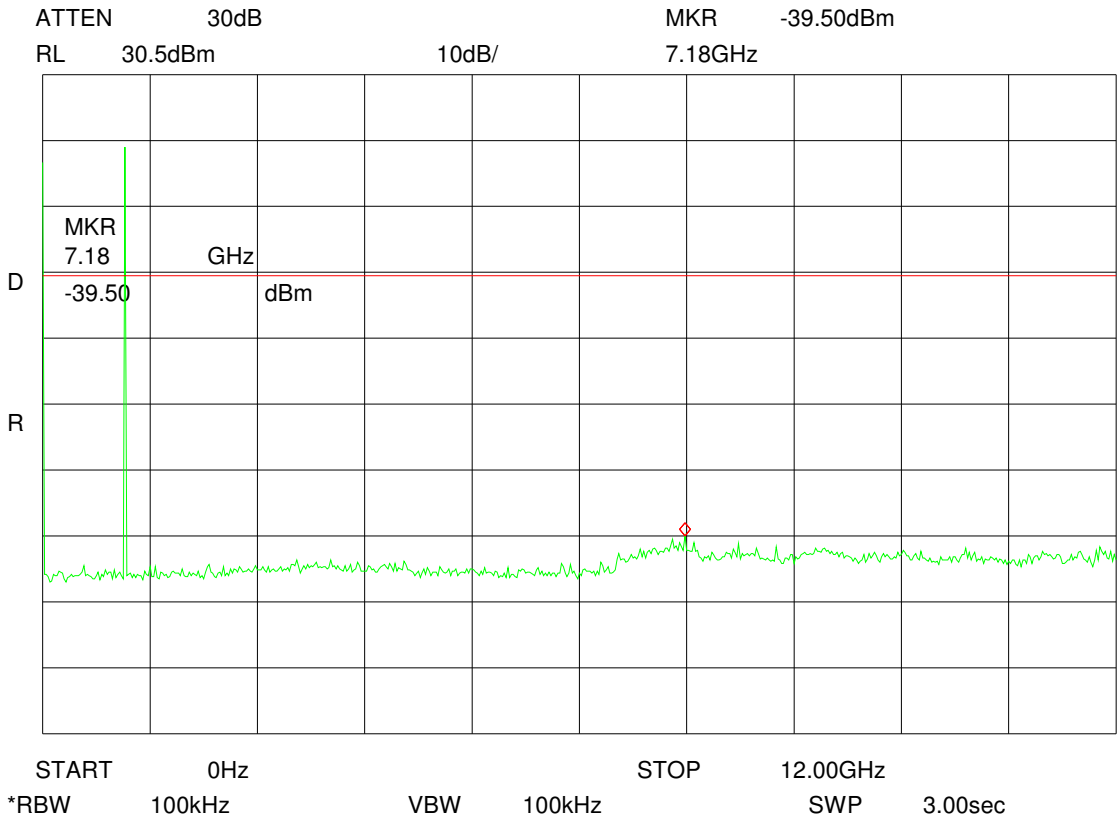
The peak at 902.75 MHz shows the carrier.

915 MHz



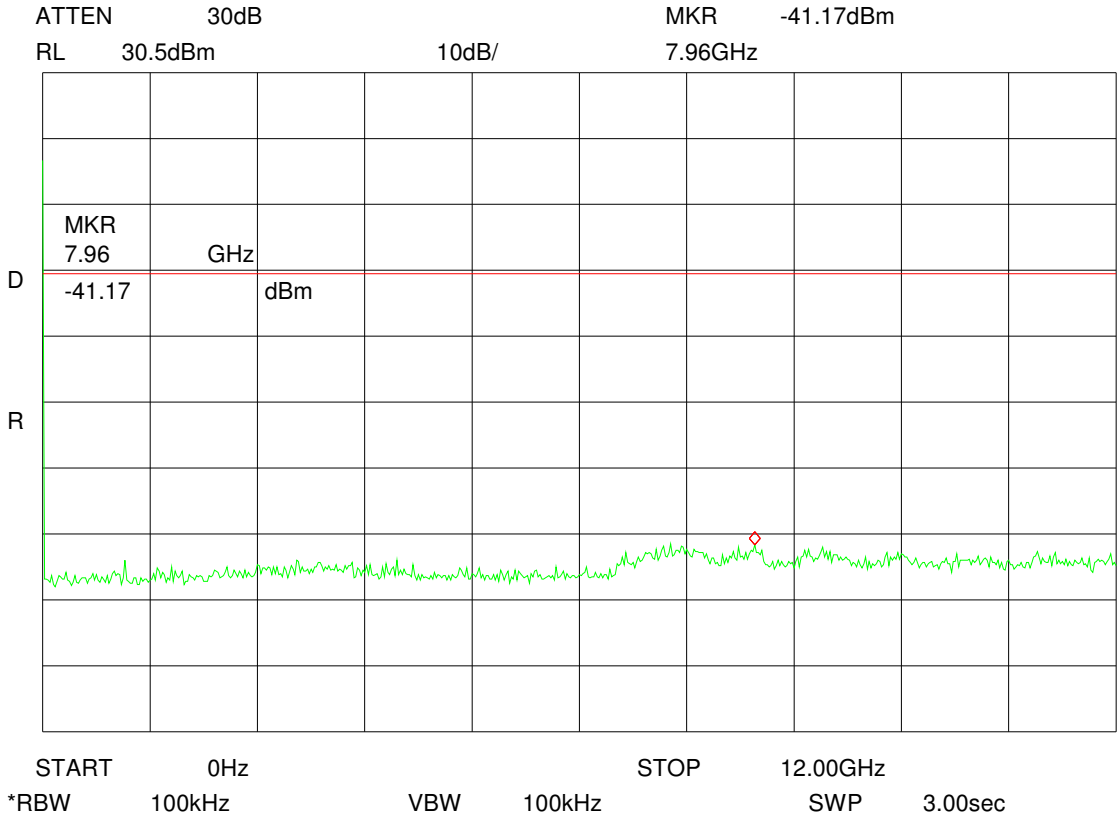
The peak at 915.00 MHz shows the carrier.

927.25 MHz



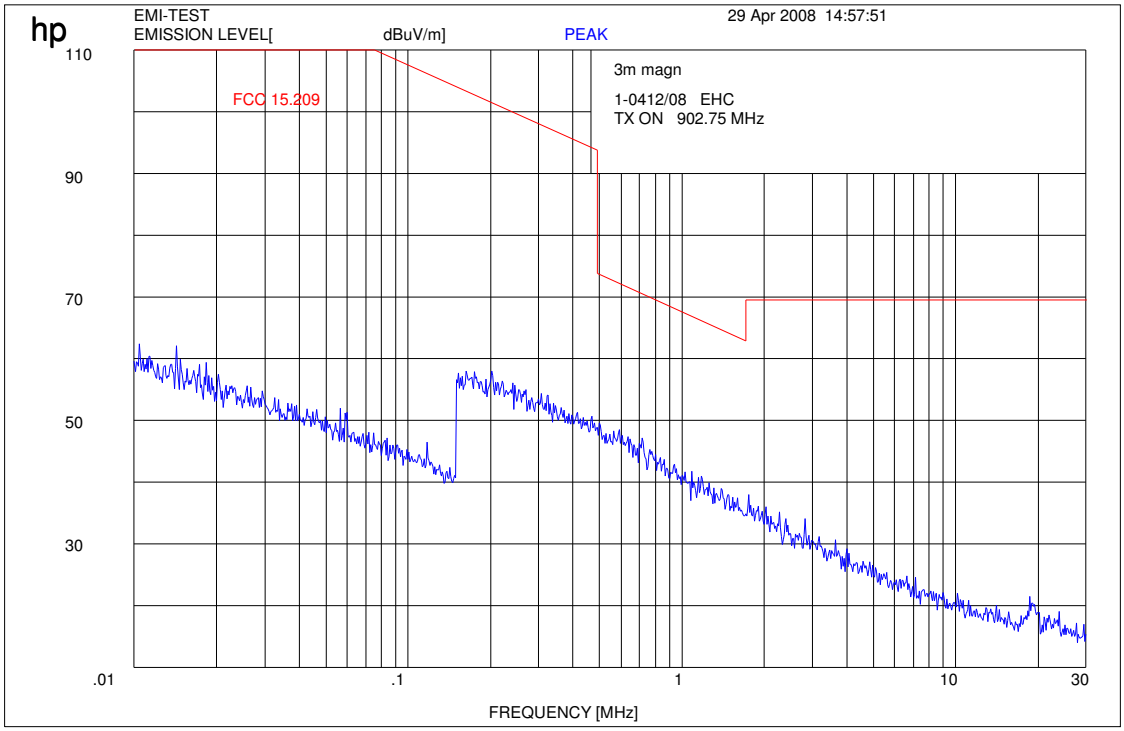
The peak at 927.25 MHz shows the carrier.

