ENGINEERING TEST REPORT

TRM220SB
Model No.: TRM220SB
FCC ID: E5MDS-TRM220SB

Applicant:

GE MDS LLC
175 Science Parkway
Rochester NY 14620

Tested in Accordance With

Federal Communications Commission (FCC)
47 CFR, Part 2, Parts 80 and 90

UltraTech's File No.: MIC-151F80-90

This Test report is Issued under the Authority of Tri M. Luu Vice President of Engineering UltraTech Group of Labs Date: May 31, 2012	
Report Prepared by: Dan Huynh Issued Date: May 31, 2012	Tested by: Mr. Hung Trinh Test Dates: April 17 - May 1, 2012

The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.
This report must not be used by the client to claim product endorsement by NVLAP or any agency of the US Government.

UltraTech

3000 Bristol Circle, Oakville, Ontario, Canada, L6H 6G4
Tel.: (905) 829-1570 Fax.: (905) 829-8050
Website: www.ultratech-labs.com, Email: vic@ultratech-labs.com, Email: tri@ultratech-labs.com

FCC 91038 | VCCI 1309 | Industry Canada / Industrie Canada Approved Test Facility 46390-2049 | NVLAP Lab Code 200093-0 | BSMI SL2-IN-E-1119R | Korea KCC-RRL CA2049

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EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Parts 2, 80 and 90
Title:	Code of Federal Regulations (CFR), Title 47 –Telecommunication, Part 80 Stations in the maritime services and Part 90 Private land mobile radio services
Purpose of Test:	To gain FCC Equipment Authorization for Radio operating in parts 80 and 90.
Test Procedures:	Both conducted and radiated emissions measurements were conducted in accordance with TIA/EIA Standard TIA-603-C – Land Mobile FM or PM Communications Equipment Measurement and performance Standards.

1.2. RELATED SUBMITTAL(S)/GRANT(S)

None.

1.3. NORMATIVE REFERENCES

Publication	Year	Title
FCC CFR Parts 0-19, 80-End	2011	Code of Federal Regulations, Title 47 – Telecommunication
ANSI C63.4	2009	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
TIA/EIA 603, Edition C	2004	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards
CISPR 22 & EN 55022	2008-09, Edition 6.0 2006	Information Technology Equipment - Radio Disturbance Characteristics - Limits and Methods of Measurement
CISPR 16-1-1 +A1 +A2	2006 2006 2007	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus
CISPR 16-1-2 +A1 +A2	2003 2004 2006	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-2: Conducted disturbances

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

Applicant	
Name:	GE MDS LLC
Address:	175 Science Parkway Rochester NY 14620 USA
Contact Person:	Mr. Dennis McCarthy Phone #: 585 242-8440 Fax #: 585 241-5590 Email Address: Dennis.McCarthy2@GE.com

Manufacturer	
Name:	GE MDS LLC
Address:	175 Science Parkway Rochester NY 14620 USA
Contact Person:	Mr. Dennis McCarthy Phone #: 585 242-8440 Fax #: 585 241-5590 Email Address: Dennis.McCarthy2@GE.com

2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

Brand Name:	GE MDS LLC
Product Name:	TRM220SB
Model Name or Number:	TRM220SB
Serial Number:	Test sample
Type of Equipment:	Licensed Non-Broadcast Station Transmitter
Power Supply Requirement:	3.6 VDC Nominal
Transmitting/Receiving Antenna Type:	Non-integral
Primary User Functions of EUT:	The transceiver is a data telemetry radio designed to operate in a point-to-multipoint environment

2.3. EUT'S TECHNICAL SPECIFICATIONS

Transmitter	
Equipment Type:	Mobile
Intended Operating Environment:	Commercial, industrial or business environment
Power Supply Requirement:	3.2 to 3.8VDC, 3.6 VDC Nominal
RF Output Power Rating:	0.5 W to 2 W
Operating Frequency Range:	216 – 220 MHz, 220 – 222 MHz
RF Output Impedance:	50 Ohm
Channel Spacing:	25 kHz
Modulation Employed:	2-Level GMSK
Occupied Bandwidth (99%):	12.69 kHz
Emission Designation:	12K7G1D
Antenna Connector Type:	MMCX or PCB Pads

2.4. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	J100; Control, data, and power	1	30-pin	--
2	RF (J302)	1	MMCX	Coax
3	RF (300/301)	1	PCB Pads	--

2.5. ANCILLARY EQUIPMENT

Ancillary Equipment # 1	
Description:	Test Jig
Brand name:	GE MDS LLC
Model Name or Number:	N/A
Connected to EUT's Port:	I/O Port

Ancillary Equipment # 3	
Description:	Laptop
Brand name:	Dell
Model Name or Number:	PPL
Connected to EUT's Port:	Test Jig of the EUT

EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21°C
Humidity:	51%
Pressure:	102 kPa
Power input source:	3.6 V DC nominal

3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TEST SIGNALS

Operating Modes:	The transmitter was operated in a continuous transmission mode with the carrier modulated as specified in the Test Data.
Special Test Software:	Special software provided by the Applicant to operate the EUT at each channel frequency continuously and in the range of typical modes of operation.
Special Hardware Used:	Test Jig.
Transmitter Test Antenna:	The EUT is tested with the transmitter antenna port terminated to a 50 Ohm RF Load.

Transmitter Test Signals	
Frequency Band(s):	216 - 220 MHz 220 - 222 MHz
Test Frequency(ies):	216 MHz and 220 MHz and 222 MHz
Transmitter Wanted Output Test Signals:	
• Transmitter Power (measured maximum output power):	33 dBm
• Normal Test Modulation:	2-Level GMSK
• Modulating signal source:	Internal

EXHIBIT 4. SUMMARY OF TEST RESULTS

4.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

Radiated Emissions were performed at the Ultratech's 3-10 TDK Semi-Anechoic Chamber situated in the Town of Oakville, province of Ontario. This test site been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville 3-10 TDK Semi-Anechoic Chamber has been filed with FCC office (FCC File No.: 91038) and Industry Canada office (Industry Canada File No.: 2049A-3). Expiry Date: 2014-04-04.

4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC Section(s)	Test Requirements	Applicability (Yes/No)
2.1046, 80.215 & 90.205	RF Power Output	Yes
2.1047(a), 80.213(d) & 90.242(b)(8)	Modulation Characteristics - Audio Frequency Response	Not Applicable
2.1047(b), 80.213(d)	Modulation Characteristics - Modulation Limiting	Yes
2.1049, 80.205, 80.211, 90.209 & 90.210	Occupied Bandwidth and Emission Limitations/Masks	Yes
2.1051, 2.1057, 80.211 & 90.210	Spurious Emissions at Antenna Terminal	Yes
2.1053, 2.1057, 80.211 & 90.210	Field Strength of Spurious Emissions	Yes
2.1055, 80.209 & 90.213	Frequency Stability	Yes
80.217	Suppression of Interference aboard ships	Yes[1]
1.1307, 1.1310 & 2.1091	RF Exposure Limit	Yes

[1] Complies with FCC Part 15, Subpart B.

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None.

4.4. DEVIATION OF STANDARD TEST PROCEDURES

None.

EXHIBIT 5. TEST DATA

5.1. RF POWER OUTPUT [§§ 2.1046, 80.215 & 90.205]

5.1.1. Limits

§ 80.215(h)(5) The transmitter power, as measured at the input terminals to the station antenna, must be 50 watts or less.

§ 90.205(e) 217–220 MHz. Limitations on power and antenna heights are specified in § 90.259.
§ 90.205(f) 220–222 MHz. Limitations on power and antenna heights are specified in § 90.729.

§ 90.259 (4) In the 217–220 MHz band, the maximum transmitter output power is 2 watts. The maximum antenna height above average terrain (HAAT) is 152 m (500 feet).

§ 90.729 (a) The permissible effective radiated power (ERP) with respect to antenna heights for land mobile, paging, or fixed stations transmitting on frequencies in the 220–221 MHz band shall be determined from the following Table. These are maximum values and applicants are required to justify power levels requested.

ERP VS. ANTENNA HEIGHT TABLE [2]

Antenna height above average terrain (HAAT), meters	Effective radiated power, watts [1]
Up to 150	500
150 to 225	250
225 to 300	125
300 to 450	60
450 to 600	30
600 to 750	20
750 to 900	15
900 to 1050	10
Above 1050	5

[1] Transmitter PEP shall be used to determine ERP.

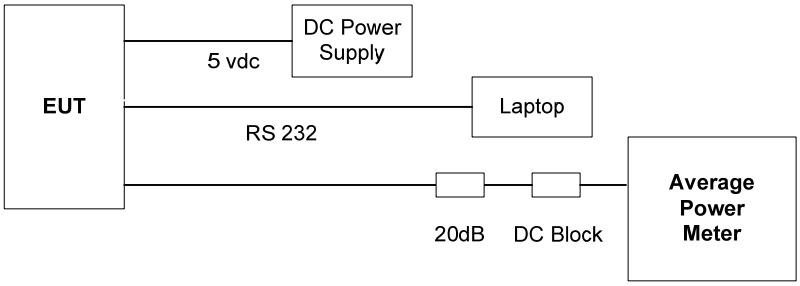
[2] These power levels apply to stations used for land mobile, paging, and fixed operations.

(b) The maximum permissible ERP for mobile units is 50 watts. Portable units are considered as mobile units. Licensees operating fixed stations or paging base stations transmitting on frequencies in the 221–222 MHz band may not operate such fixed stations or paging base stations at power levels greater than 50 watts ERP, and may not transmit from antennas that are higher than 7 meters above average terrain, except that transmissions from antennas that are higher than 7 meters above average terrain will be permitted if the effective radiated power of such transmissions is reduced below 50 watts ERP by 20 log10(h/7) dB, where h is the height above average terrain (HAAT), in meters.

5.1.2. Method of Measurements

Refer to Section 8.1 of this report for measurement details.

5.1.3. Test Arrangement



5.1.4. Test Data

Operation Mode	Frequency (MHz)	Measured Average Power (dBm)	Measured Average Power (W)	Power Rating (W)
High Power 2-Level GMSK 9600 bps	216.0	33.48	2.23	2
	220.0	33.29	2.13	2
	222.0	33.19	2.08	2
High Power 2-Level GMSK 19200 bps	216.0	33.49	2.23	2
	220.0	33.29	2.13	2
	222.0	33.20	2.09	2
Low Power 2-Level GMSK 9600 bps	216.0	27.41	0.55	0.5
	220.0	27.25	0.53	0.5
	222.0	27.15	0.52	0.5
Low Power 2-Level GMSK 19200 bps	216.0	27.42	0.55	0.5
	220.0	27.25	0.53	0.5
	222.0	27.16	0.52	0.5

5.2. MODULATION LIMITING [§§ 2.1047(b), 80.213(d)]

5.2.1. Limits

§ **2.1047(b):** Equipment which employs modulation limiting. A curve or family of curves showing the percentage of modulation versus the modulation input voltage shall be supplied. The information submitted shall be sufficient to show modulation limiting capability throughout the range of modulating frequencies and input modulating signal levels employed.

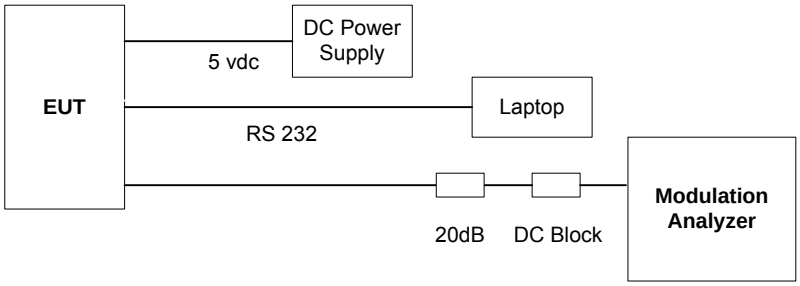
§ 80.213 (d) Ship and coast station transmitters operating in the 156-162 MHz and 216-220 bands must be capable of proper operation with a frequency deviation that does not exceed ±5 kHz when using any emission authorized by Sec. 80.207.

5.2.2. Method of Measurements

For Audio Transmitter: The carrier frequency deviation was measured with the tone input signal level varied from 0 Vp to audio input rating level plus 16 dB at frequencies 0.1, 0.5, 1.0, 3.0 and 5.0 kHz. The maximum deviation was recorded at each test condition.

For Data Transmitter with Maximum Frequency Deviation set by Factory: The EUT was set at maximum frequency deviation, and its peak frequency deviation was then measured using EUT's internal random data source.

5.2.3. Test Arrangement



5.2.4. Test Data

5.2.4.1. Data Modulation Limiting for 25 kHz Channel Spacing Operation (Factory Setting)

Modulation	Peak Frequency Deviation (kHz)
9600 baud	2.545
19200 baud	2.064

5.3. OCCUPIED BANDWIDTH & EMISSION MASK [§§2.1049, 80.205, 80.211, 90.209 & 90.210]

5.3.1. Limits

Emissions shall be attenuated below the mean output power of the transmitter as follows:

Frequency Band	Channel Spacing (kHz)	Authorized Bandwidth (kHz)	Applicable Mask
§ 80.211 Emission limitations			
216–220	25	20	See § 80.211 (f)
§ 90.210 Emission masks			
216–220	6 .25	20/11 .25/6	Mask C
220–222	5	4	Mask F

§ 80.211 (f) Emission Limitations:

(1) On any frequency removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: At least 25 dB;
(2) On any frequency removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: At least 35 dB; and
(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 plus $10\log_{10}$ (mean power in watts) dB.

§ 90.210 (c) Emission Mask C. For transmitters that are not equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier output power (P) as follows:

(1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5 kHz, but not more than 10 kHz: At least 83 log (f_d/5) dB;
(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 10 kHz, but not more than 250 percent of the authorized bandwidth: At least 29 log (f_d^2/11) dB or 50 dB, whichever is the lesser attenuation;
(3) On any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

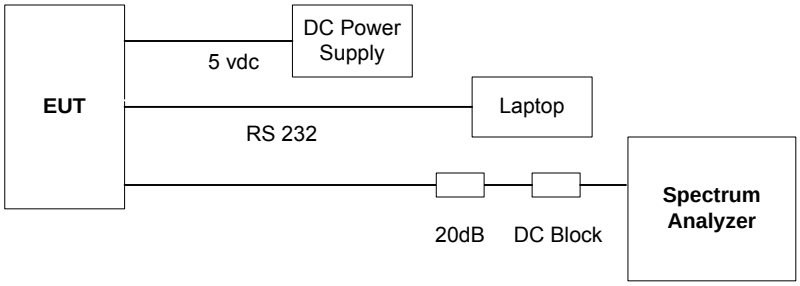
§ 90.210 (f) Emission Mask F. For transmitters operating in the 220–222 MHz frequency band, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

(1) On any frequency from the center of the authorized bandwidth f_o to the edge of the authorized bandwidth f_e: Zero dB.
(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 2 kHz up to and including 3.75 kHz: 30 + 20(f_d -2) dB or 55 + 10 log (P), or 65 dB, whichever is the lesser attenuation.
(3) On any frequency beyond 3.75 kHz removed from the center of the authorized bandwidth f_d: At least 55 + 10 log (P) dB.

5.3.2. Method of Measurements

Refer to Section 8.4 of this report for measurement details

5.3.3. Test Arrangement



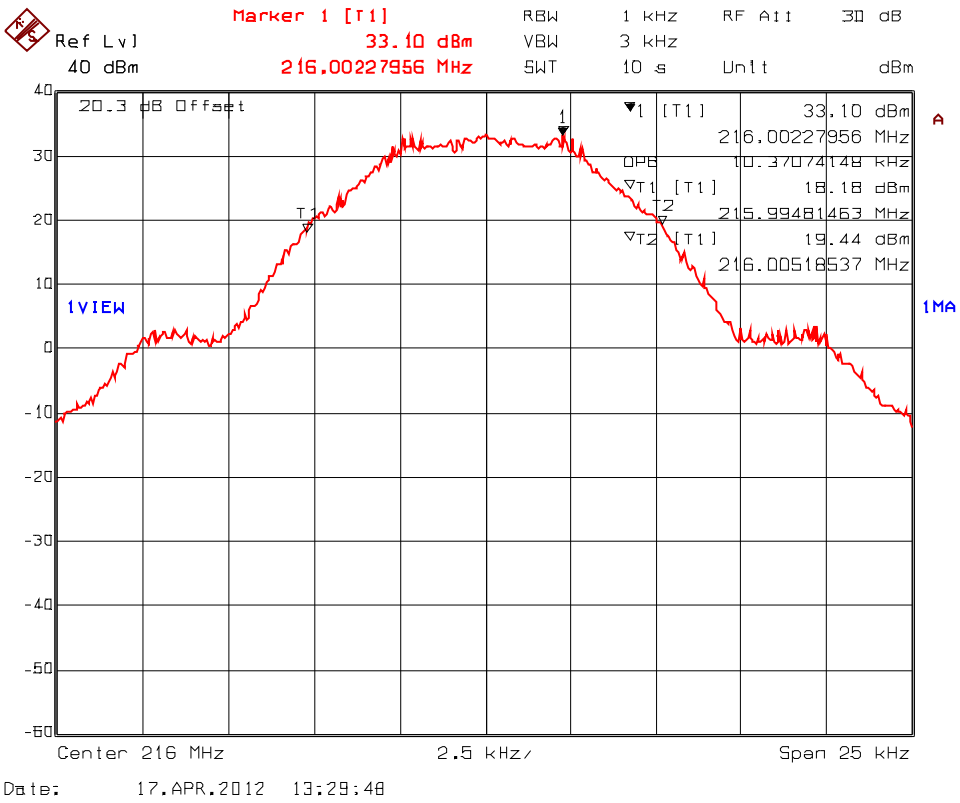
5.3.4. Test Data

5.3.4.1. 99% Occupied Bandwidth

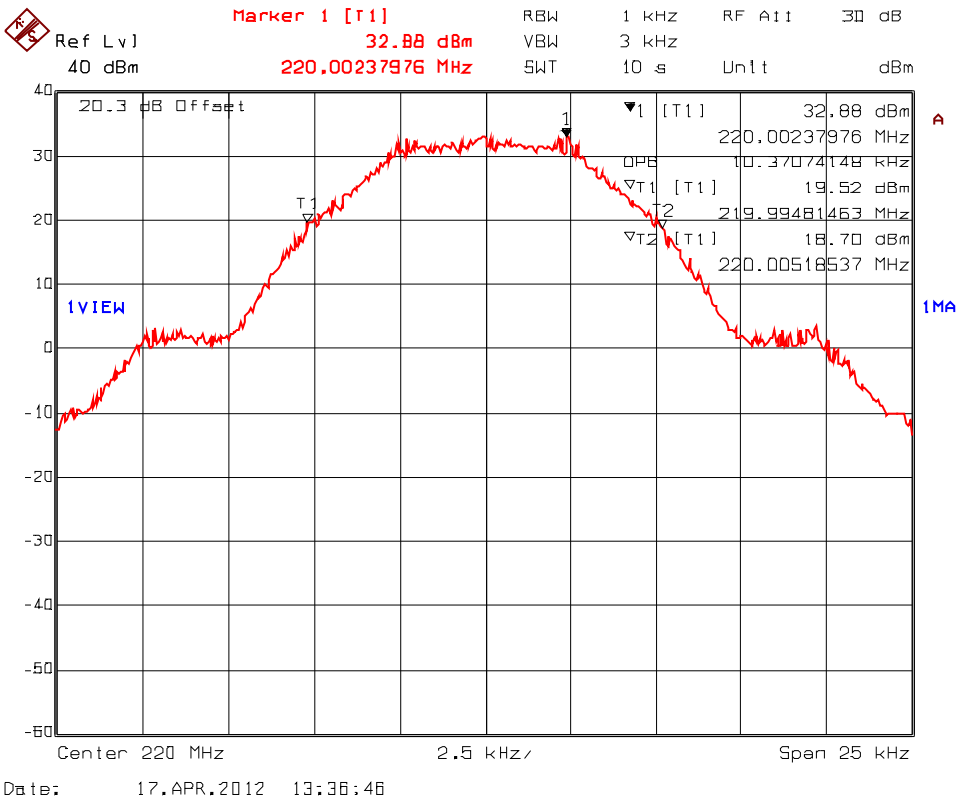
Remark: 99% Occupied Bandwidth measurements were done using the built-in auto function of the analyzer.				
Operation Mode	**Frequency (MHz)**	***Channel Spacing (kHz)**	**Measured 99% OBW (kHz)**	**Authorized Bandwidth (kHz)**
High Power 2-Level GMSK 9600 bps	216.0	25	10.371	20
	220.0	25	10.371	20
	222.0	25	10.371	20
High Power 2-Level GMSK 19200 bps	216.0	25	12.685	20
	220.0	25	12.565	20
	222.0	25	12.385	20
*The EUT is a narrow band designed to operate on 2.5 kHz, 5.0 kHz or 6.25 kHz frequency increments using 25 kHz channels. The occupied bandwidth at 25 kHz channel spacing is an aggregate of contiguous channels of 2.5 kHz, 5.0 kHz or 6.25 kHz frequencies.				

See the following plots for details of measurements.

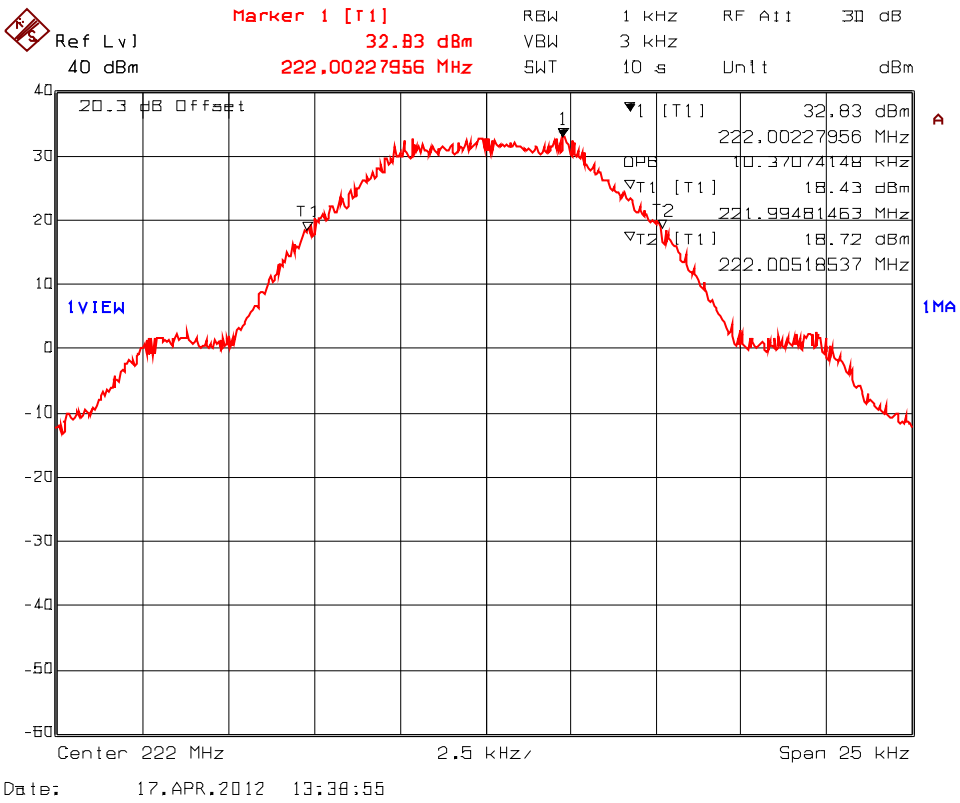
Plot 5.3.4.1.1. Occupied Bandwidth, 216.0 MHz, 25 kHz Channel Spacing, High Power (2 W), 9600 baud



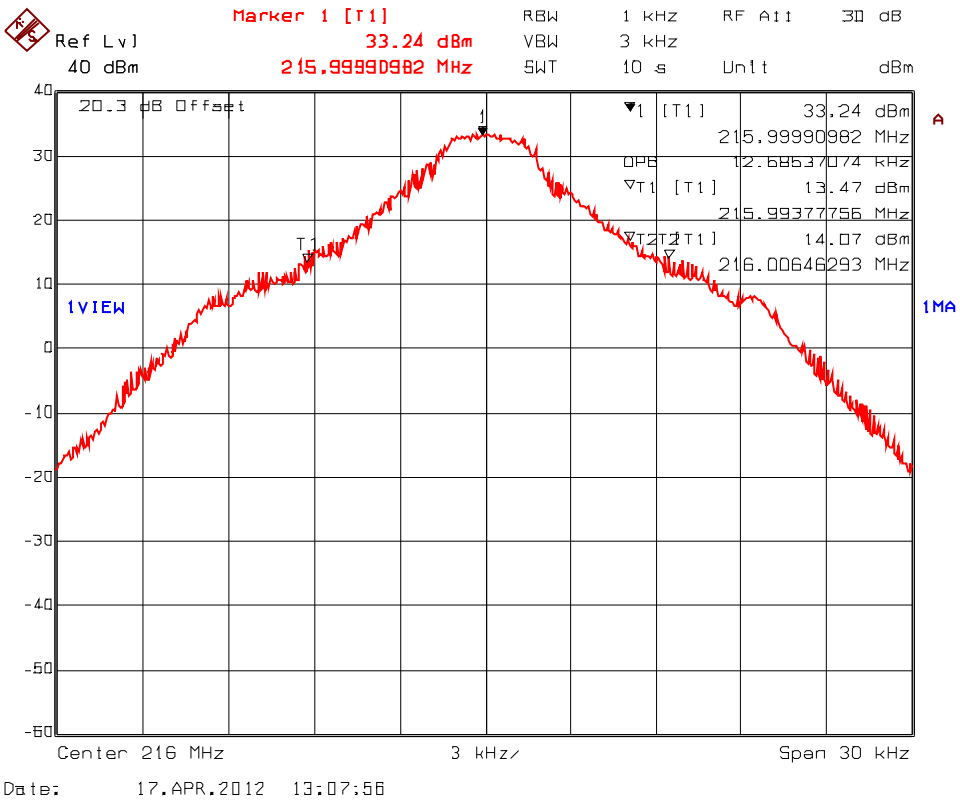
Plot 5.3.4.1.2. Occupied Bandwidth, 220.0 MHz, 25 kHz Channel Spacing, High Power (2 W), 9600 baud



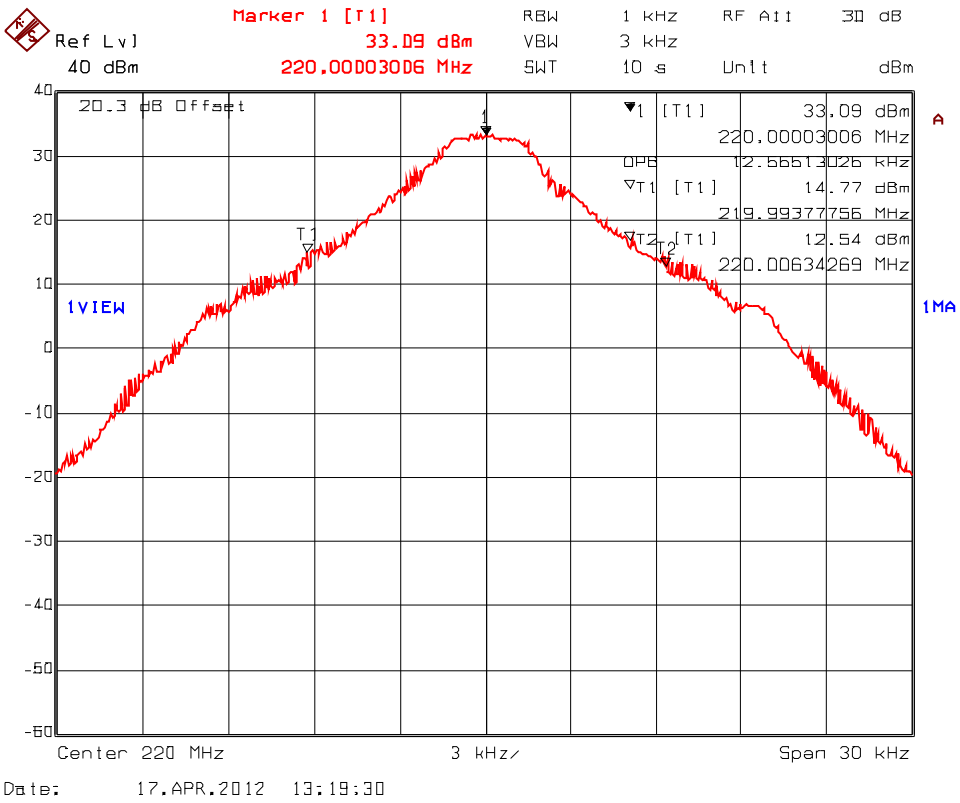
Plot 5.3.4.1.3. Occupied Bandwidth, 222.0 MHz, 25 kHz Channel Spacing, High Power (2 W), 9600 baud



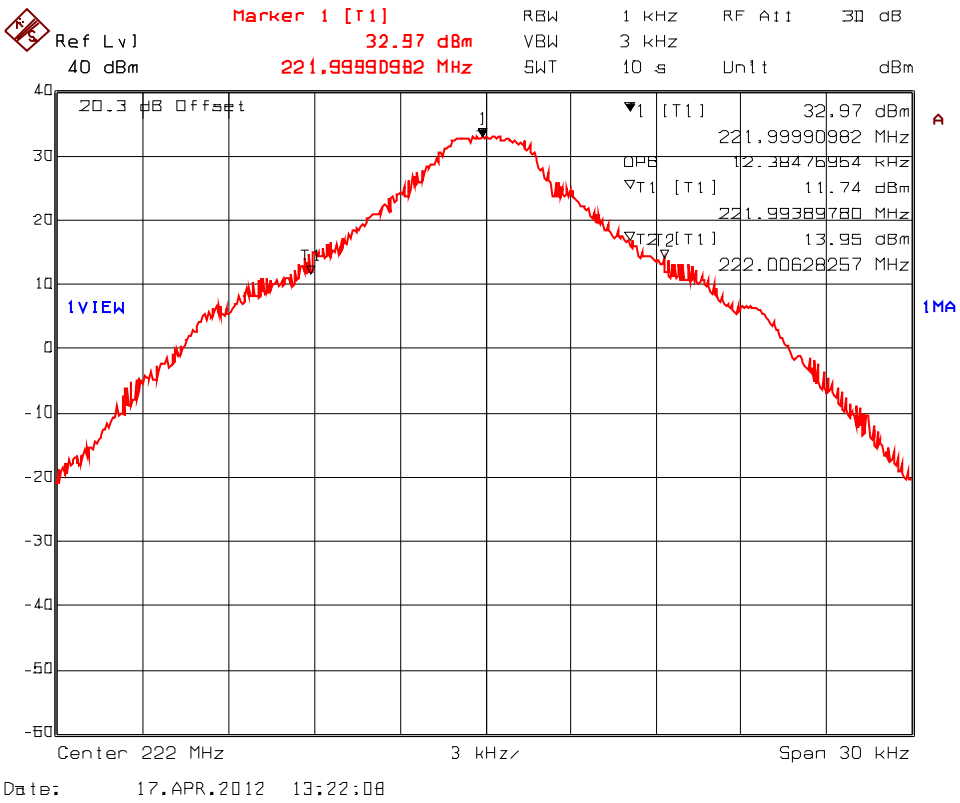
Plot 5.3.4.1.4. Occupied Bandwidth, 216.0 MHz, 25 kHz Channel Spacing, High Power (2 W), 19200 baud



Plot 5.3.4.1.5. Occupied Bandwidth, 220.0 MHz, 25 kHz Channel Spacing, High Power (2 W), 19200 baud

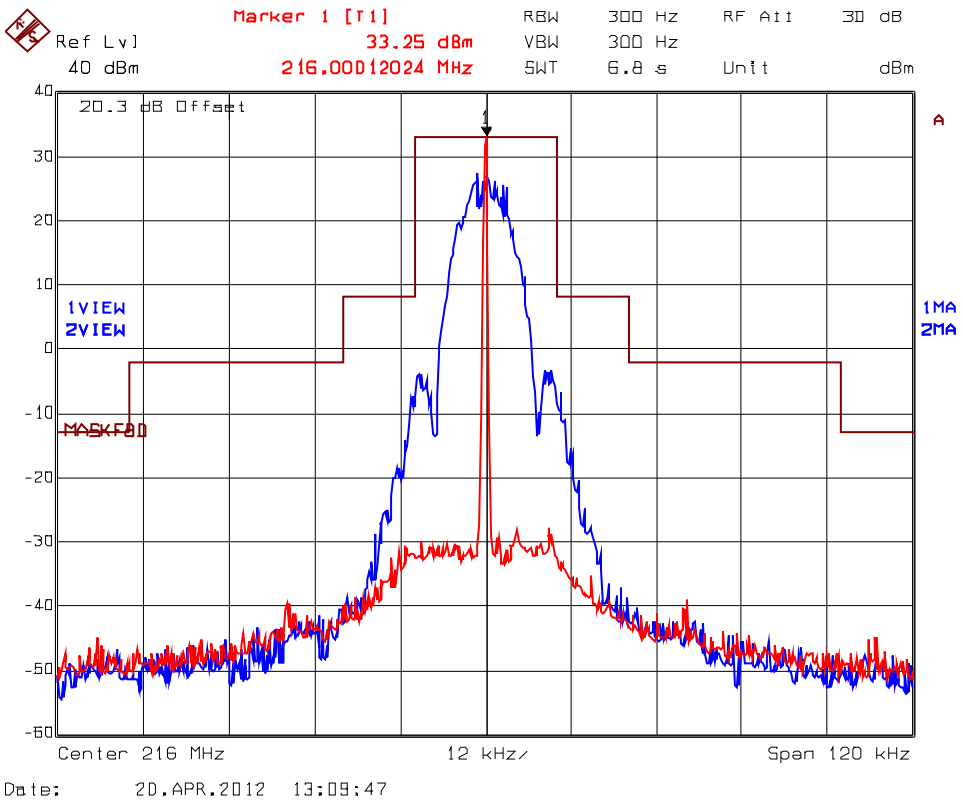


Plot 5.3.4.1.6. Occupied Bandwidth, 222.0 MHz, 25 kHz Channel Spacing, High Power (2 W), 19200 baud

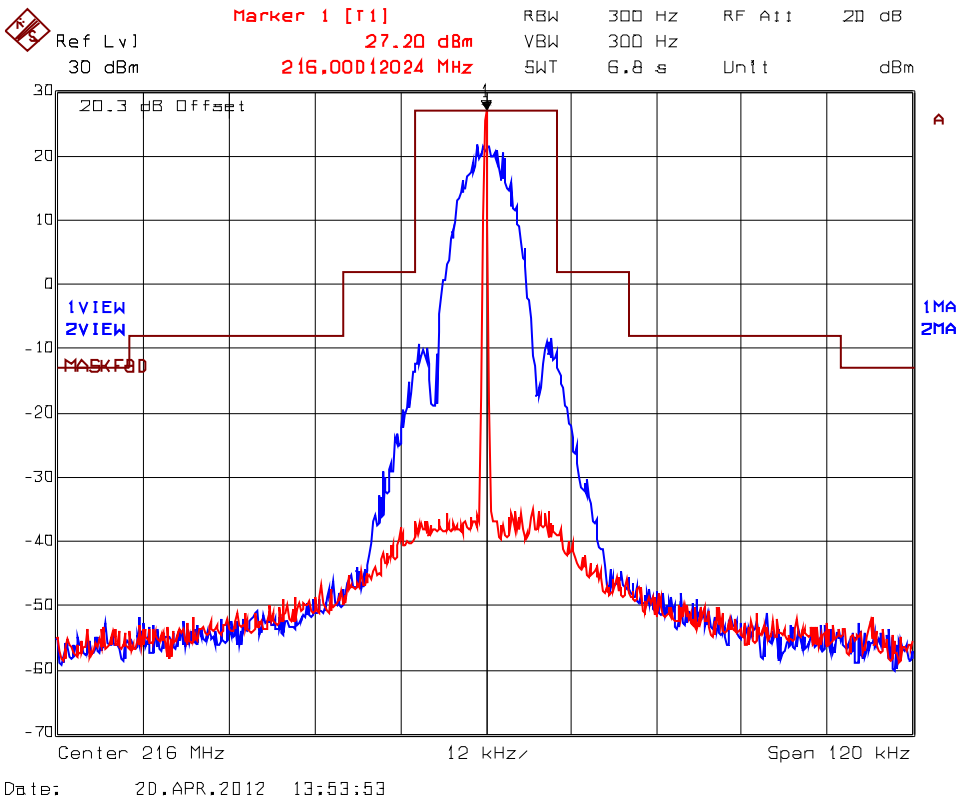


5.3.4.2. Emission Limitations for § 80.211 (f)

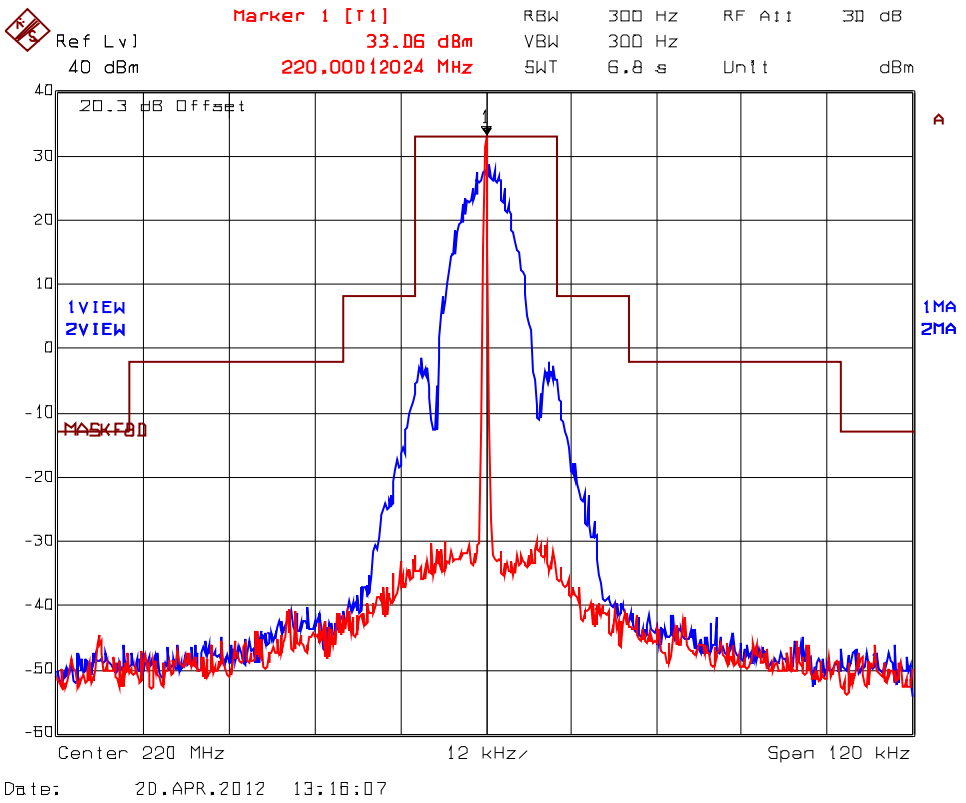
Plot 5.3.4.2.1. Emission Limitations for 80.211(f) , 216.0 MHz, 25 kHz Channel Spacing, High Power (2 W), 9600 baud