Idle Mode

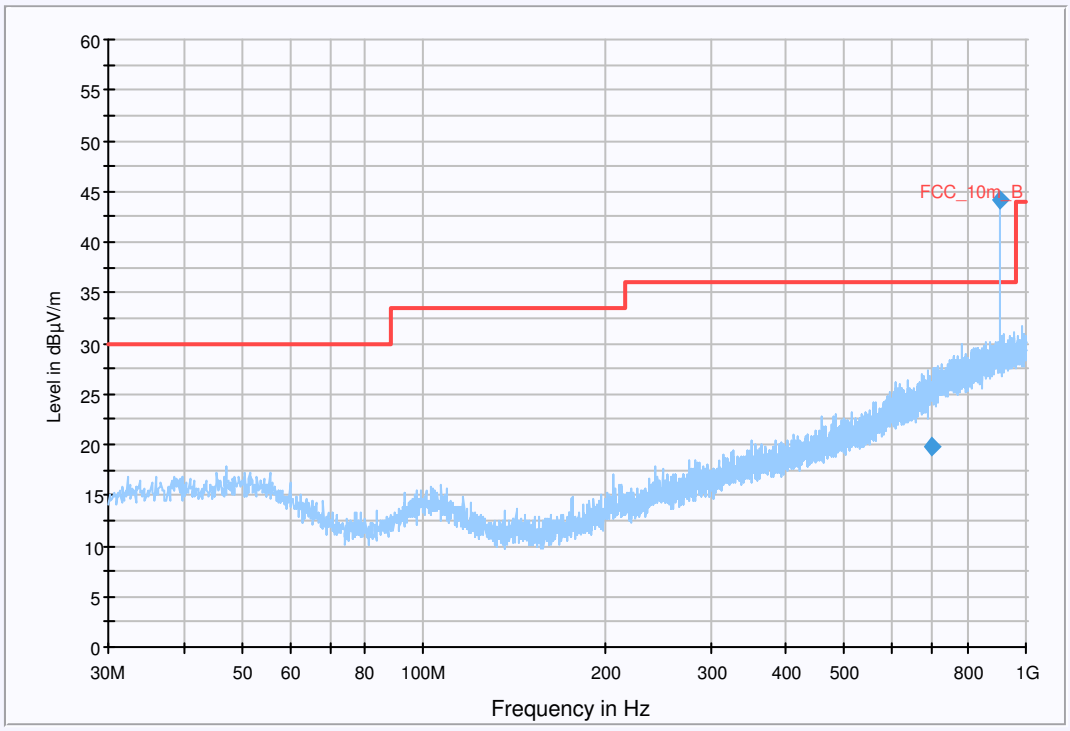

ATTEN 30dB
MKR -41.17dBm
RL 30.5dBm
10dB/
7.96GHz
MKR
7.96 GHz
D
-41.17 dBm
R
START 0Hz
STOP 12.00GHz
*RBW 100kHz
VBW 100kHz
SWP 3.00sec

3.6 Spurious Emissions - radiated (Transmitter) FHSS §15.209

Plot 1: 9 kHz – 30 MHz vertical / horizontal (low channel)



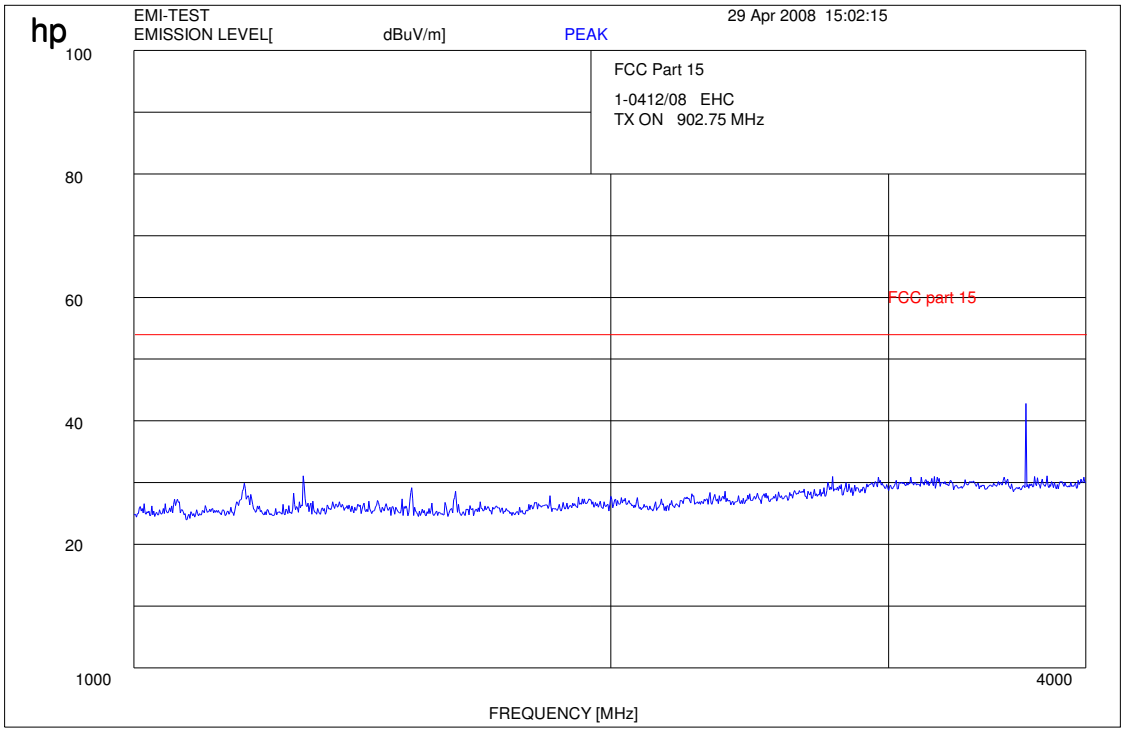
Plot 2: 30 MHz – 1 GHz vertical / horizontal (low channel)



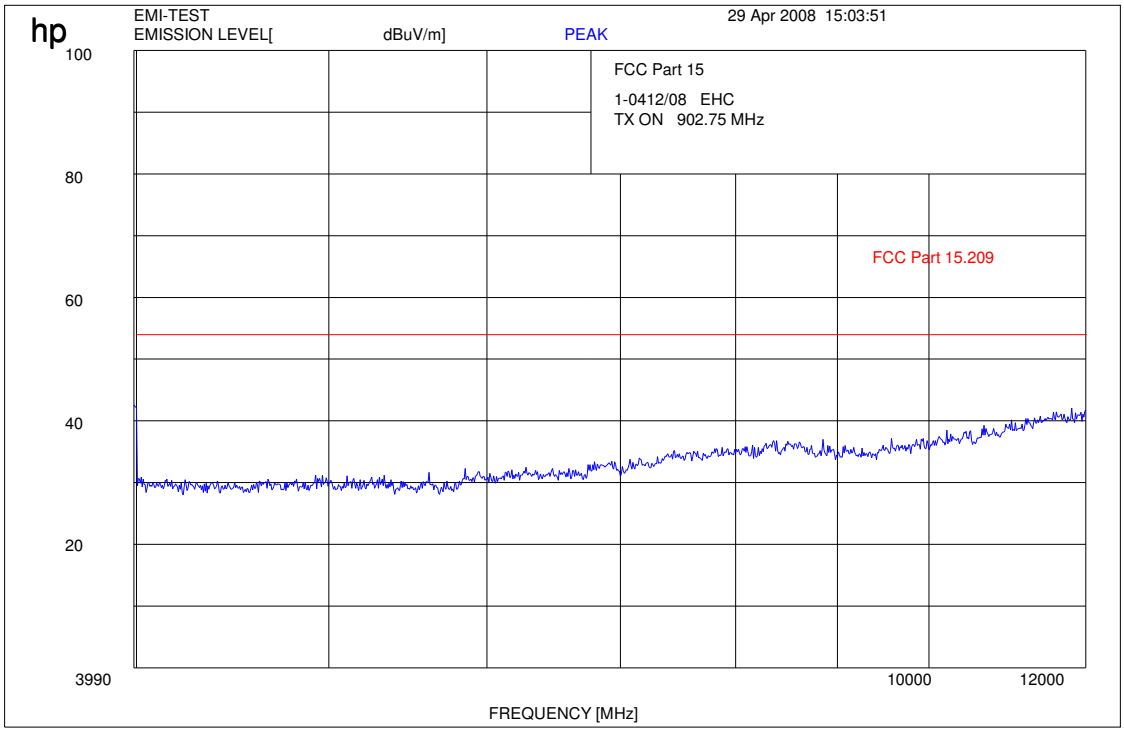
Carrier suppressed with a tunable filter to avoid overload of the preamp.

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
700.406500	19.8	15000.000	120.000	140.0	V	84.0	22.9	16.2	36.0	
902.749600	44.1	15000.000	120.000	100.0	H	334.0	26.1	-8.1	36.0	used band

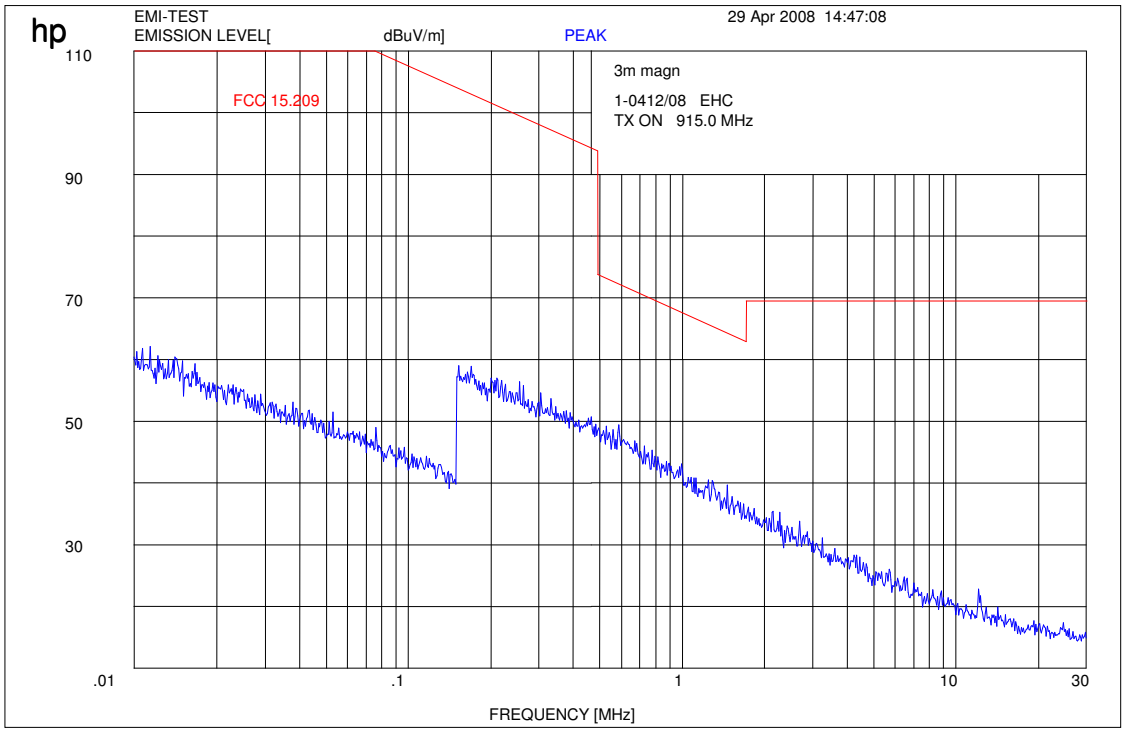
Plot 3: 1 GHz – 4 GHz horizontal / vertical (low channel)



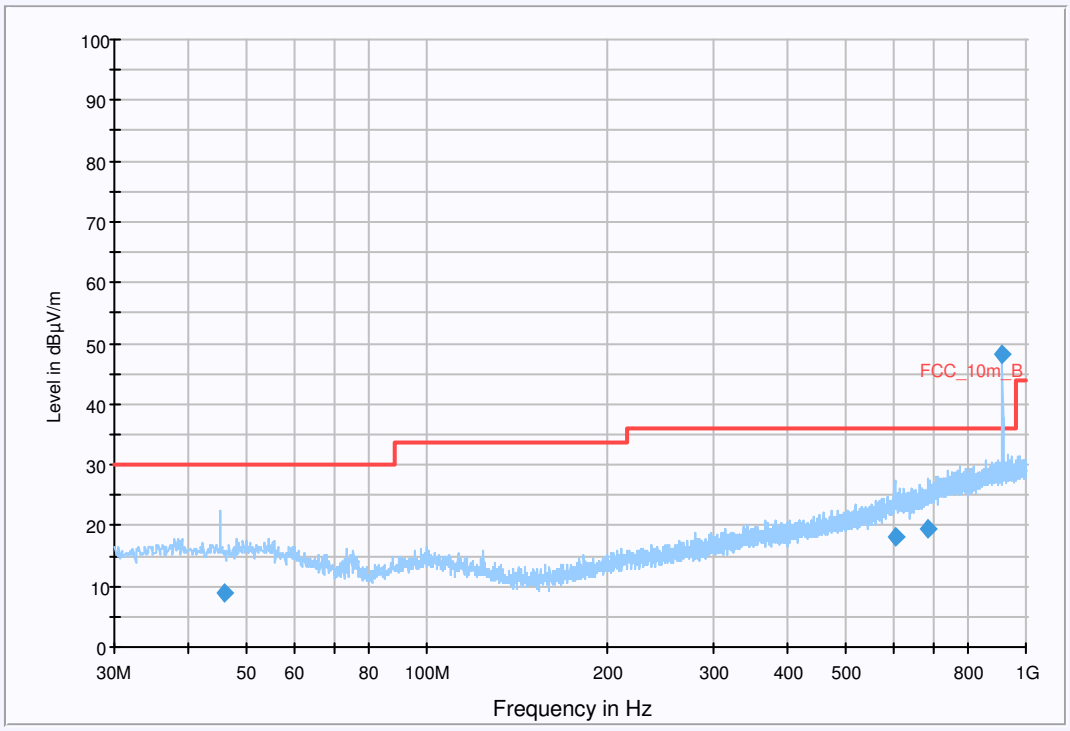
Plot 4: 4 GHz – 12 GHz vertical / horizontal (low channel)



Plot 5: 9 kHz – 30 MHz vertical / horizontal (mid channel)



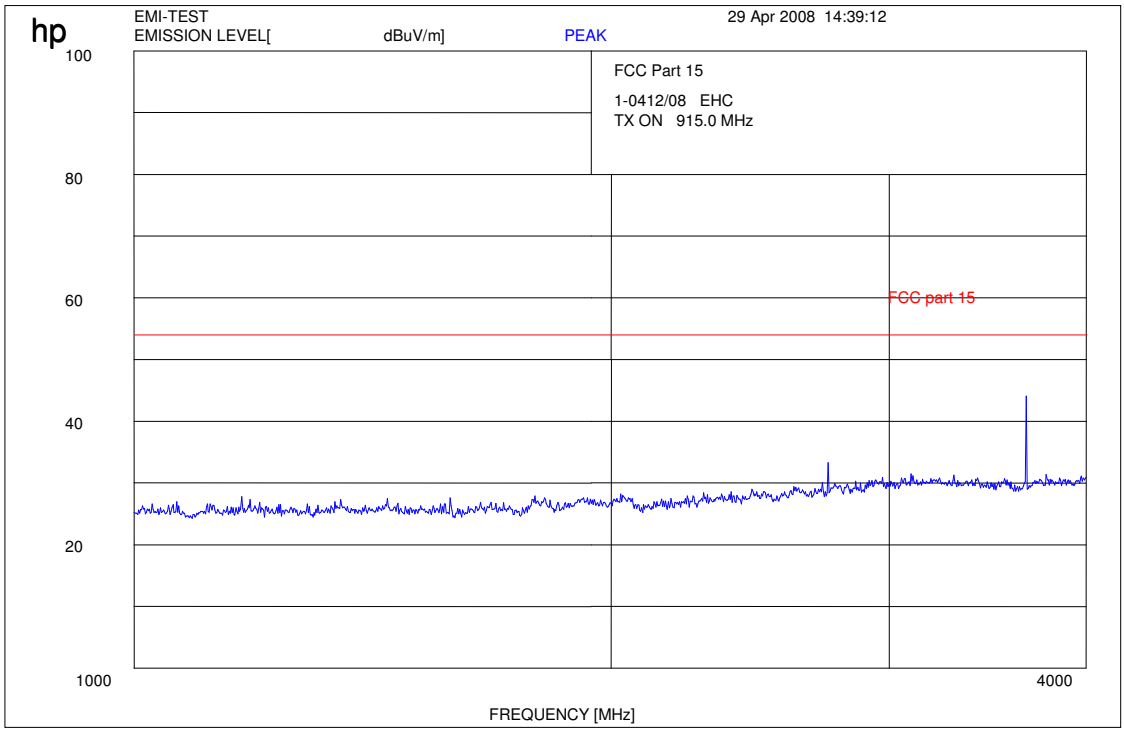
Plot 6: 30 MHz – 1 GHz vertical / horizontal (mid channel)



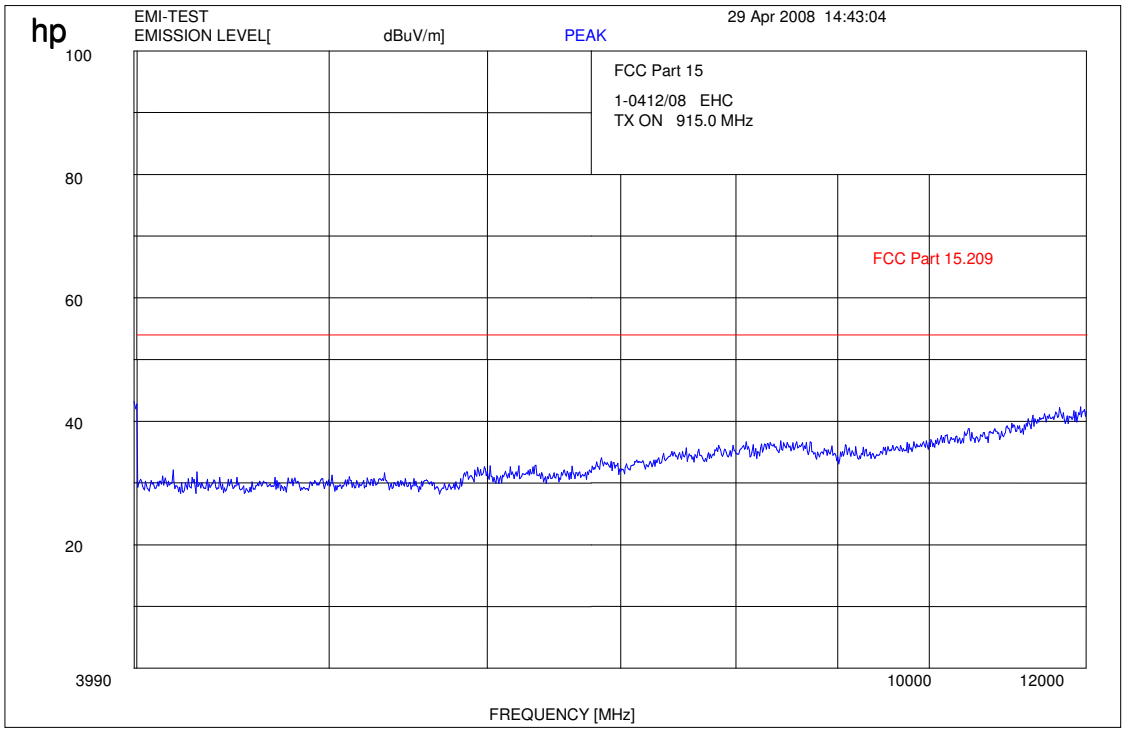
Carrier suppressed with a tunable filter to avoid overload of the preamp.