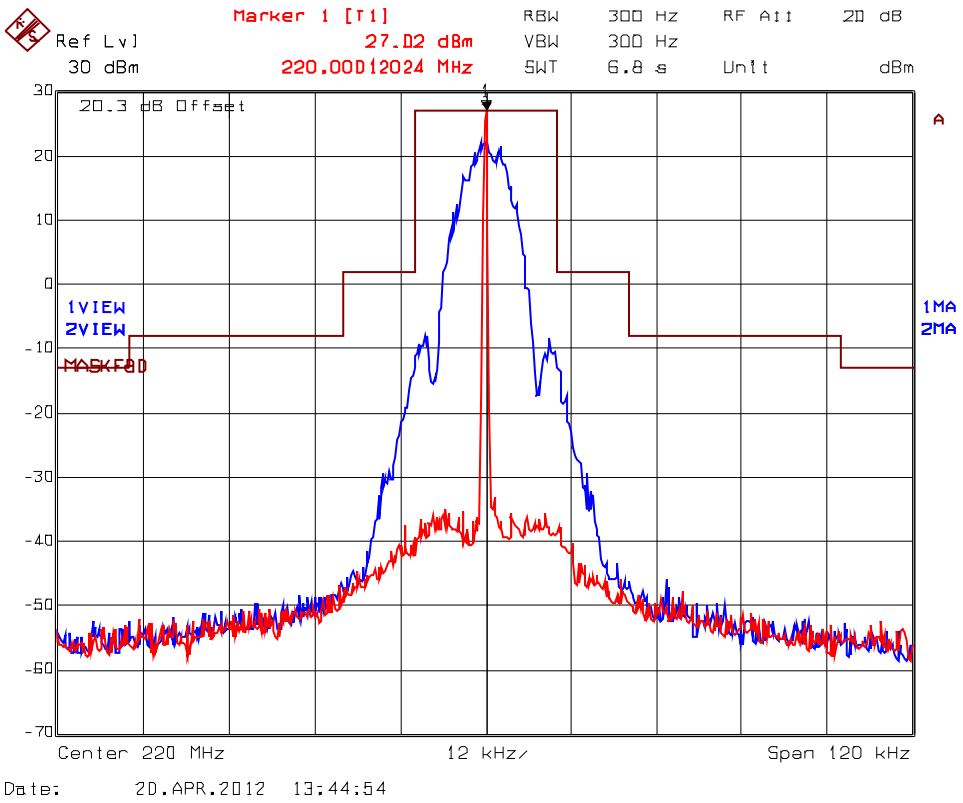
Plot 5.3.4.2.2. Emission Limitations for 80.211(f) , 216.0 MHz, 25 kHz Channel Spacing, Low Power (0.5 W), 9600 baud



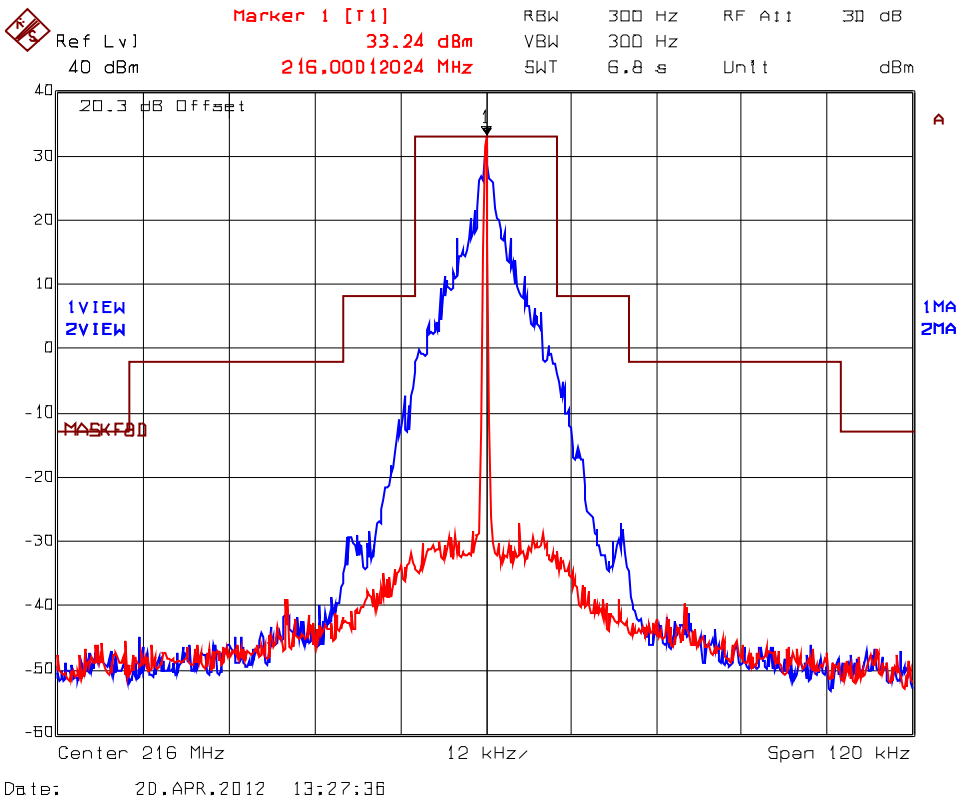
Plot 5.3.4.2.3. Emission Limitations for 80.211(f) , 220.0 MHz, 25 kHz Channel Spacing, High Power (2 W), 9600 baud



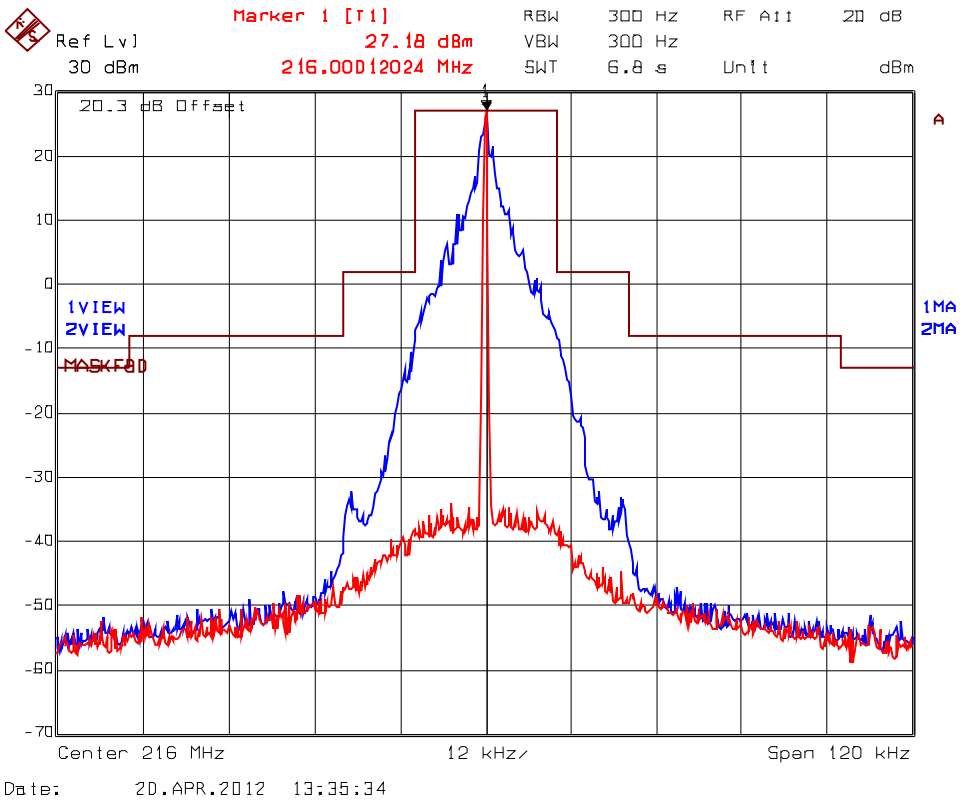
Plot 5.3.4.2.4. Emission Limitations for 80.211(f) , 220.0 MHz, 25 kHz Channel Spacing, Low Power (0.5 W), 9600 baud



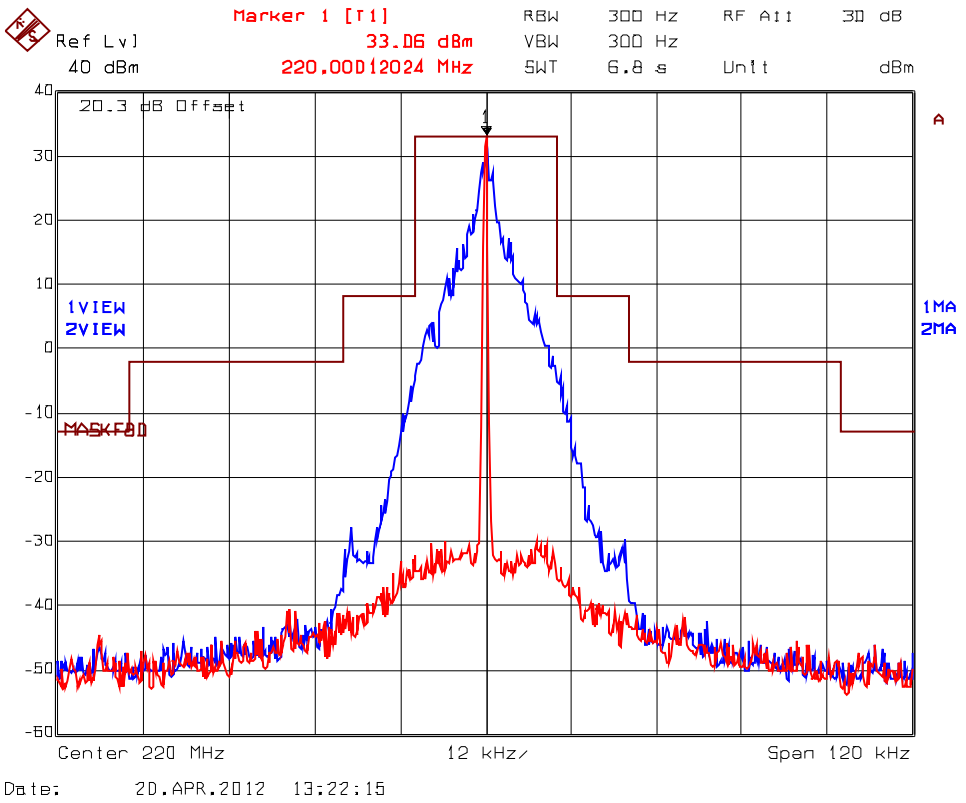
Plot 5.3.4.2.5. Emission Limitations for 80.211(f) , 216.0 MHz, 25 kHz Channel Spacing, High Power (2 W), 19200 baud



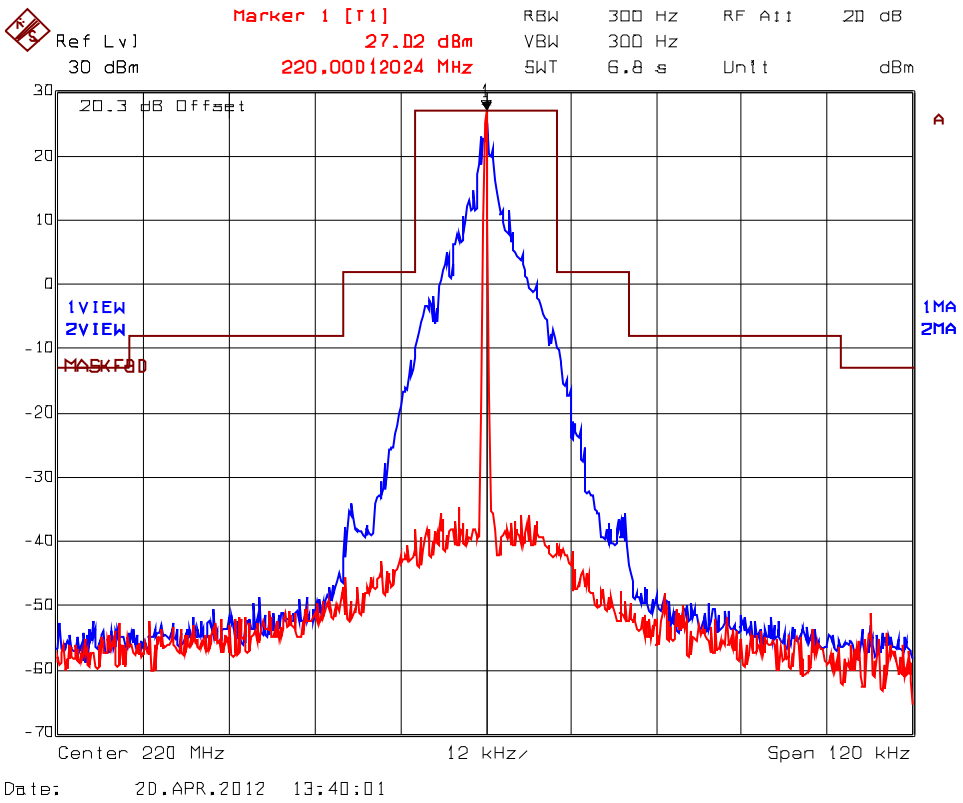
Plot 5.3.4.2.6. Emission Limitations for 80.211(f) , 216.0 MHz, 25 kHz Channel Spacing, Low Power (0.5 W), 19200 baud



Plot 5.3.4.2.7. Emission Limitations for 80.211(f) , 220.0 MHz, 25 kHz Channel Spacing, High Power (2 W), 19200 baud

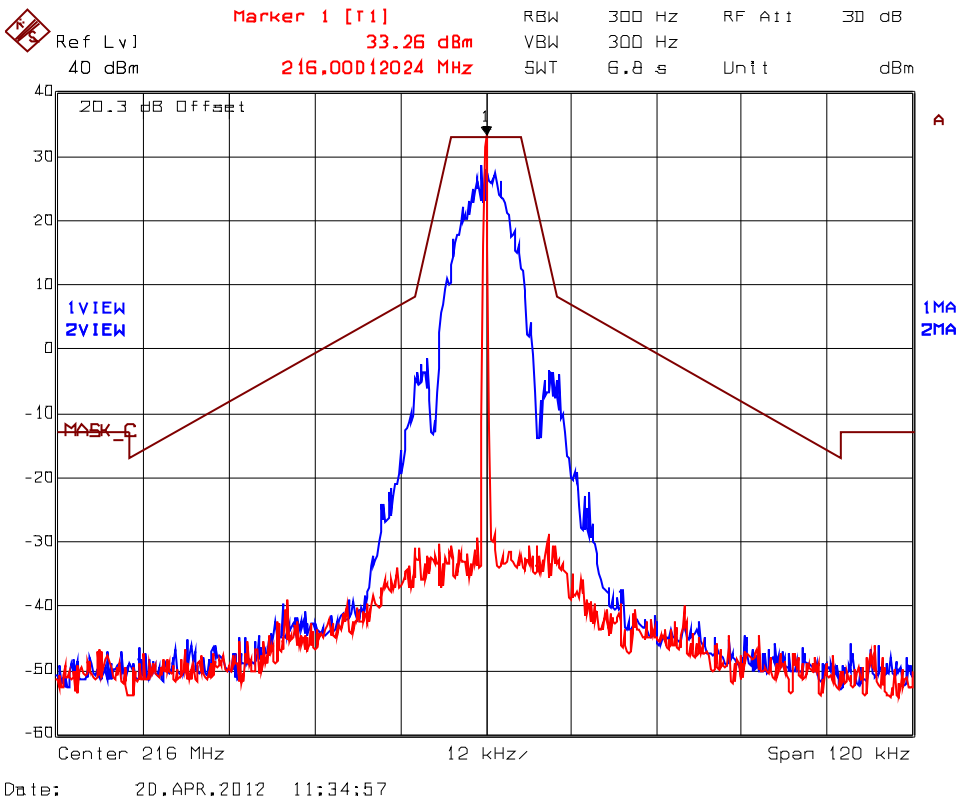


Plot 5.3.4.2.8. Emission Limitations for 80.211(f) , 220.0 MHz, 25 kHz Channel Spacing, Low Power (0.5 W), 19200 baud