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
45.661150	9.0	15000.000	120.000	171.0	V	292.0	13.5	21.0	30.0	
603.996750	18.1	15000.000	120.000	292.0	V	34.0	21.1	17.9	36.0	
685.425850	19.4	15000.000	120.000	318.0	V	64.0	22.5	16.6	36.0	
914.995250	48.2	15000.000	120.000	120.0	H	223.0	26.2	12.2	36.0	Used band

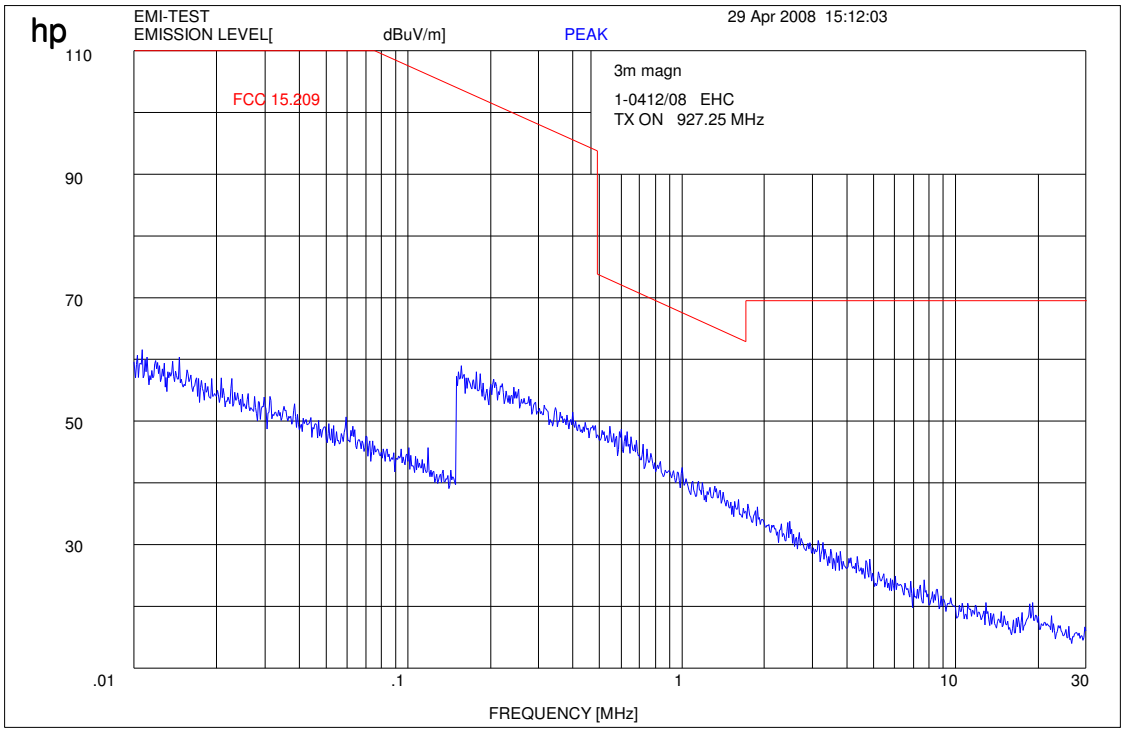
Plot 7: 1 GHz – 4 GHz vertical / horizontal (mid channel)



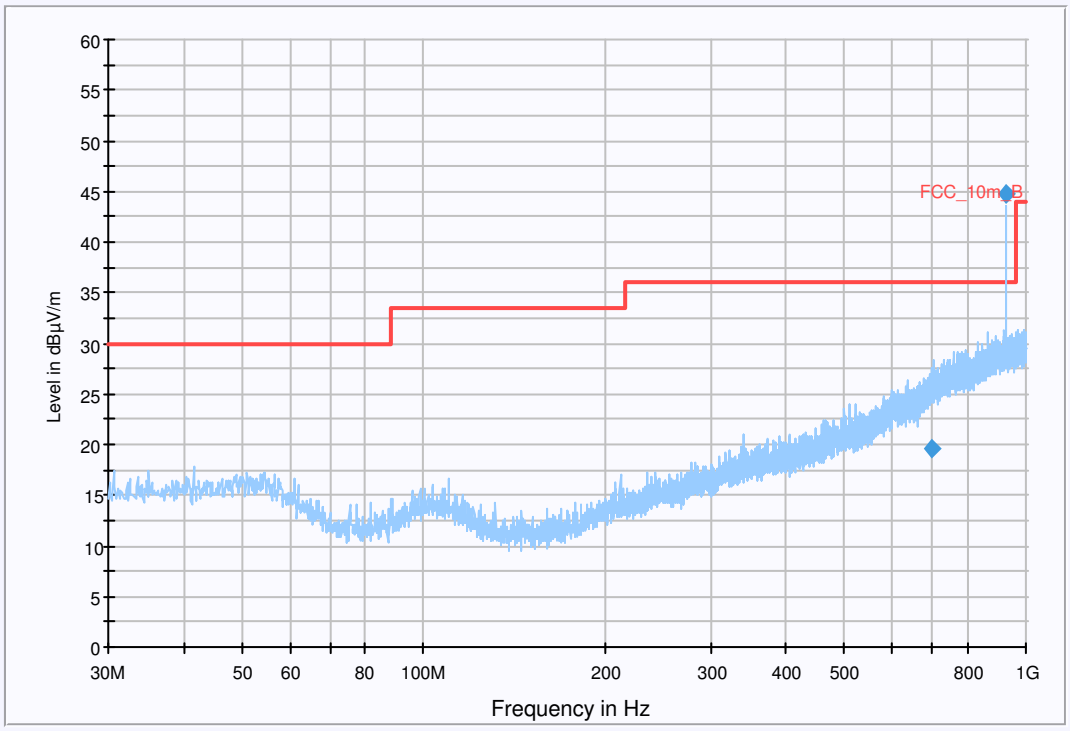
Plot 8: 4 GHz – 12 GHz vertical / horizontal (mid channel)



Plot 9: 9 kHz – 30 MHz vertical / horizontal (high channel)



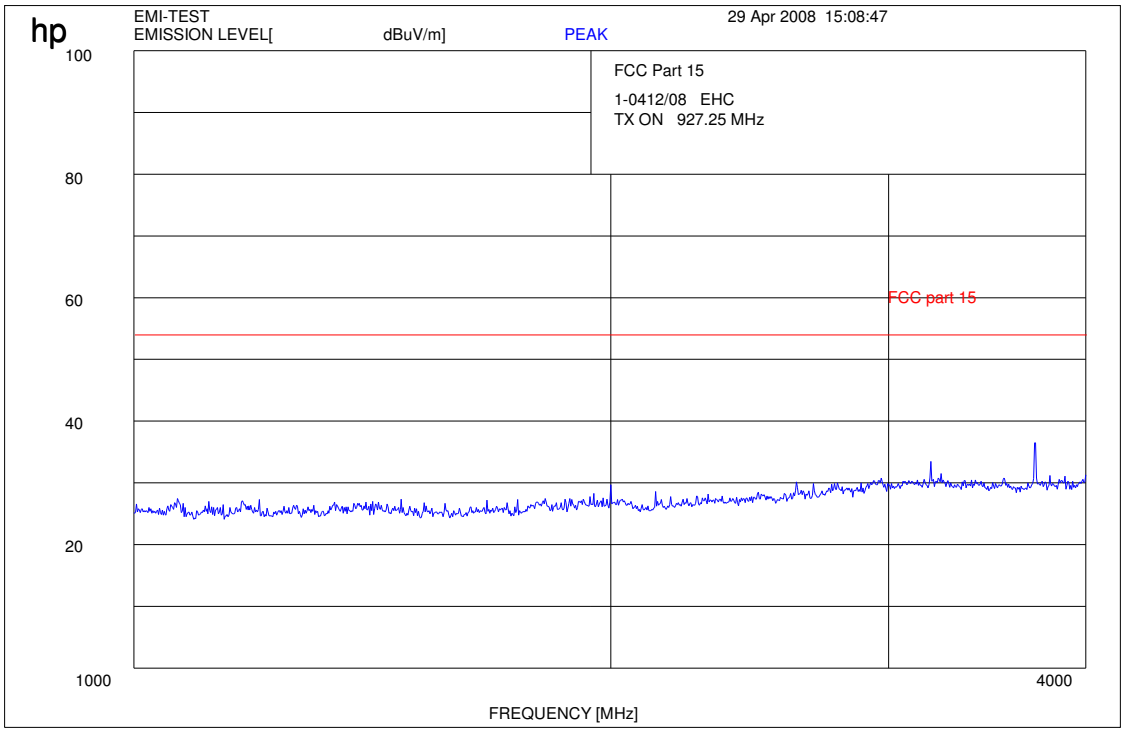
Plot 10: 30 MHz – 1 GHz vertical / horizontal (high channel)



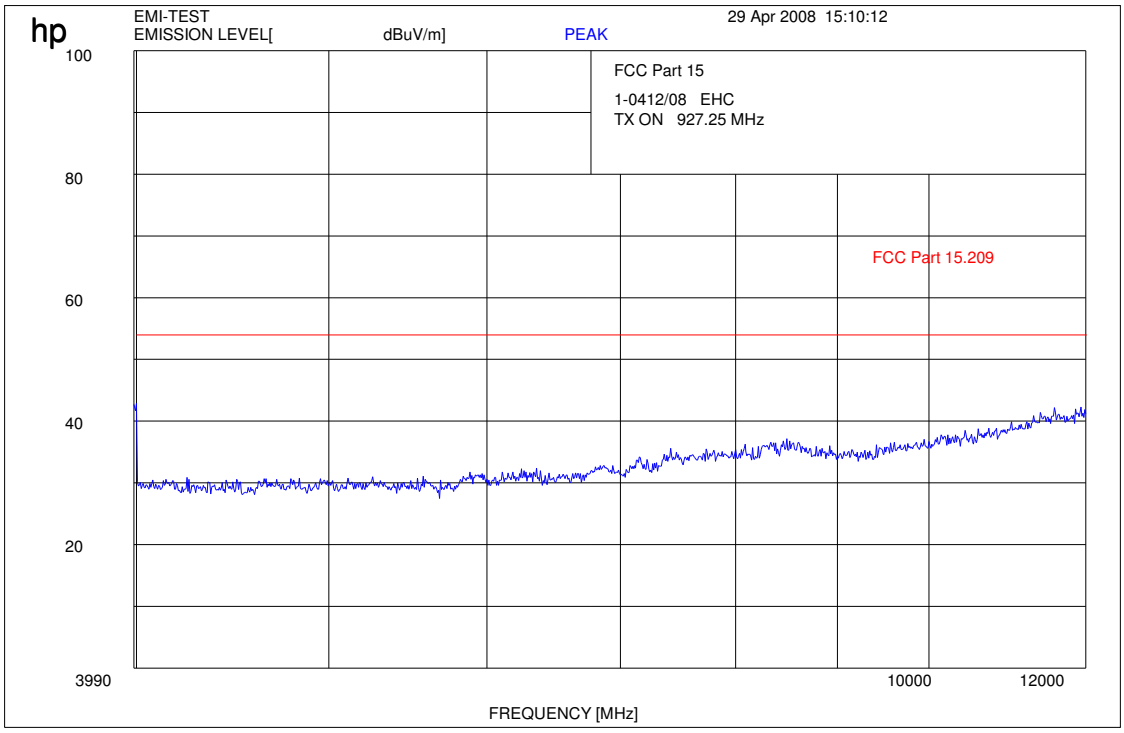
Carrier suppressed with a tunable filter to avoid overload of the preamp.

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
695.551450	19.7	15000.000	120.000	200.0	V	83.0	22.8	16.3	36.0	
927.242650	44.8	15000.000	120.000	114.0	H	334.0	26.3	-8.8	36.0	Used band

Plot 11: 1 GHz – 4 GHz vertical / horizontal (high channel)



Plot 12: 4 GHz – 12 GHz vertical / horizontal (high channel)



Results:

SPURIOUS EMISSIONS LEVEL §15.209								
902.75 MHz			915.00 MHz			927.25 MHz		
F [MHz]	Detector	Level [dBµV/m]	F [MHz]	Detector	Level [dBµV/m]	F [MHz]	Detector	Level [dBµV/m]
< Limit (see plots above)			< Limit (see plots above)			< Limit (see plots above)		
Measurement uncertainty			±3 dB					

f < 1 GHz: RBW/VBW: 100 kHz f ≥ 1GHz: RBW/VBW: 1 MHz

Limits: § 15.247 (c)

In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

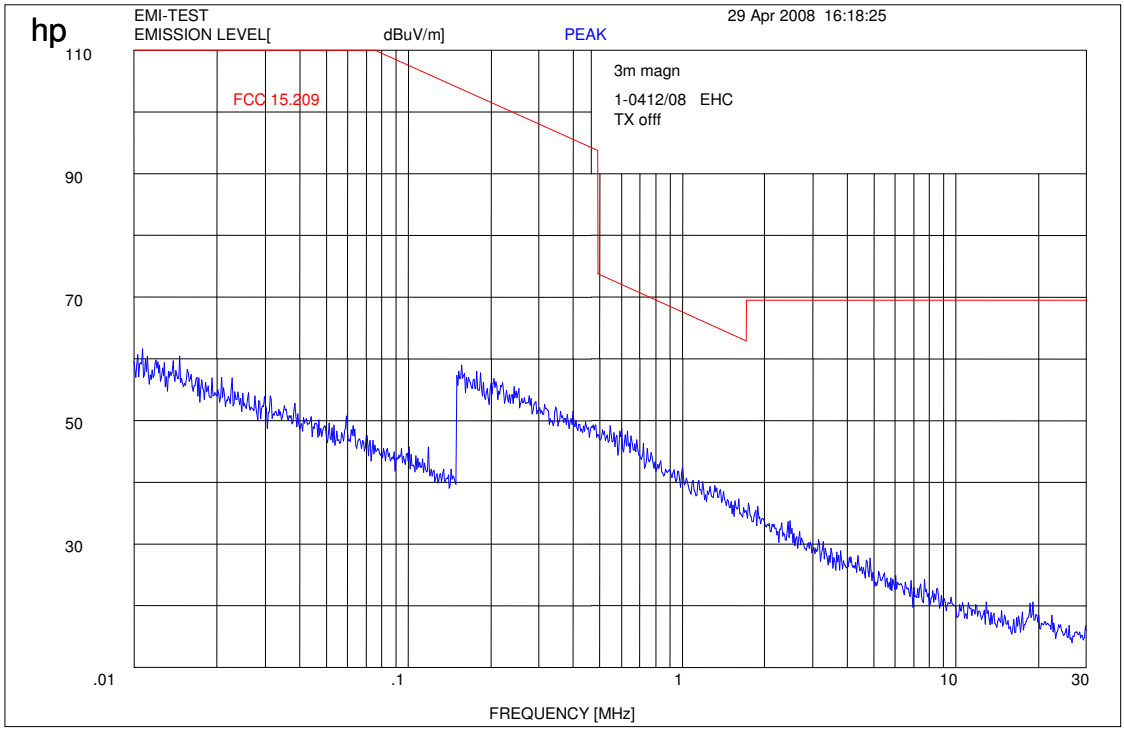
Limits: § 15.209

Frequency [MHz]	Field strength [µV/m]	Measurement distance (m)
0.009 – 0.490	2400 / F(kHz)	300
0.490 – 1.705	24000 / F(kHz)	30
1.705 – 30.0	30	30
30 - 88	100 (40 dBµV/m)	3
88 - 216	150 (43.5 dBµV/m)	3
216 - 960	200 (46 dBµV/m)	3
above 960	500 (54 dBµV/m)	3

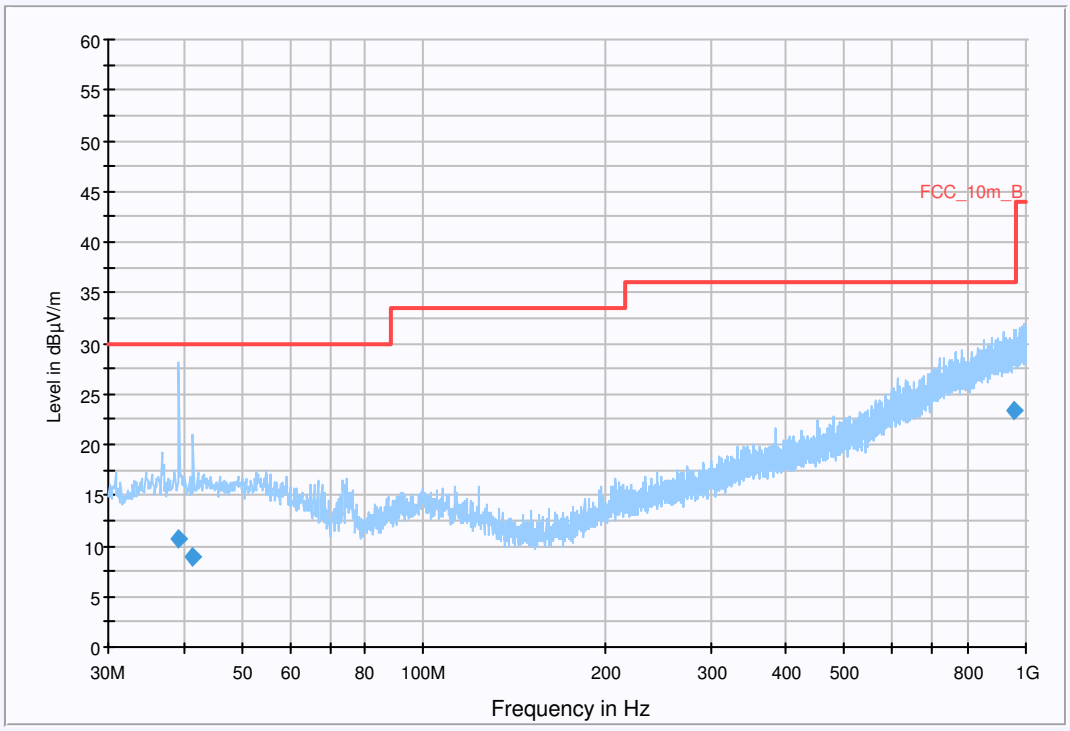
3.7 Spurious Emissions - radiated (Receiver) §15.109 / 209

Idle Mode, Carrier off

Plot 1: 9 kHz – 30 MHz vertical / horizontal (receiver)