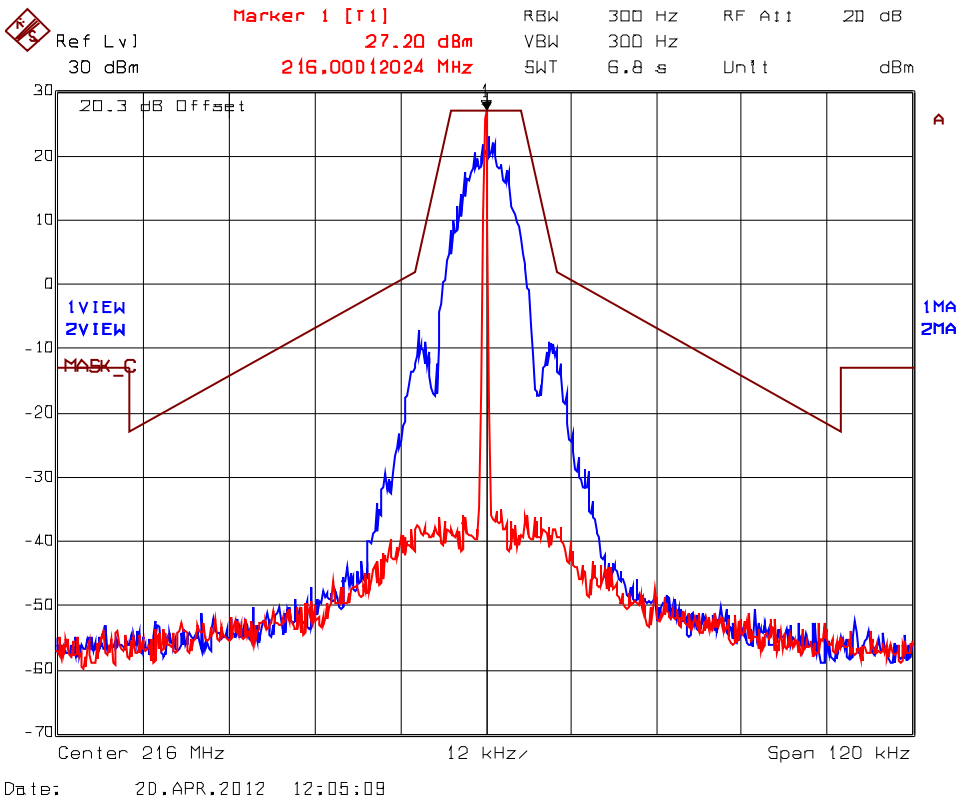


5.3.4.3. Emission Mask C (216 – 220 MHz Band)

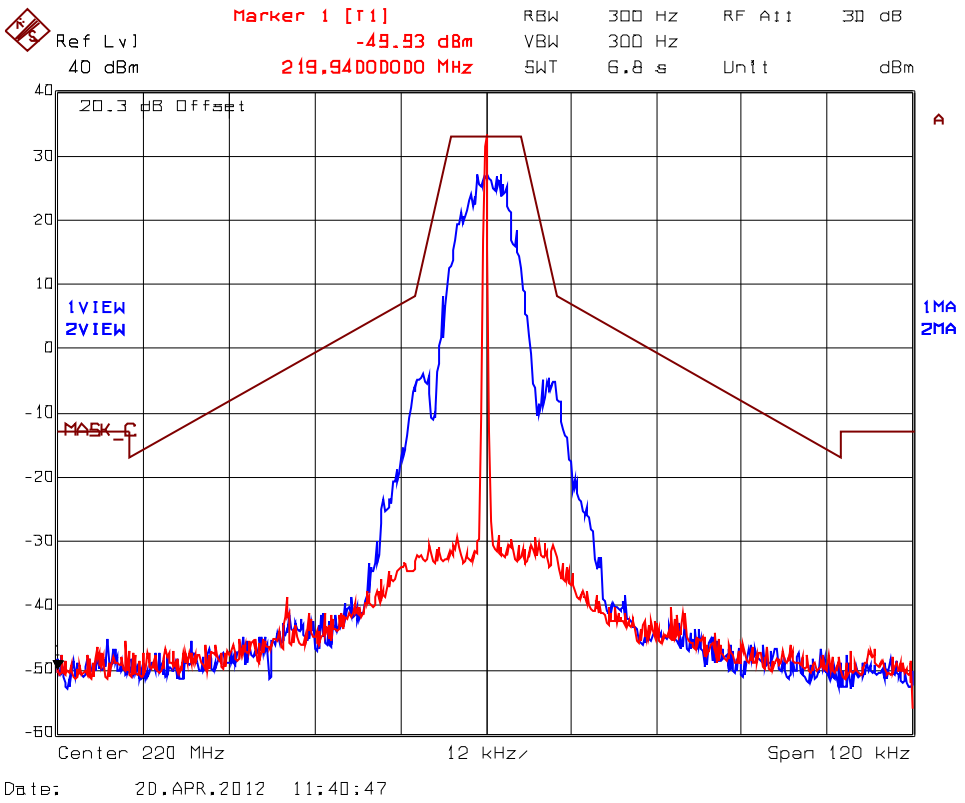
Plot 5.3.4.3.1. Emission Mask C, 216.0 MHz, 25 kHz Channel Spacing, High Power (2 W), 9600 baud



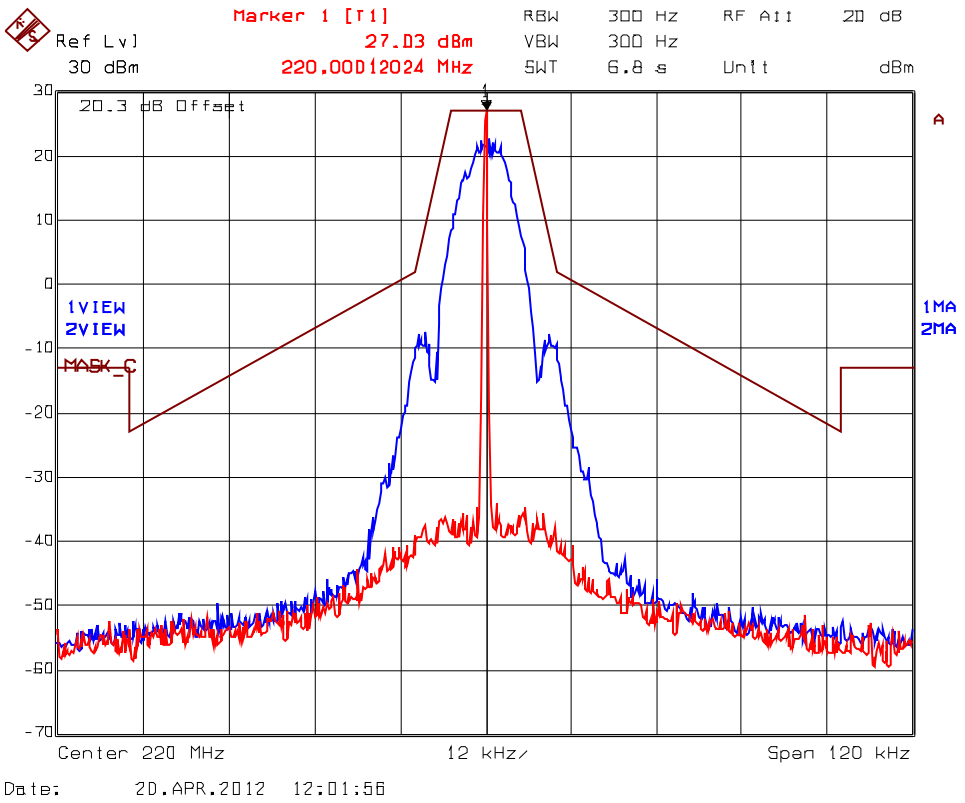
Plot 5.3.4.3.2. Emission Mask C , 216.0 MHz, 25 kHz Channel Spacing, Low Power (0.5 W), 9600 baud



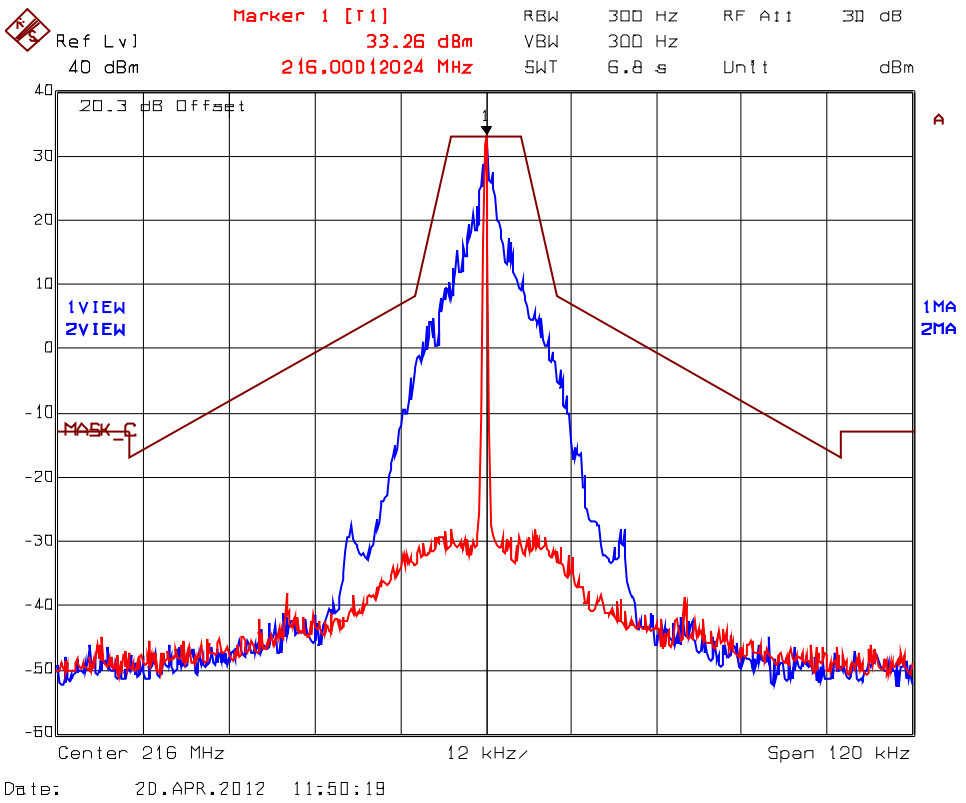
Plot 5.3.4.3.3. Emission Mask C , 220.0 MHz, 25 kHz Channel Spacing, High Power (2 W), 9600 baud



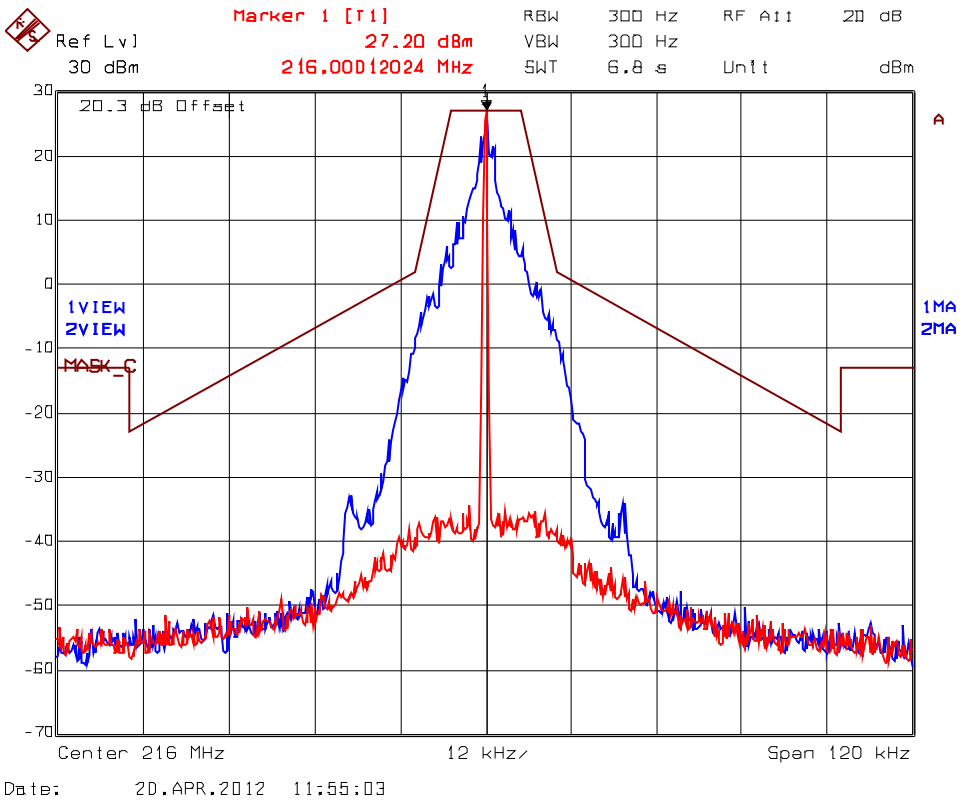
Plot 5.3.4.3.4. Emission Mask C , 220.0 MHz, 25 kHz Channel Spacing, Low Power (0.5 W), 9600 baud



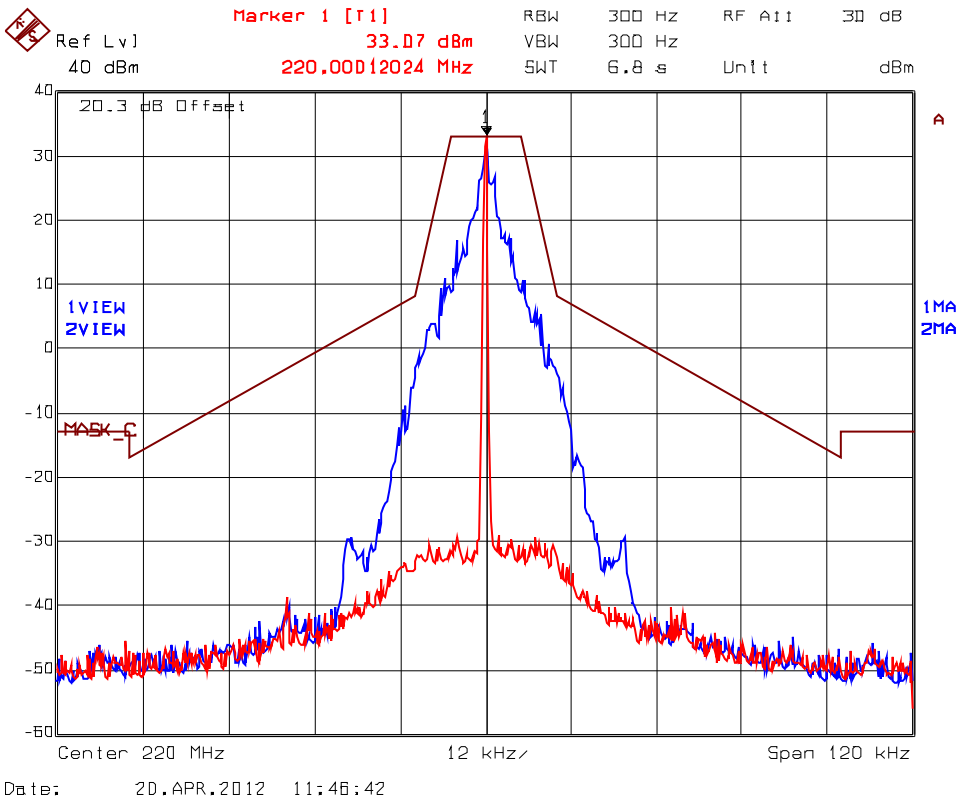
Plot 5.3.4.3.5. Emission Mask C , 216.0 MHz, 25 kHz Channel Spacing, High Power (2 W), 19200 baud



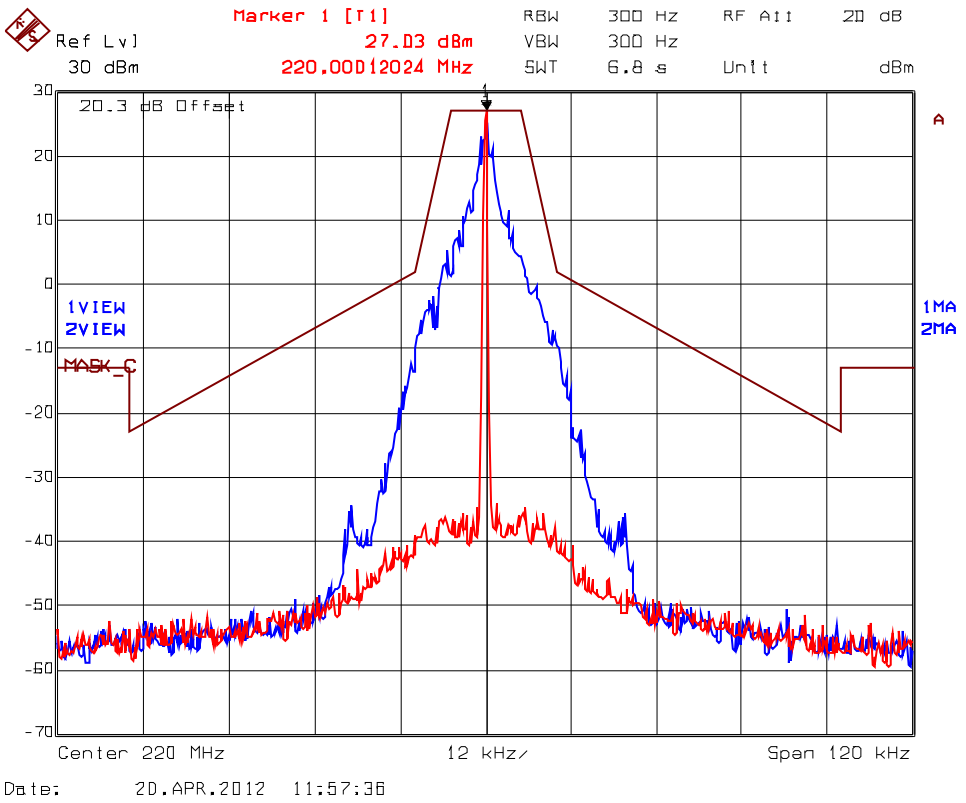
Plot 5.3.4.3.6. Emission Mask C , 216.0 MHz, 25 kHz Channel Spacing, Low Power (0.5 W), 19200 baud



Plot 5.3.4.3.7. Emission Mask C , 220.0 MHz, 25 kHz Channel Spacing, High Power (2 W), 19200 baud

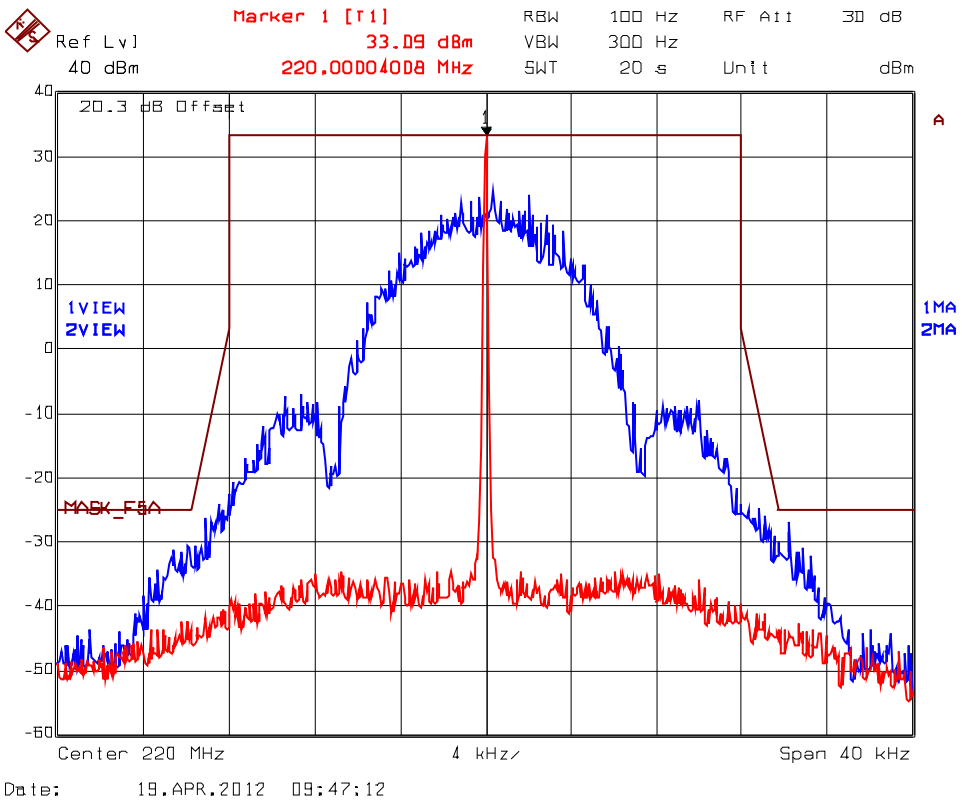


Plot 5.3.4.3.8. Emission Mask C , 220.0 MHz, 25 kHz Channel Spacing, Low Power (0.5 W), 19200 baud