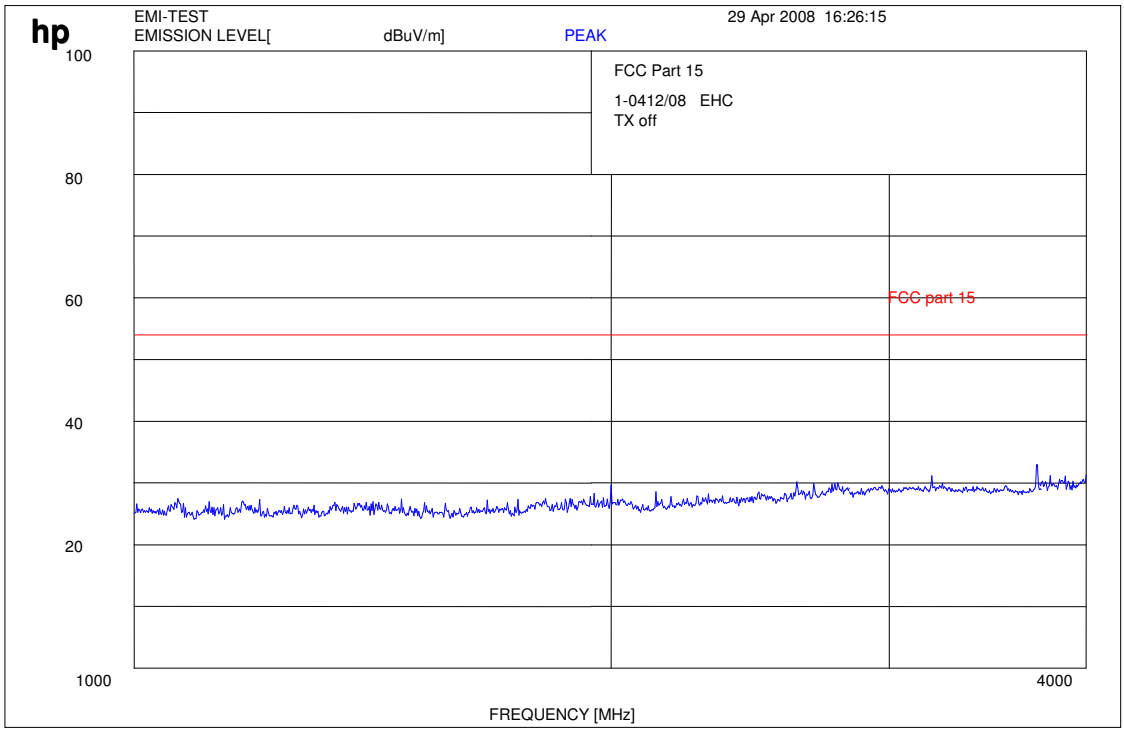


Plot 2: 30 MHz – 1 GHz (receiver)

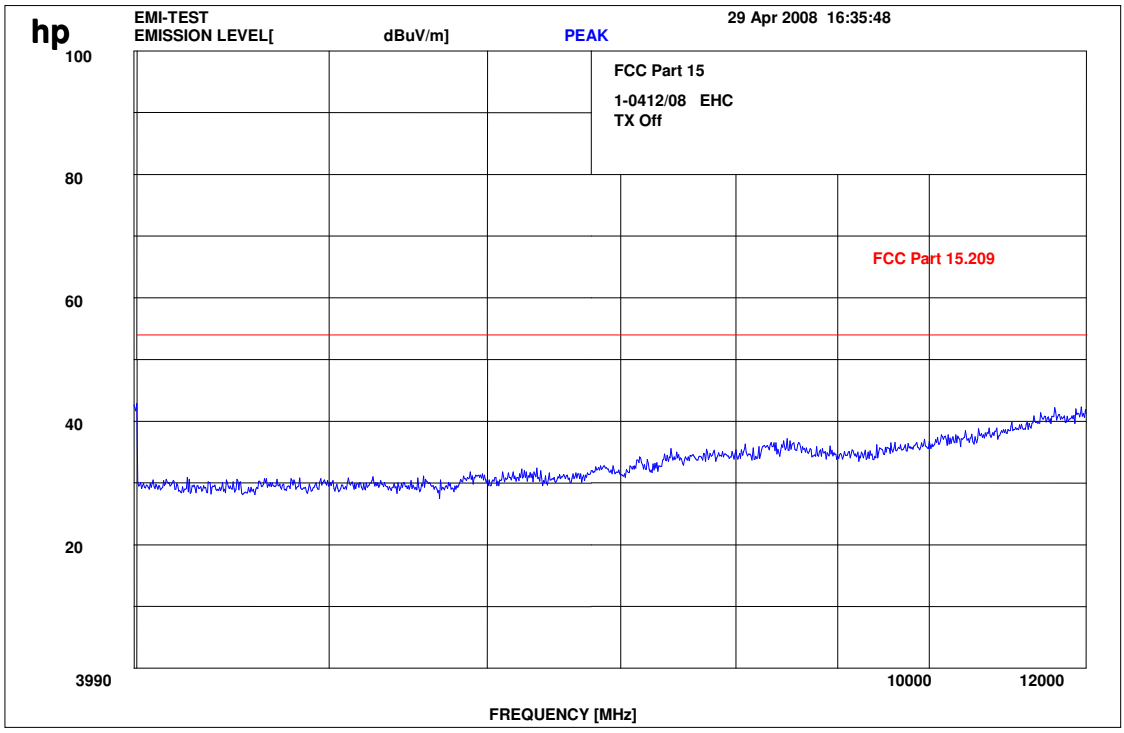


Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
39.288850	10.6	15000.000	120.000	153.0	V	220.0	13.6	19.4	30.0	
41.529100	9.0	15000.000	120.000	400.0	H	314.0	13.6	21.0	30.0	
...	...	...	...	...	...	...	...	...	...	...

Plot 3: 1 GHz – 4 GHz vertical / horizontal (receiver)



Plot 4: 4 GHz – 12 GHz vertical / horizontal (receiver)



Results:

Spurious Emissions level [µV/m]			
f[MHz]	Detector	Level [µV/m]	
< Limit (see plots above)			
Measurement uncertainty			±3 dB

f < 1 GHz: RBW/VBW: 100 kHz f ≥ 1GHz: RBW/VBW: 1 MHz

Measurement distance see table

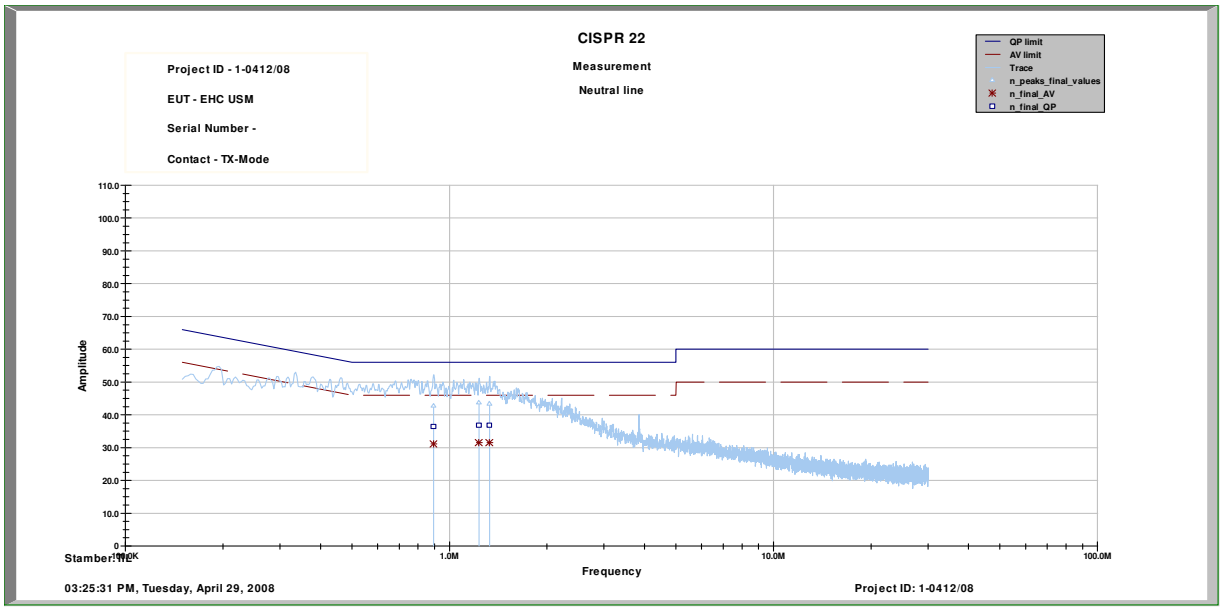
Limits: § 15.109 / 209

Frequency (MHz)	Field strength (µV/m)	Measurement distance (m)
0.009 – 0.490	2400 / F(kHz)	300
0.490 – 1.705	24000 / F(kHz)	30
1.705 – 30.0	30	30
30 - 88	100 (40 dBµV/m)	3
88 - 216	150 (43.5 dBµV/m)	3
216 - 960	200 (46 dBµV/m)	3
above 960	500 (54 dBµV/m)	3