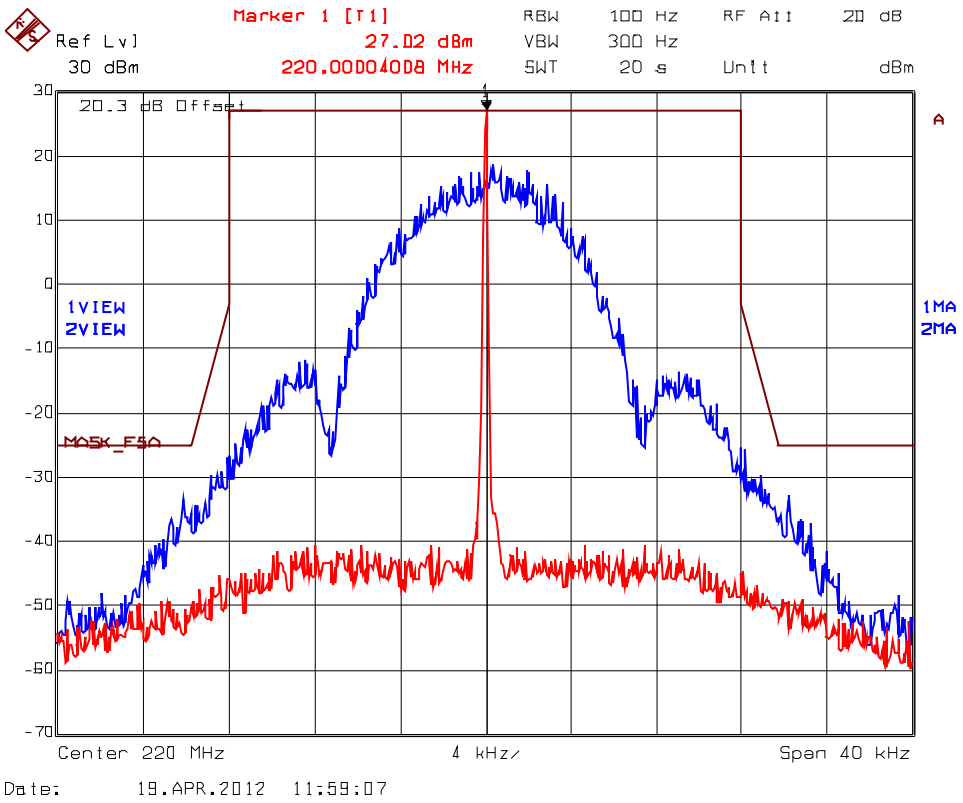


5.3.4.4. Emission Mask F (220 -222 MHz Band)

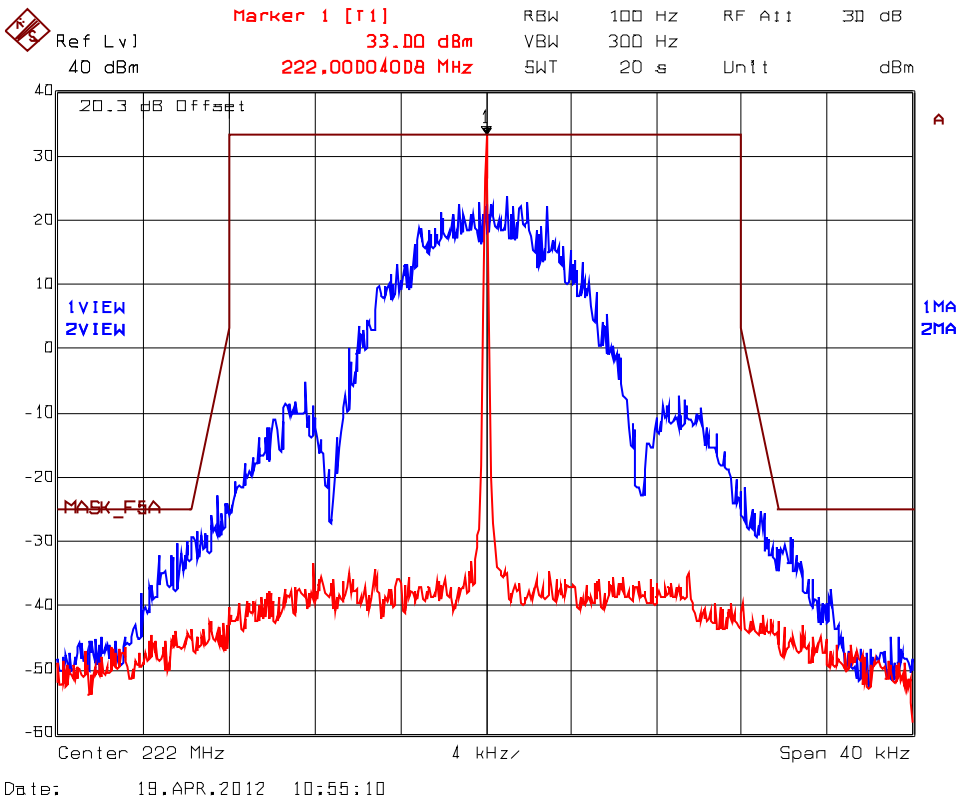
Plot 5.3.4.4.1. Emission Mask F, 220.0 MHz, 25 kHz Channel Spacing, High Power (2 W), 9600 baud



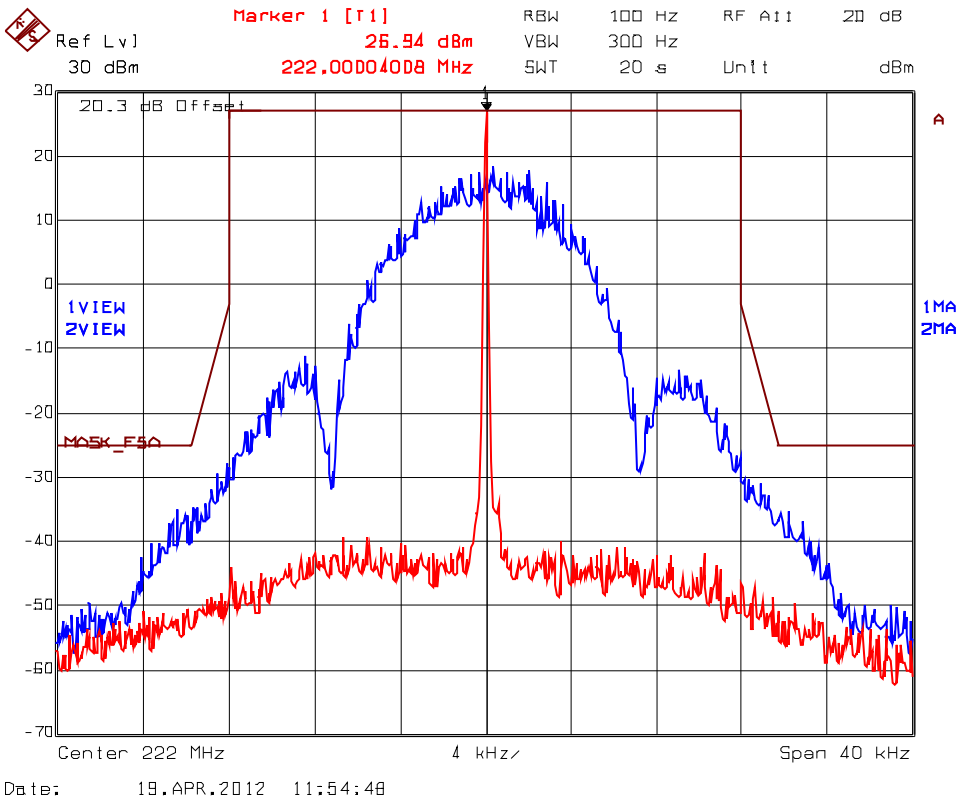
Plot 5.3.4.4.2. Emission Mask F , 220.0 MHz, 25 kHz Channel Spacing, Low Power (0.5 W), 9600 baud



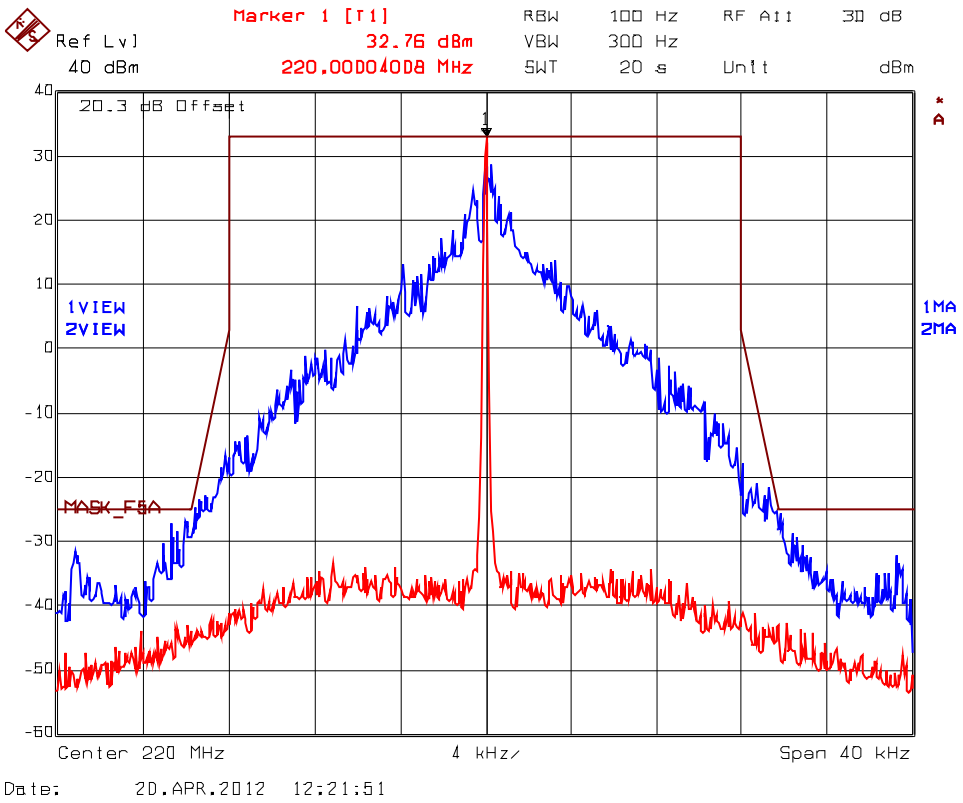
Plot 5.3.4.4.3. Emission Mask F , 222.0 MHz, 25 kHz Channel Spacing, High Power (2 W), 9600 baud



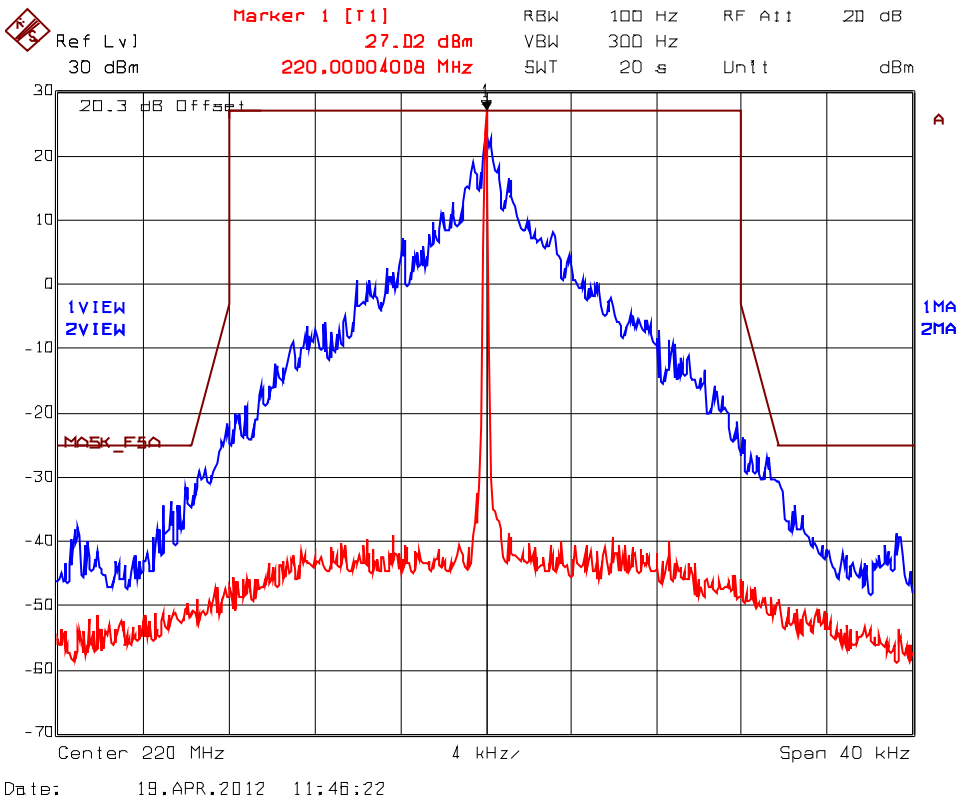
Plot 5.3.4.4.4. Emission Mask F , 222.0 MHz, 25 kHz Channel Spacing, Low Power (0.5 W), 9600 baud



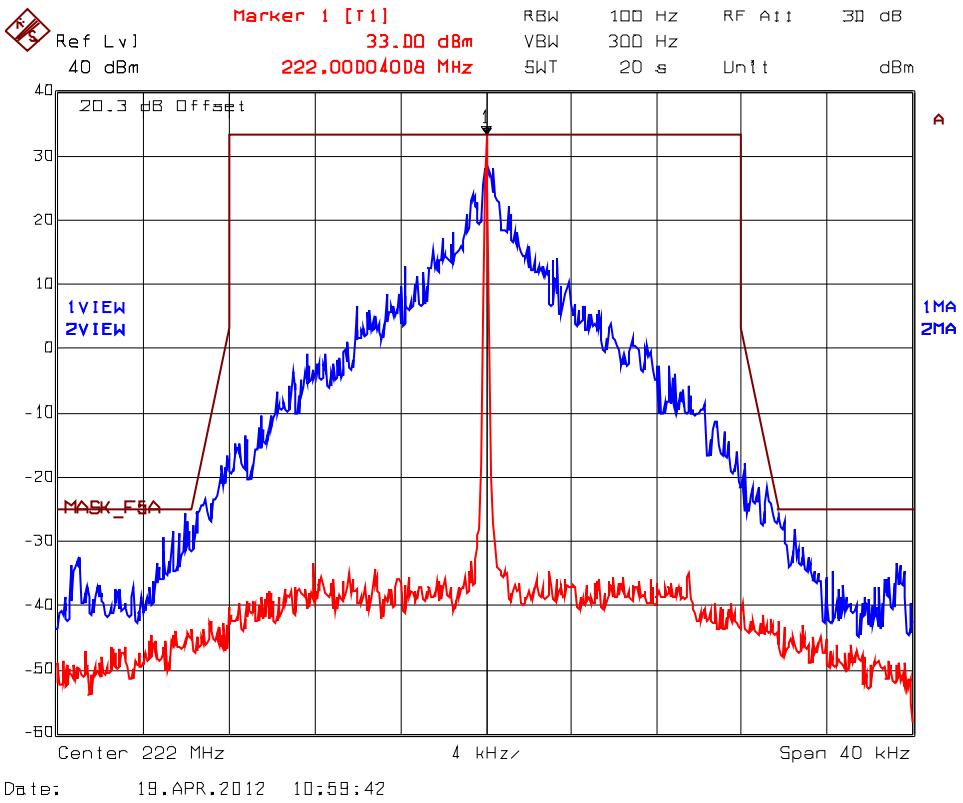
Plot 5.3.4.4.5. Emission Mask F , 220.0 MHz, 25 kHz Channel Spacing, High Power (2 W), 19200 baud



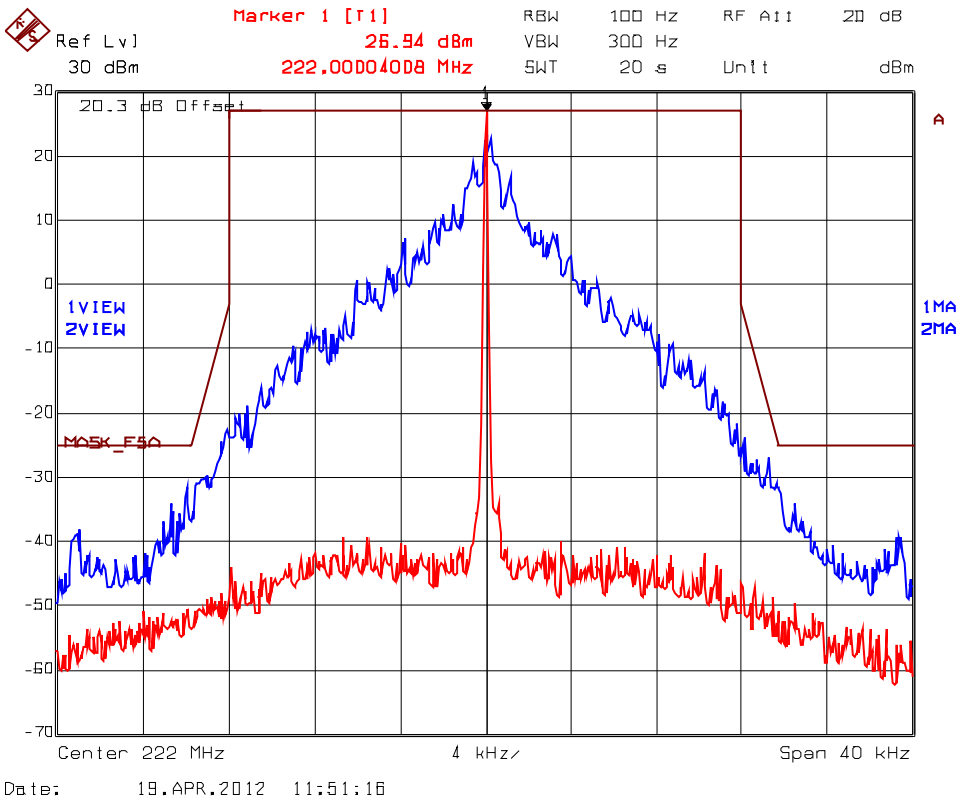
Plot 5.3.4.4.6. Emission Mask F , 220.0 MHz, 25 kHz Channel Spacing, Low Power (0.5 W), 19200 baud



Plot 5.3.4.4.7. Emission Mask F , 222.0 MHz, 25 kHz Channel Spacing, High Power (2 W), 19200 baud



Plot 5.3.4.4.8. Emission Mask F , 222.0 MHz, 25 kHz Channel Spacing, Low Power (0.5 W), 19200 baud



5.4. TRANSMITTER ANTENNA POWER SPURIOUS/HARMONIC CONDUCTED EMISSIONS [§§ 2.1051, 80.211 & 90.210]

5.4.1. Limits

§ 80.211 (f)(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 plus 10log10 (mean power in watts) dB.

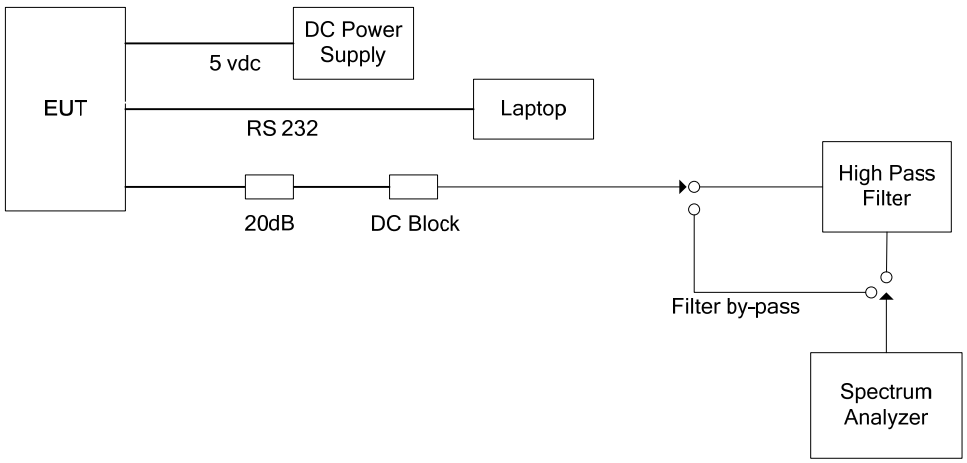
§ 90.210 (c)(3) On any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

§ 90.210 (f)(3) On any frequency beyond 3.75 kHz removed from the center of the authorized bandwidth $f_{d\leq}$ At least 55 + 10 log (P) dB.