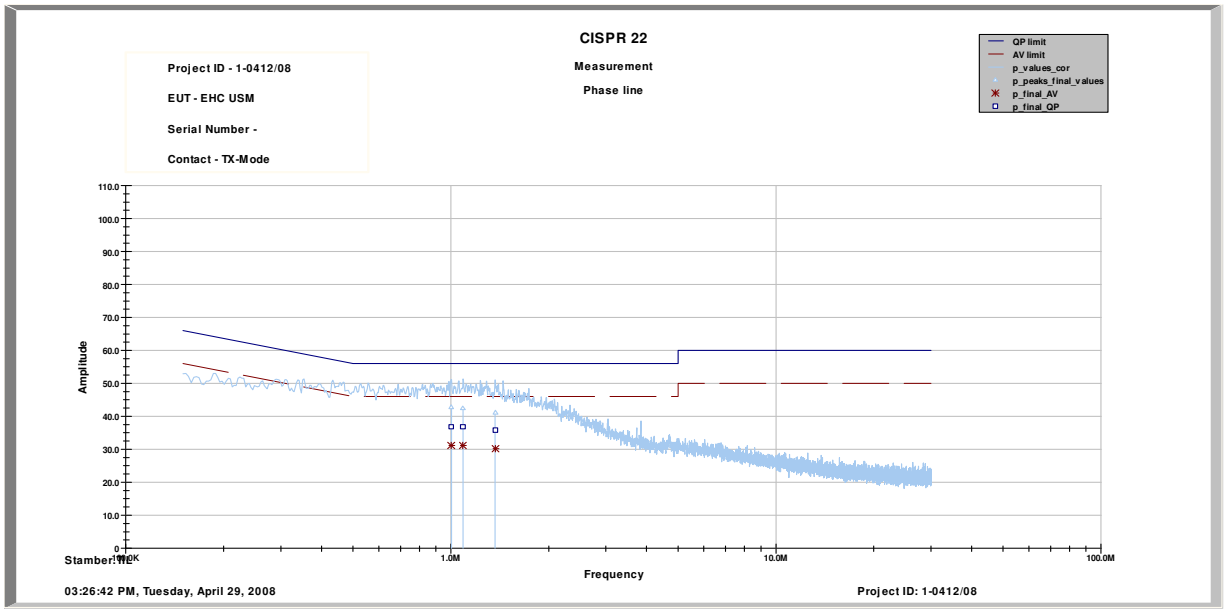
3.8 Conducted Emissions <30 MHz §15.107/207

TX Mode Mid Channel

Plot 1: Neutral Line

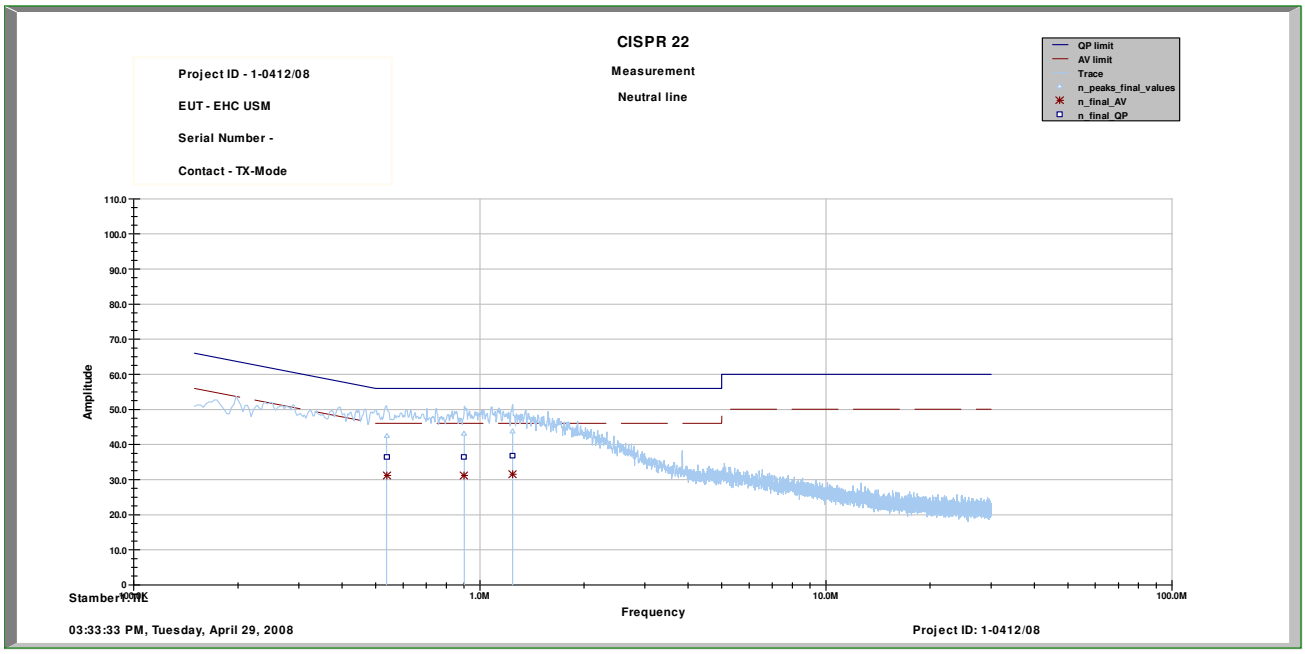


Plot 2: Phase Line

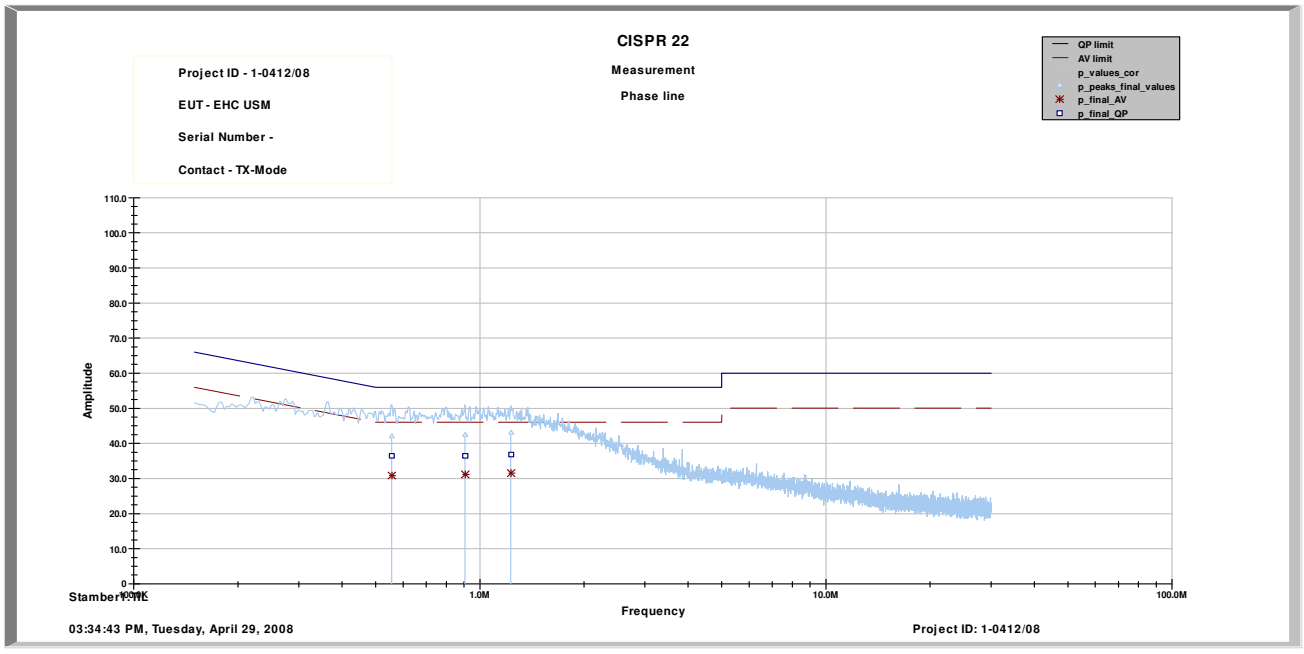


Idle Mode

Plot 3: Neutral Line



Plot 4: Phase Line



Limits:

Under normal test conditions only	See plots

3.9 Frequency Stability

TEST CONDITIONS		FREQUENCY			
		Channel 1			
		915.000 MHz			
T nom = -20°C	V nom = 5.0 V DC	914.999 MHz			
T nom = -10°C	V nom = 5.0 V DC	914.999 MHz			
T nom = 0°C	V nom = 5.0 V DC	914.999 MHz			
T nom = 10°C	V nom = 5.0 V DC	914.998 MHz			
T nom = 20°C	V nom = 5.0 V DC	914.997 MHz			
T nom = 30°C	V nom = 5.0 V DC	914.995 MHz			
T nom = 40°C	V nom = 5.0 V DC	914.994 MHz			
T nom = 50°C	V nom = 5.0 V DC	914.993 MHz			
Maximum freq. error (kHz) / ppm		-7.0 kHz / -7.7 ppm			
Measurement uncertainty		$<1x10^{-7}$			

The test was performed with the EUT placed in a climatic chamber connected to a frequency counter. The EUT was sending a CW signal.

Under normal and environmental test conditions	

3.10 Used Test Equipment

Anechoic chamber C:

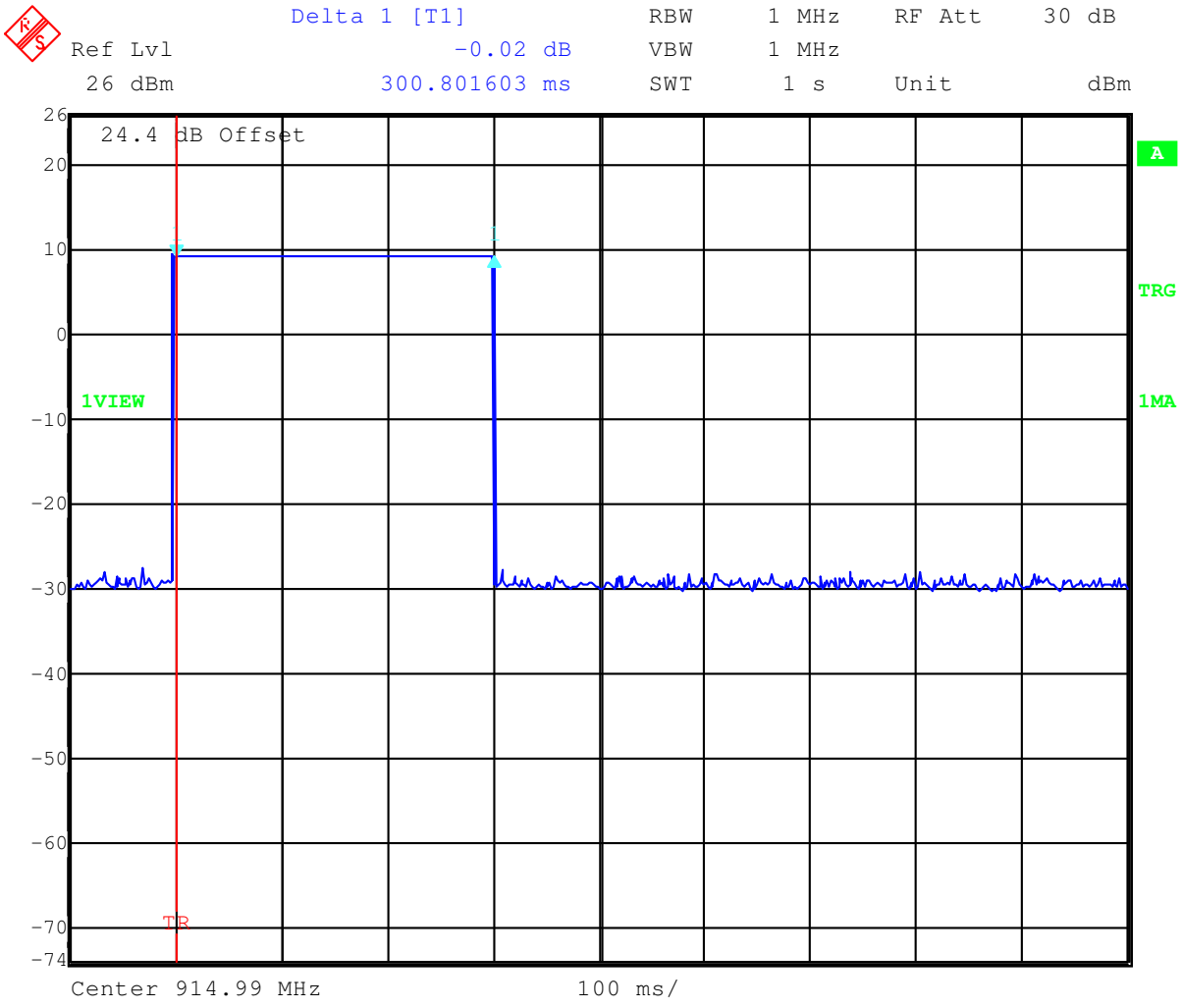
No	Equipment/Type	Manuf.	Serial Nr.	Inv. No. Cetecom	Last Calibration	Frequency (months)	Next Calibration
1	Anechoic chamber	MWB	87400/02	300000996	Monthly verification		
2	System-Rack 85900	HP I.V.	*	300000222	n.a.		
3	Measurement System 1						
4	Spektrum Analyzer 8566B	HP	2747A05306	300001000	05.10.2006	24	05.10.2008
5	Spektrum Analyzer Display 85662A	HP	2816A16541	300002297	05.10.2006	24	05.10.2008
6	Quasi-Peak-Adapter 85650A	HP	2811A01131	300000999	05.10.2006	24	05.10.2008
7	RF-Preselector 85685A	HP	2837A00779	300000218	08.11.2006	24	08.11.2008
8	PC Vectra VL	HP		300001688	n.a.		
9	Software EMI	HP		300000983	n.a.		
10	Measurement System 2						
11	FSP 30	R&S	100623	ICT 300003464	05.10.2007	24	15.10.2009
12	PC	F+W			n.a.		
13	TILE	TILE			n.a.		
14	Biconical antenna	EMCO	S/N: 860 942/003		Monthly verification (System cal.)		
15	Log. Period. Antenna 3146	EMCO	2130	300001603	Monthly verification (System cal.)		
16	Double Ridged Antenna HP 3115P	EMCO	3088	300001032	Monthly verification (System cal.)		
17	Active Loop Antenna 6502	EMCO	2210	300001015	Monthly verification (System cal.)		
18	Power Supply 6032A	HP	2818A03450	300001040	12.05.2007	36	12.05.2010
19	Busisolator	Kontron		300001056	n.a.		
20	Leitungsteiler 11850C	HP		300000997	Monthly verification (System cal.)		
21	Power attenuator 8325	Byrd	1530	300001595	Monthly verification (System cal.)		
22	Band reject filter WRCG1855/1910	Wainwright	7	300003350	Monthly verification (System cal.)		
23	Band reject filter WRCG2400/2483	Wainwright	11	300003351	Monthly verification (System cal.)		

RiFu Laboratory:

No.	Instrument/Ancillary	Manufacturer	Type	Serial-No.	Internal identification
1	Spectrum Analyzer	HP	8565E	--	300001665
2	Frequency Counter	HP	5351B	--	300000893
3	Power Supply	Heiden	1108-32	--	300001392
4	Div. Cables	Huber & Suhner	--	--	--
5	Climatic Chamber	Voetsch	VT4002	--	300003019

Anechoic chamber F:

No.	Instrument/Ancillary	Manufacturer	Type	Serial-No.	Internal identification
F-6	Control Computer	F+W		FW0502032	300003303
F-7	Bilog antenna	Chase	CBL 6112A	2110	300000573
F-8a	Amplifier	Veritech Microwave Inc.	0518C-138	- / -	- / -
F-9b	Switch	HP	3488A	- / -	300000368
F-10	EMI Test receiver	R&S	ESCI	100083	300003312
F-11	Turntable Controller	EMCO	1061 3M	1218	300000661
F-12	Tower Controller	EMCO	1051 Controller	1262	300000625
F-13	Tower	EMCO	1051 Tower	1262	300000625
F-14	Ultra Notch-Filter Rejected band Ch. 62	WRCD		9	



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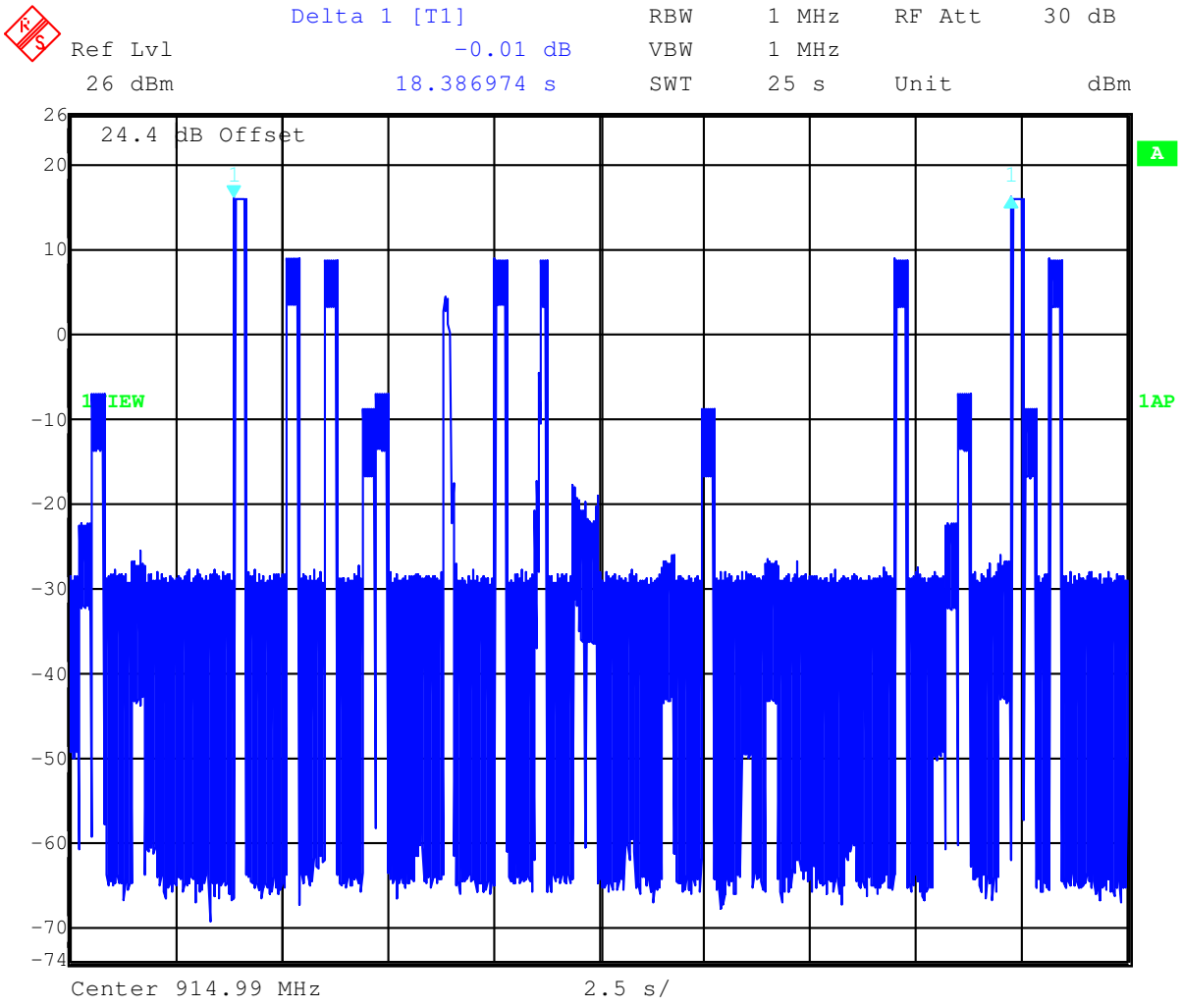

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