5.4.2. Method of Measurements

Refer to Section 8.5 of this report for measurement details

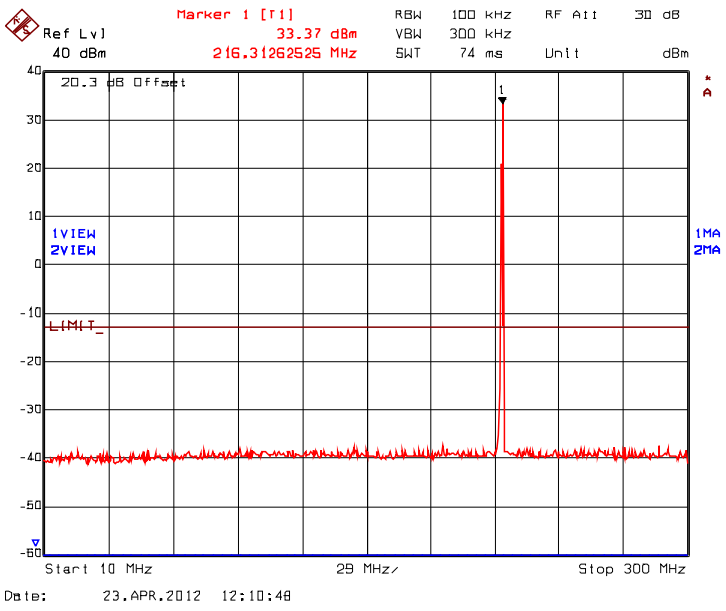
5.4.3. Test Arrangement



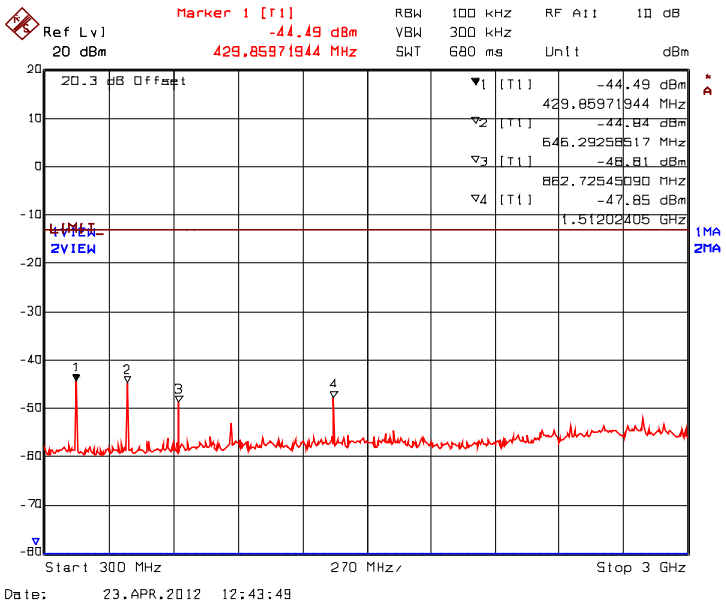
5.4.4. Test Data

5.4.4.1. Conducted Spurious Emissions for 216-220 MHz Band (§§ 80.211(f)(3), 90.210 (c)(3))

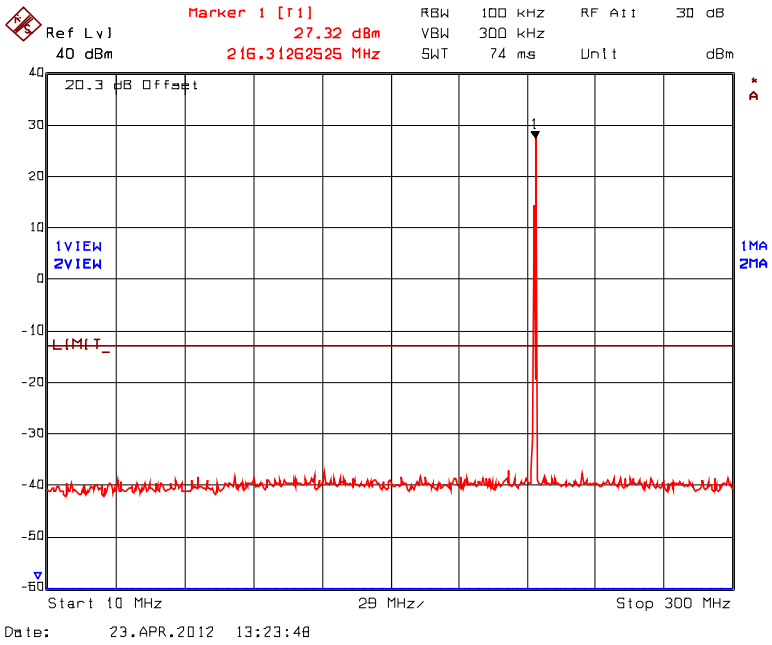
Plot 5.4.4.1.1. Conducted Spurious Emissions, 216 MHz, 25 kHz Channel Spacing, 9600 baud, 2 W, 30 MHz - 300 MHz



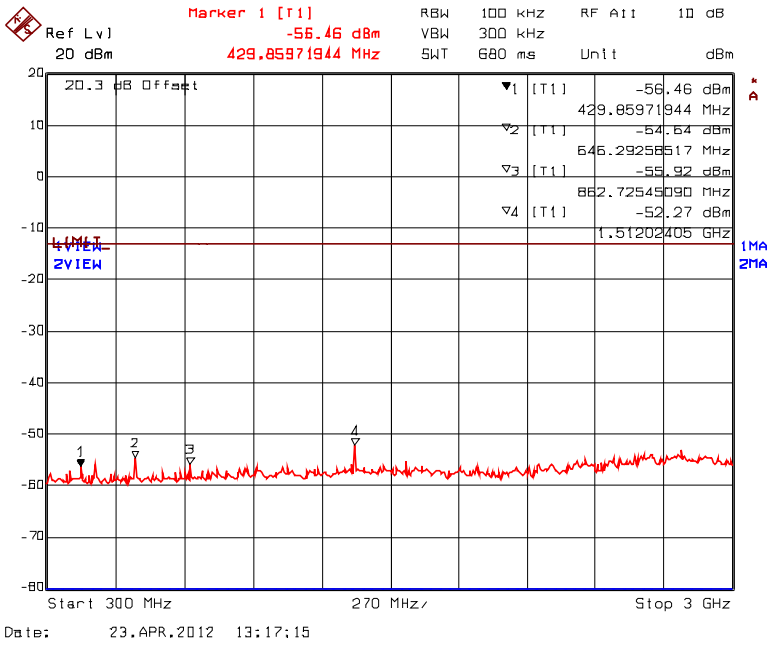
Plot 5.4.4.1.2. Conducted Spurious Emissions, 216 MHz, 25 kHz Channel Spacing, 9600 baud, 2 W, 300 MHz - 3 GHz



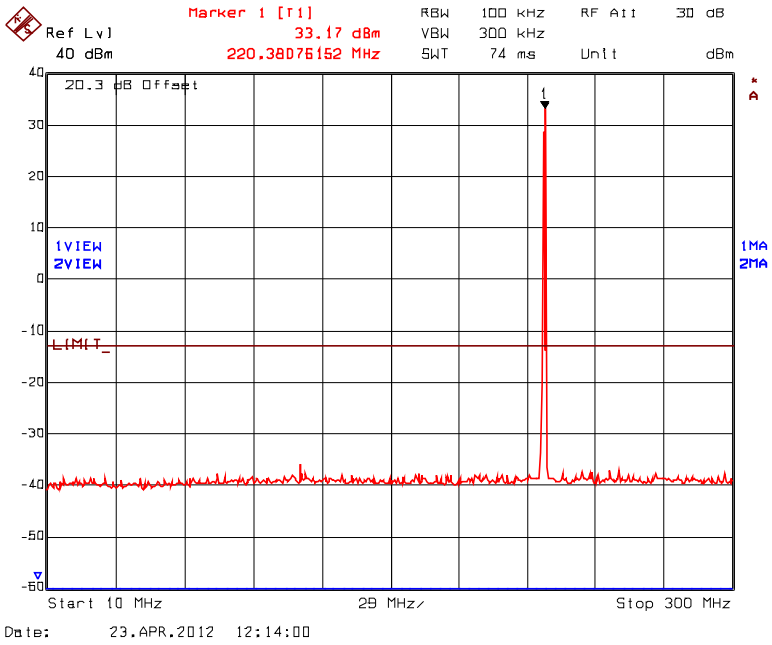
Plot 5.4.4.1.3. Conducted Spurious Emissions, 216 MHz, 25 kHz Channel Spacing, 9600 baud, 0.5 W, 30 MHz - 300 MHz



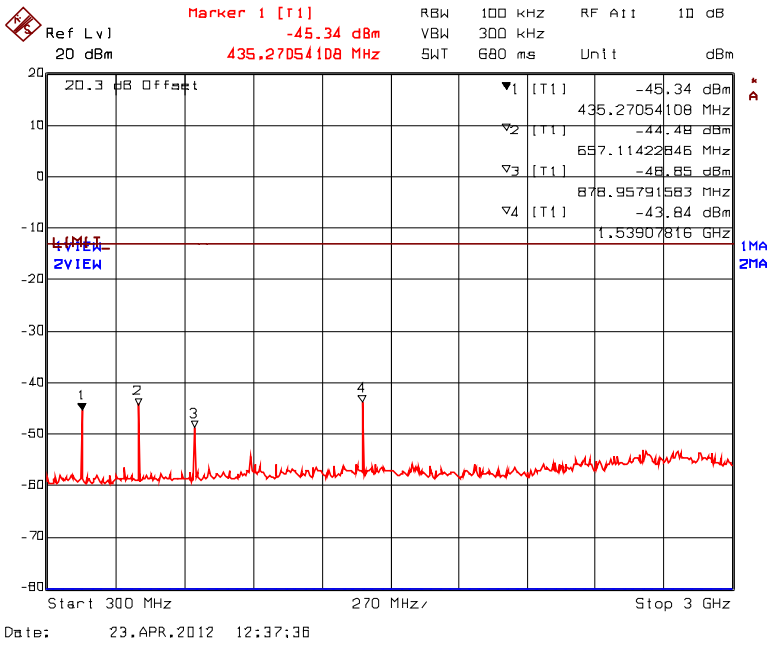
Plot 5.4.4.1.4. Conducted Spurious Emissions, 216 MHz, 25 kHz Channel Spacing, 9600 baud, 0.5 W, 300 MHz - 3 GHz



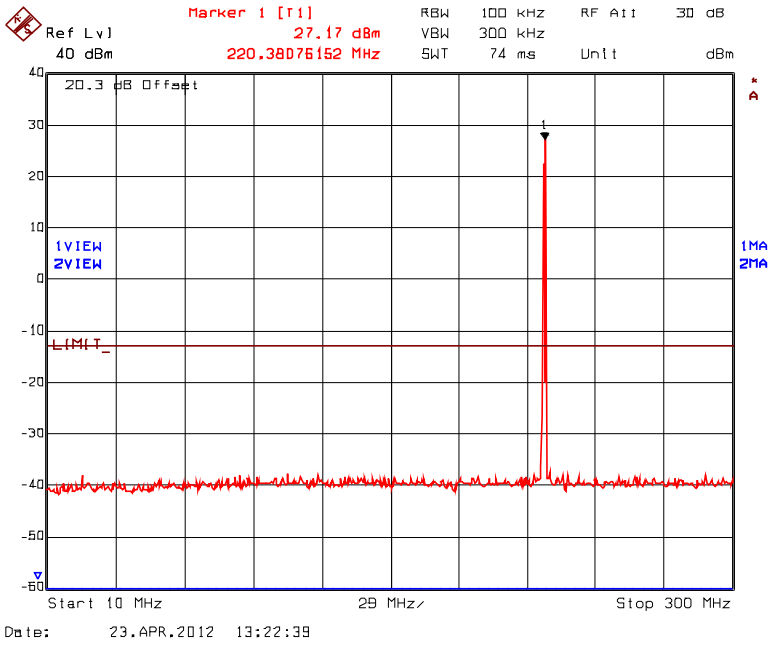
Plot 5.4.4.1.5. Conducted Spurious Emissions, 220 MHz, 25 kHz Channel Spacing, 9600 baud, 2 W, 30 MHz - 300 MHz



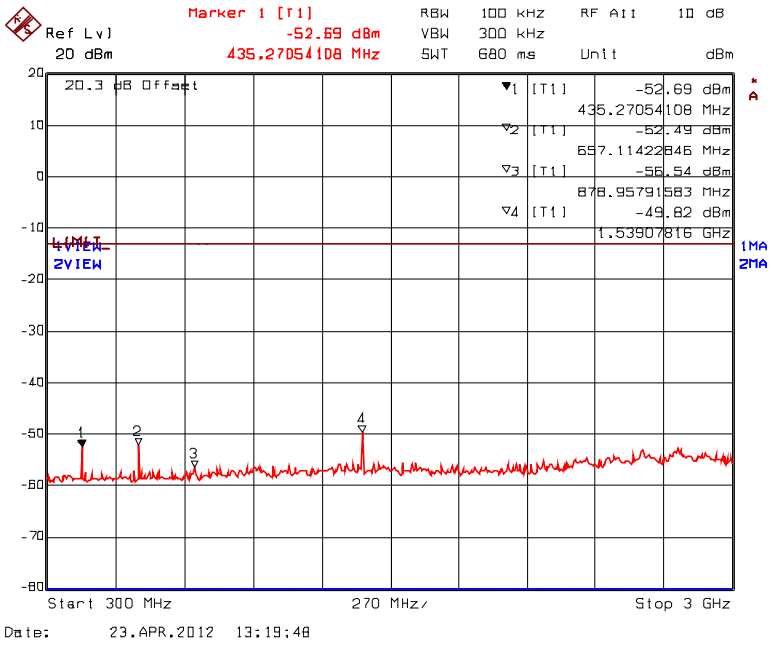
Plot 5.4.4.1.6. Conducted Spurious Emissions, 220 MHz, 25 kHz Channel Spacing, 9600 baud, 2 W, 300 MHz - 3 GHz



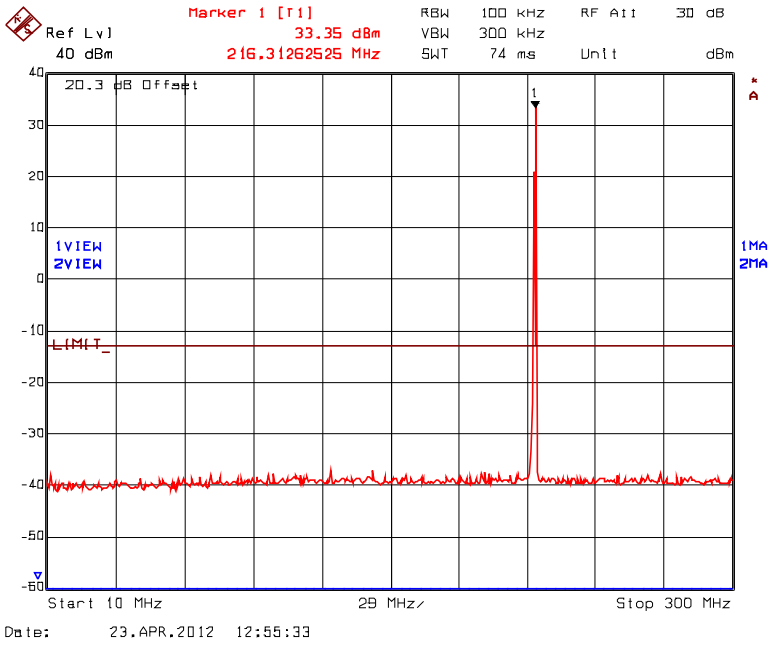
Plot 5.4.4.1.7. Conducted Spurious Emissions, 220 MHz, 25 kHz Channel Spacing, 9600 baud, 0.5 W, 30 MHz - 300 MHz



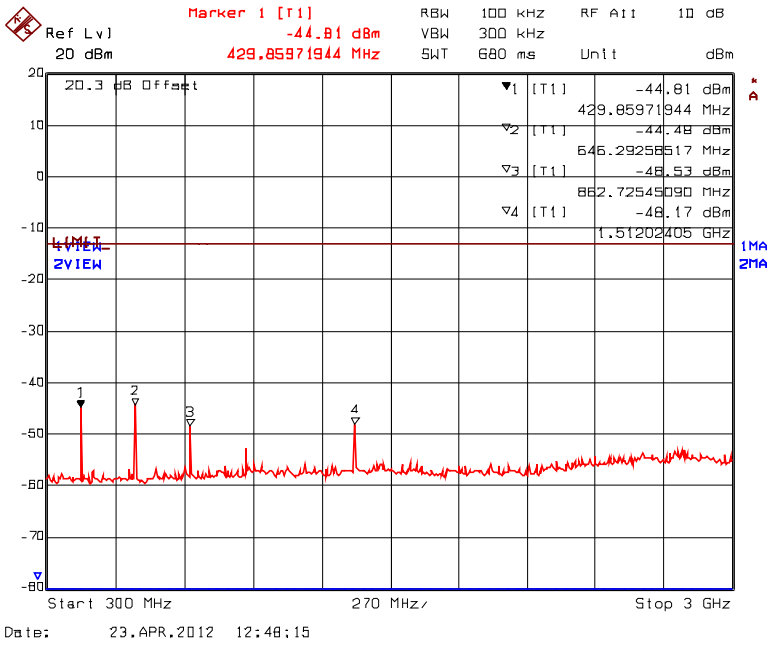
Plot 5.4.4.1.8. Conducted Spurious Emissions, 220 MHz, 25 kHz Channel Spacing, 9600 baud, 0.5 W, 300 MHz - 3 GHz



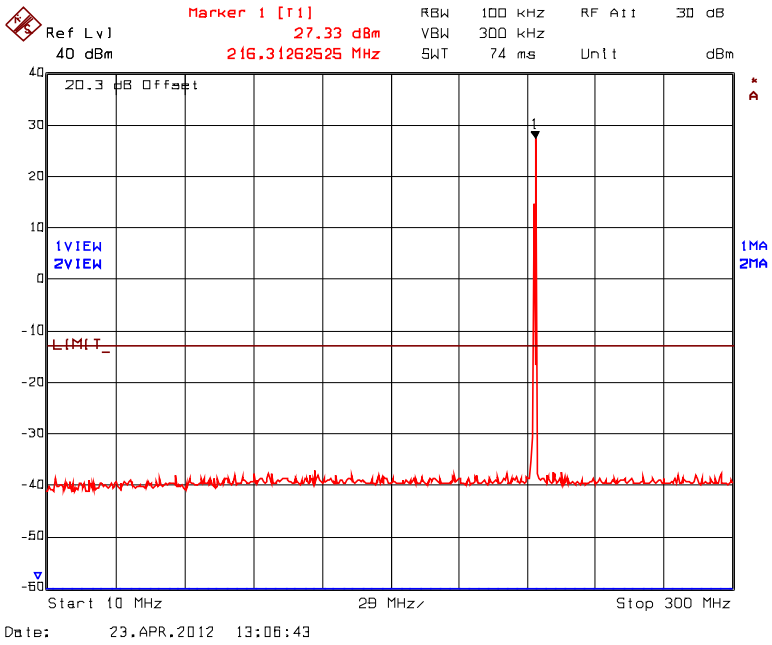
Plot 5.4.4.1.9. Conducted Spurious Emissions, 216 MHz, 25 kHz Channel Spacing, 19200 baud, 2 W, 30 MHz - 300 MHz



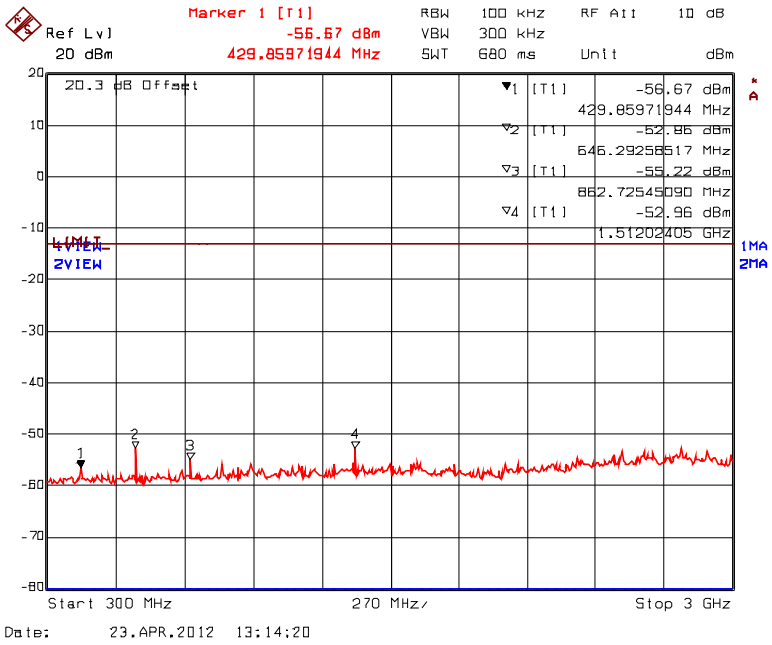
Plot 5.4.4.1.10. Conducted Spurious Emissions, 216 MHz, 25 kHz Channel Spacing, 19200 baud, 2 W, 300 MHz - 3 GHz



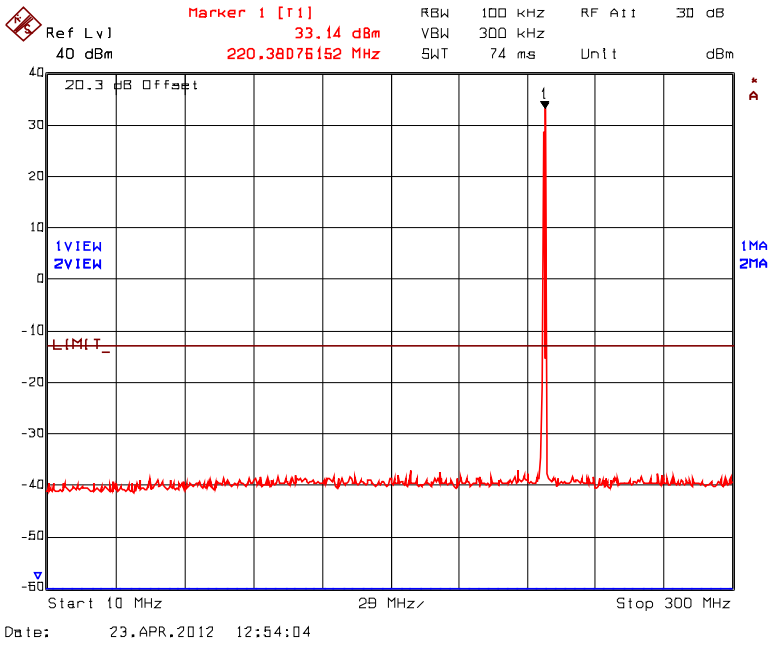
Plot 5.4.4.1.11. Conducted Spurious Emissions, 216 MHz, 25 kHz Channel Spacing, 19200 baud, 0.5 W, 30 MHz - 300 MHz



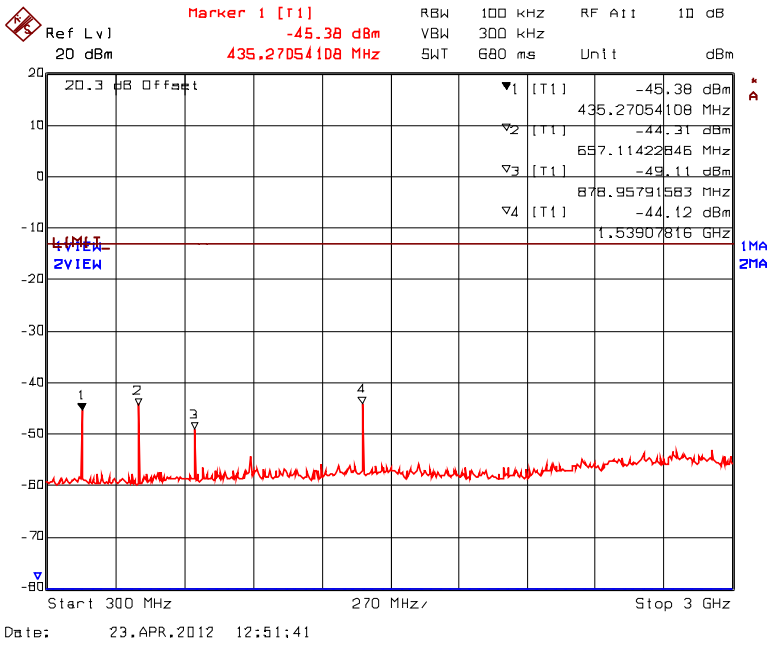
Plot 5.4.4.1.12. Conducted Spurious Emissions, 216 MHz, 25 kHz Channel Spacing, 19200 baud, 0.5 W, 300 MHz - 3 GHz



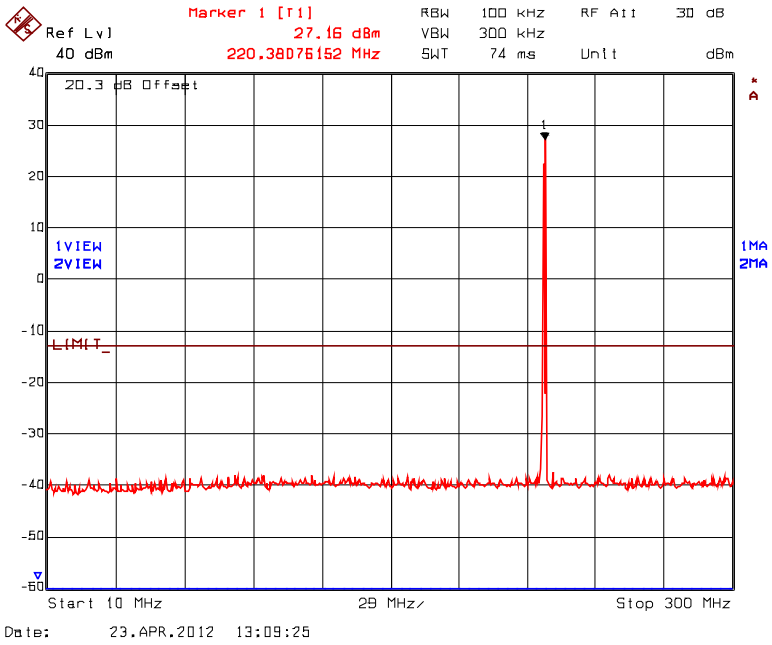
Plot 5.4.4.1.13. Conducted Spurious Emissions, 220 MHz, 25 kHz Channel Spacing, 19200 baud, 2 W, 30 MHz - 300 MHz



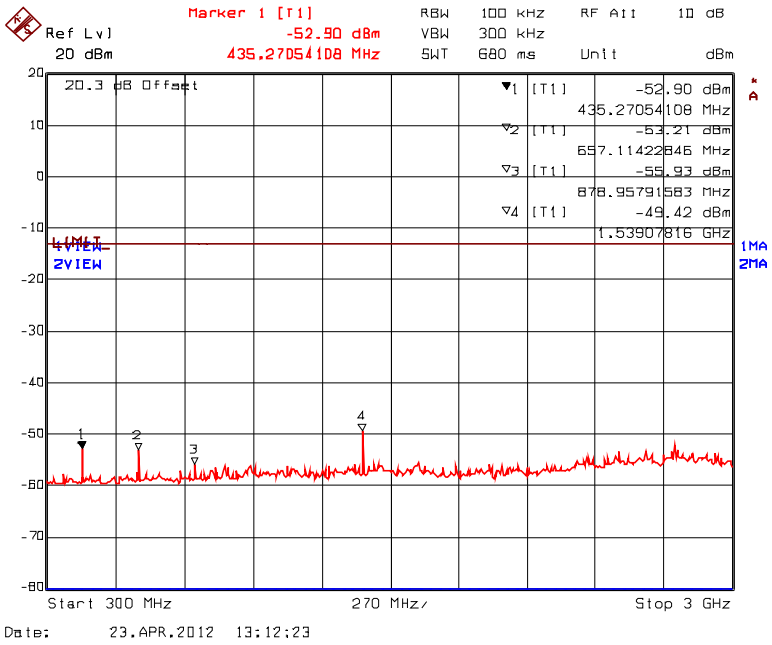
Plot 5.4.4.1.14. Conducted Spurious Emissions, 220 MHz, 25 kHz Channel Spacing, 19200 baud, 2 W, 300 MHz - 3 GHz



Plot 5.4.4.1.15. Conducted Spurious Emissions, 220 MHz, 25 kHz Channel Spacing, 19200 baud, 0.5 W, 30 MHz - 300 MHz

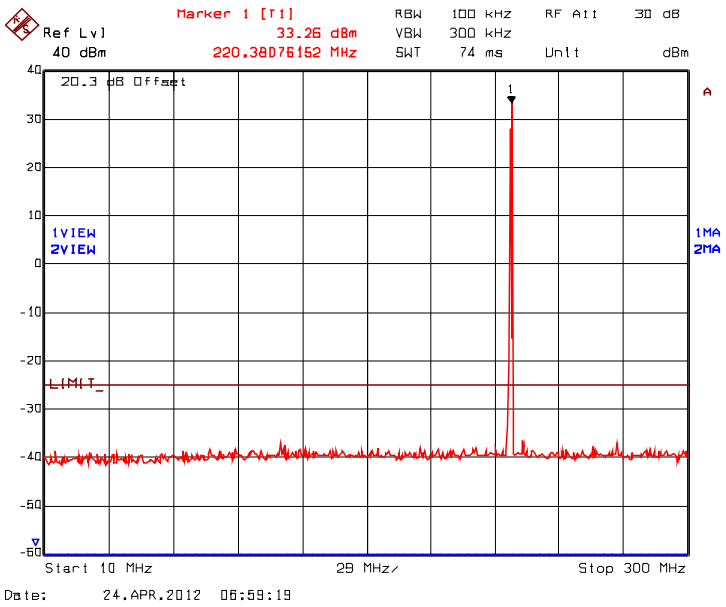


Plot 5.4.4.1.16. Conducted Spurious Emissions, 220 MHz, 25 kHz Channel Spacing, 19200 baud, 0.5 W, 300 MHz - 3 GHz

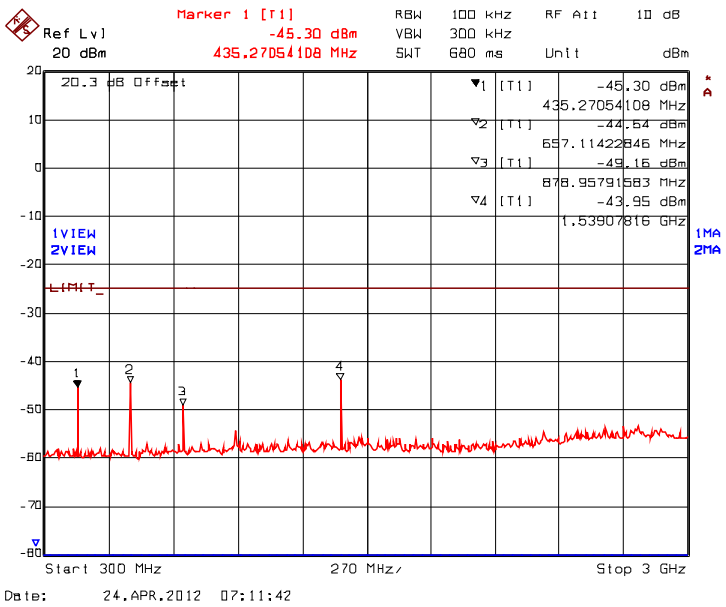


5.4.4.2. Conducted Spurious Emissions for 220-222 MHz Band (§ 90.210 (f)(3))

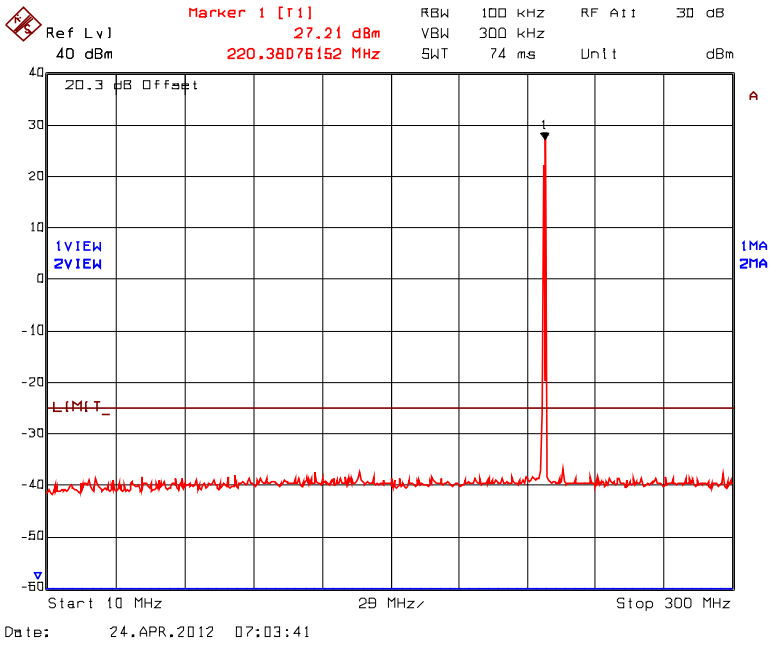
Plot 5.4.4.2.1. Conducted Spurious Emissions, 220 MHz, 25 kHz Channel Spacing, 9600 baud, 2 W, 30 MHz - 300 MHz



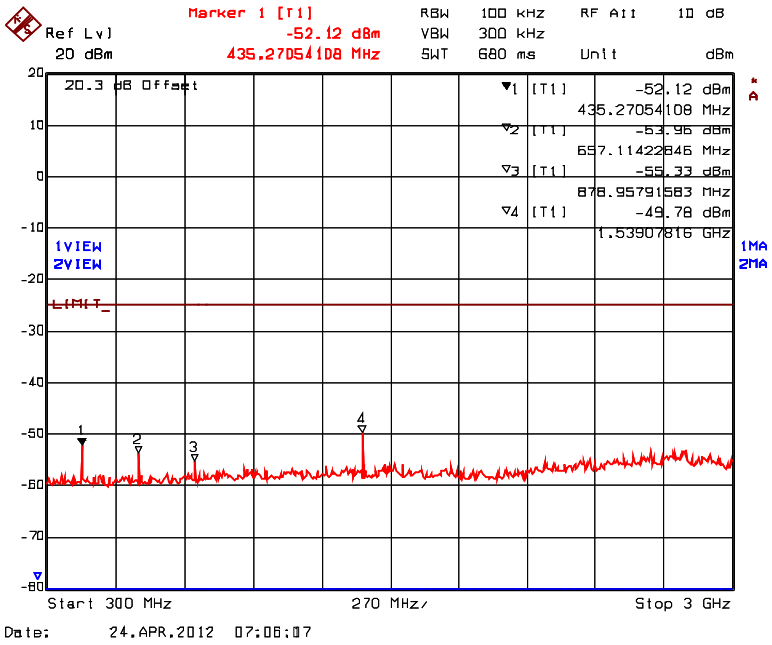
Plot 5.4.4.2.2. Conducted Spurious Emissions, 220 MHz, 25 kHz Channel Spacing, 9600 baud, 2 W, 300 MHz - 3 GHz



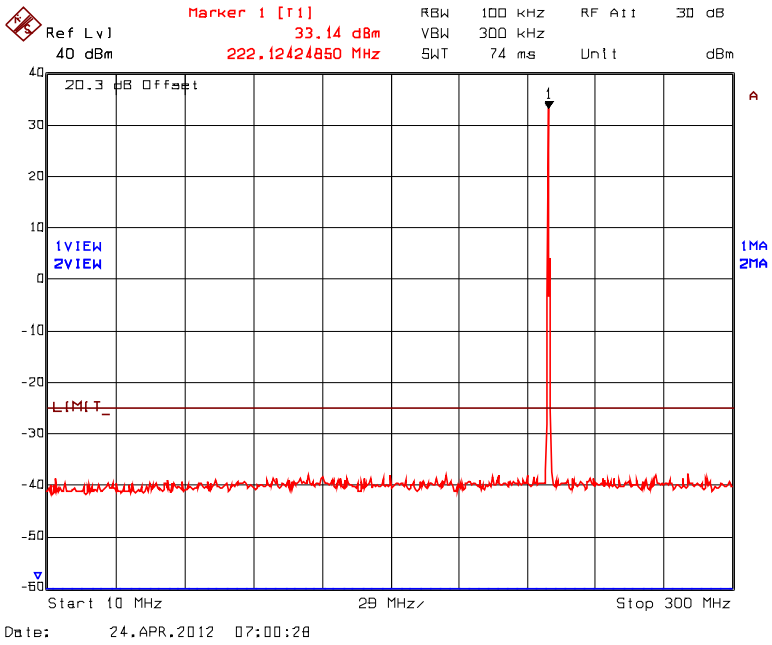
Plot 5.4.4.2.3. Conducted Spurious Emissions, 220 MHz, 25 kHz Channel Spacing, 9600 baud, 0.5 W, 30 MHz - 300 MHz



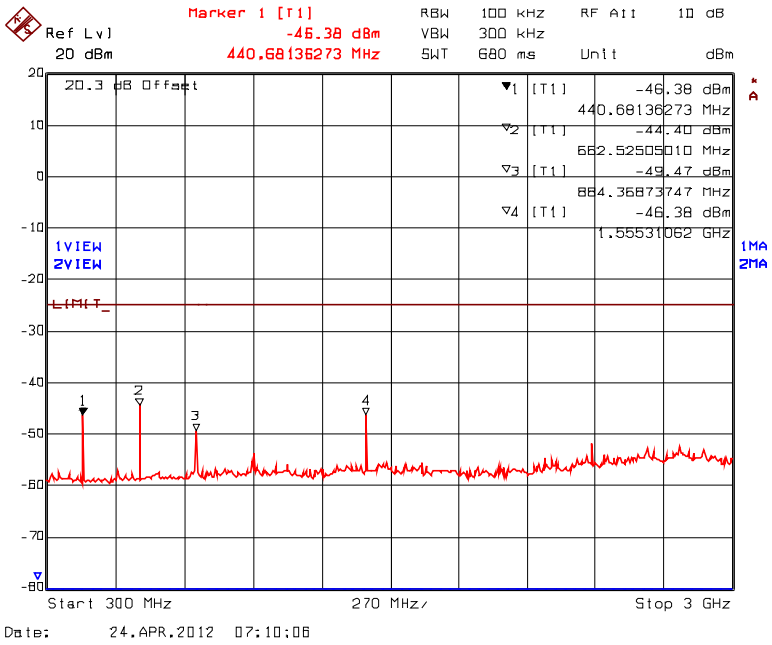
Plot 5.4.4.2.4. Conducted Spurious Emissions, 220 MHz, 25 kHz Channel Spacing, 9600 baud, 0.5 W, 300 MHz - 3 GHz



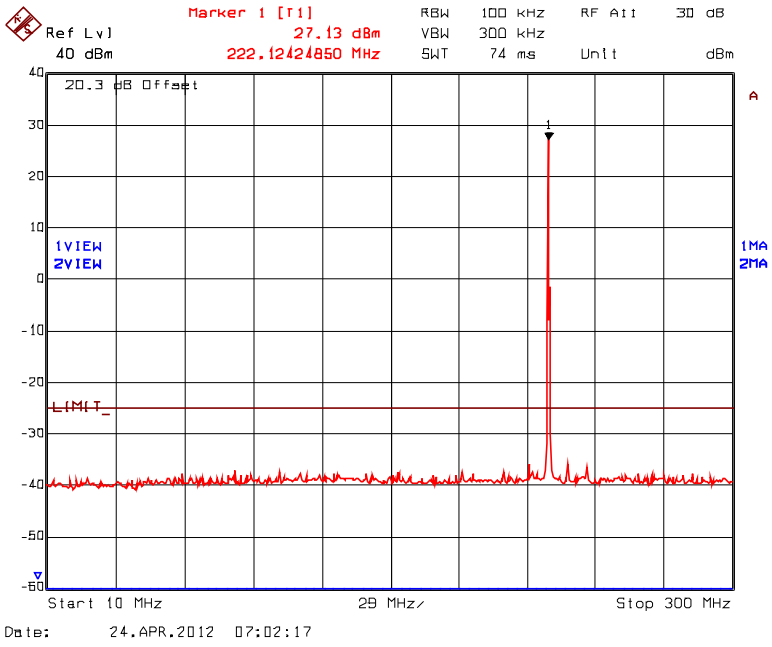
Plot 5.4.4.2.5. Conducted Spurious Emissions, 222 MHz, 25 kHz Channel Spacing, 9600 baud, 2 W, 30 MHz - 300 MHz



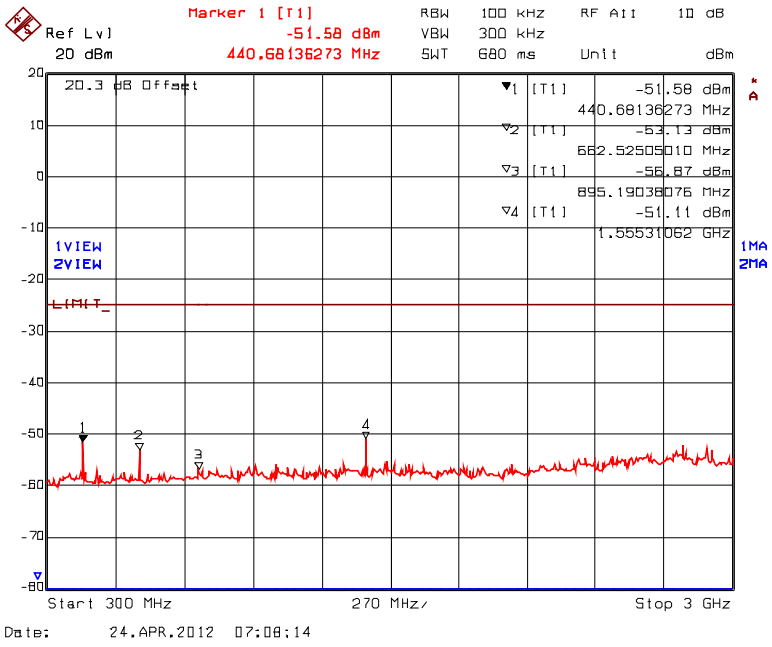
Plot 5.4.4.2.6. Conducted Spurious Emissions, 222 MHz, 25 kHz Channel Spacing, 9600 baud, 2 W, 300 MHz - 3 GHz



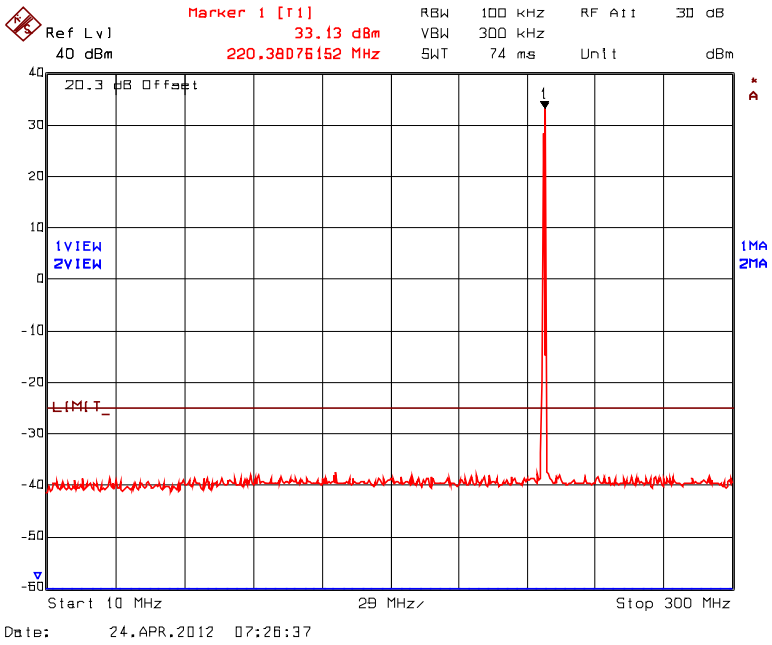
Plot 5.4.4.2.7. Conducted Spurious Emissions, 222 MHz, 25 kHz Channel Spacing, 9600 baud, 0.5 W, 30 MHz - 300 MHz



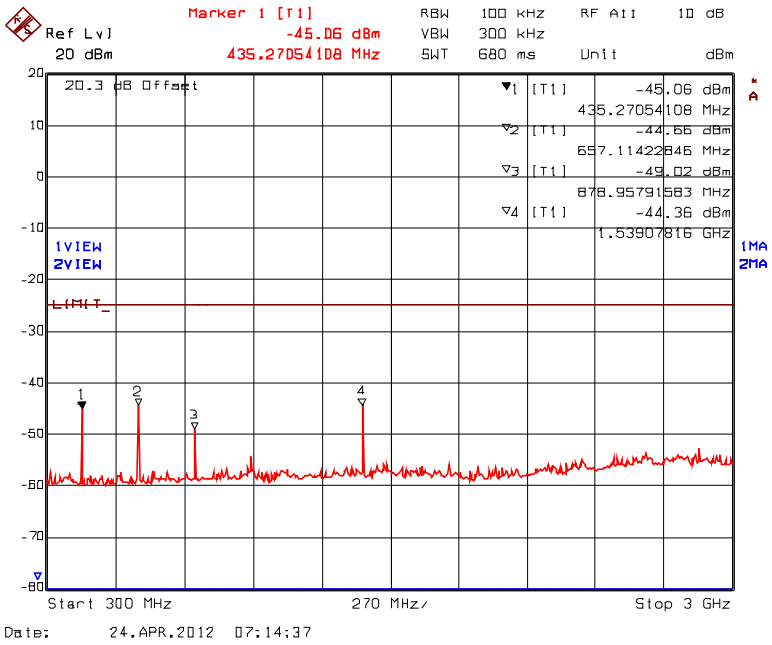
Plot 5.4.4.2.8. Conducted Spurious Emissions, 222 MHz, 25 kHz Channel Spacing, 9600 baud, 0.5 W, 300 MHz - 3 GHz



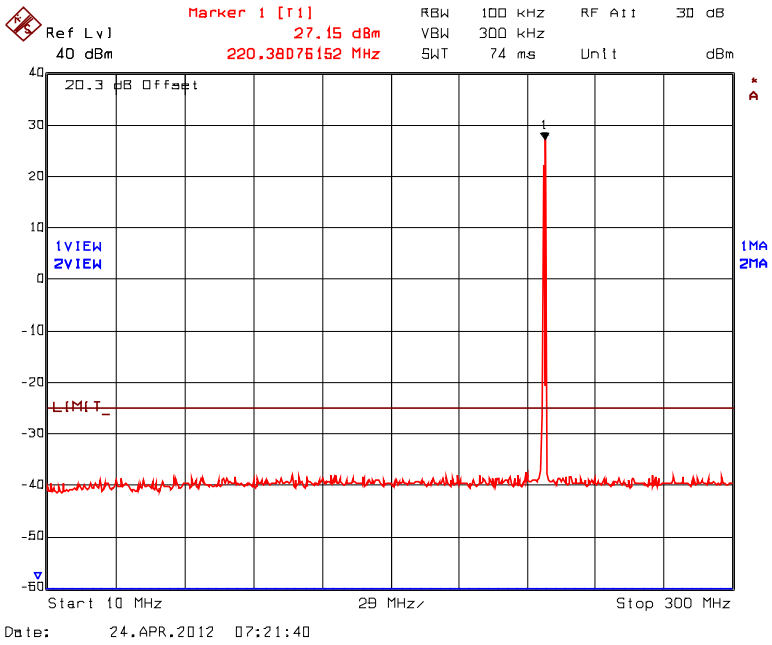
Plot 5.4.4.2.9. Conducted Spurious Emissions, 220 MHz, 25 kHz Channel Spacing, 19200 baud, 2 W, 30 MHz - 300 MHz



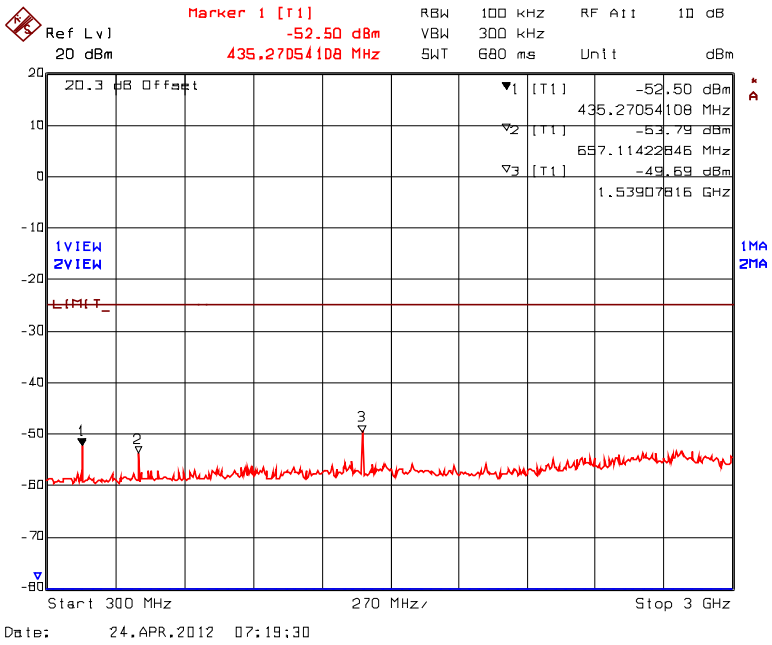
Plot 5.4.4.2.10. Conducted Spurious Emissions, 220 MHz, 25 kHz Channel Spacing, 19200 baud, 2 W, 300 MHz - 3 GHz



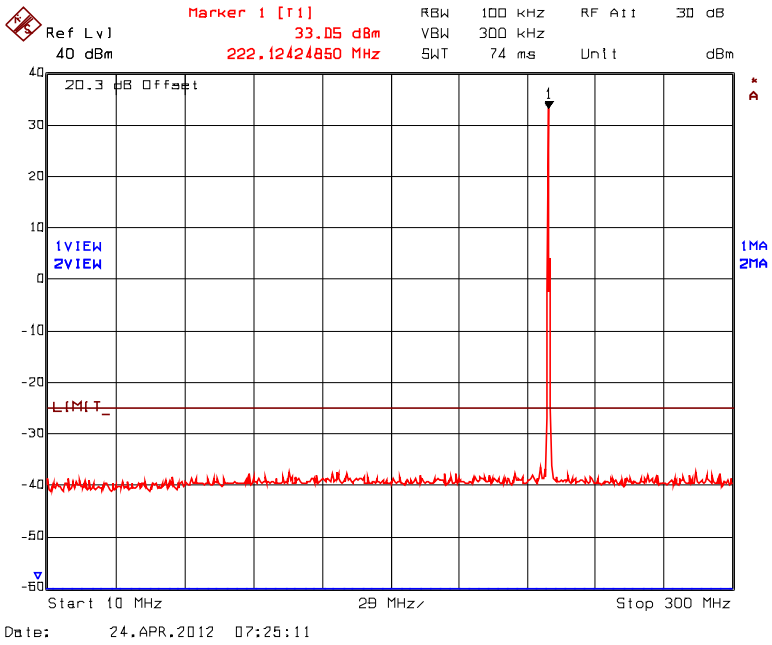
Plot 5.4.4.2.11. Conducted Spurious Emissions, 220 MHz, 25 kHz Channel Spacing, 19200 baud, 0.5 W, 30 MHz - 300 MHz



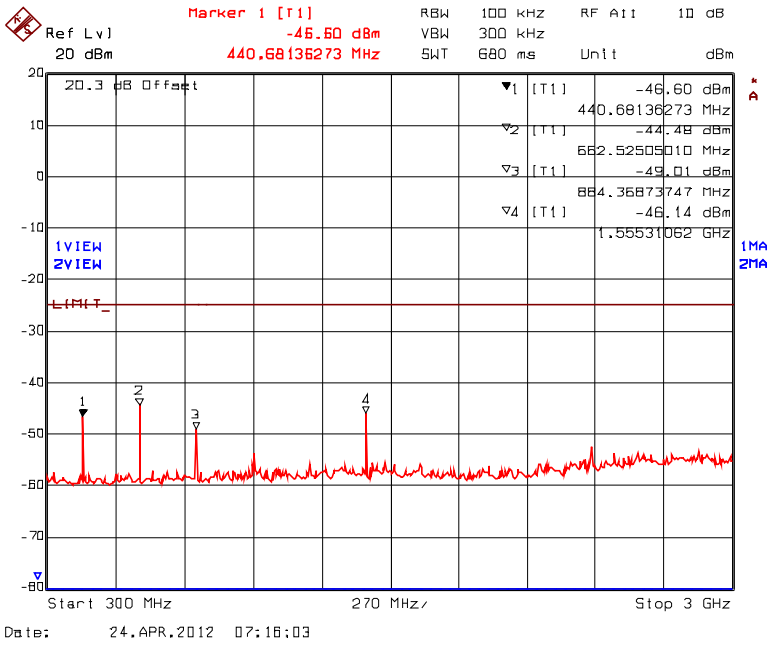
Plot 5.4.4.2.12. Conducted Spurious Emissions, 220 MHz, 25 kHz Channel Spacing, 19200 baud, 0.5 W, 300 MHz - 3 GHz



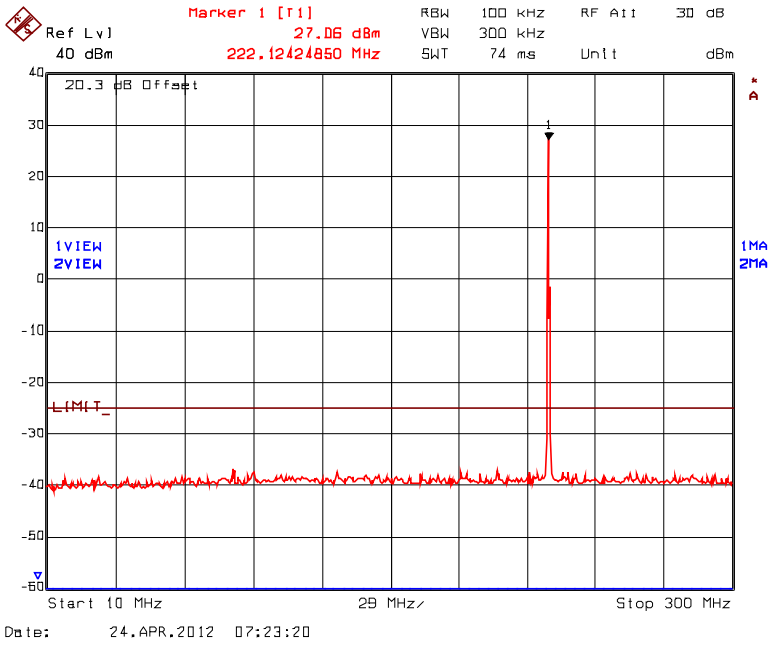
Plot 5.4.4.2.13. Conducted Spurious Emissions, 222 MHz, 25 kHz Channel Spacing, 19200 baud, 2 W, 30 MHz - 300 MHz



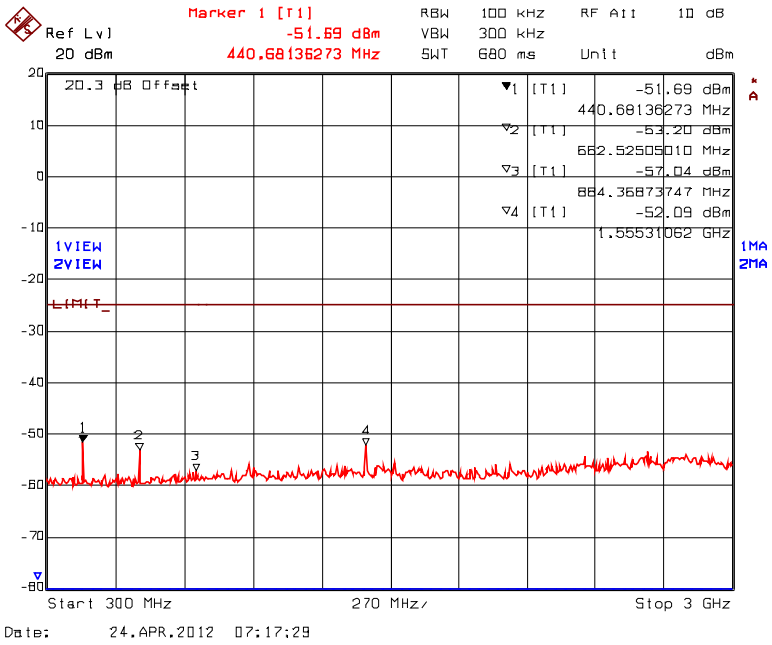
Plot 5.4.4.2.14. Conducted Spurious Emissions, 222 MHz, 25 kHz Channel Spacing, 19200 baud, 2 W, 300 MHz - 3 GHz



Plot 5.4.4.2.15. Conducted Spurious Emissions, 222 MHz, 25 kHz Channel Spacing, 19200 baud, 0.5 W, 30 MHz - 300 MHz



Plot 5.4.4.2.16. Conducted Spurious Emissions, 222 MHz, 25 kHz Channel Spacing, 19200 baud, 0.5 W, 300 MHz - 3 GHz



5.5. TRANSMITTER SPURIOUS/HARMONIC RADIATED EMISSIONS [§§ 2.1053, 80.211 & 90.210]

5.5.1. Limits

§ 80.211 (f)(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 plus 10log10 (mean power in watts) dB.

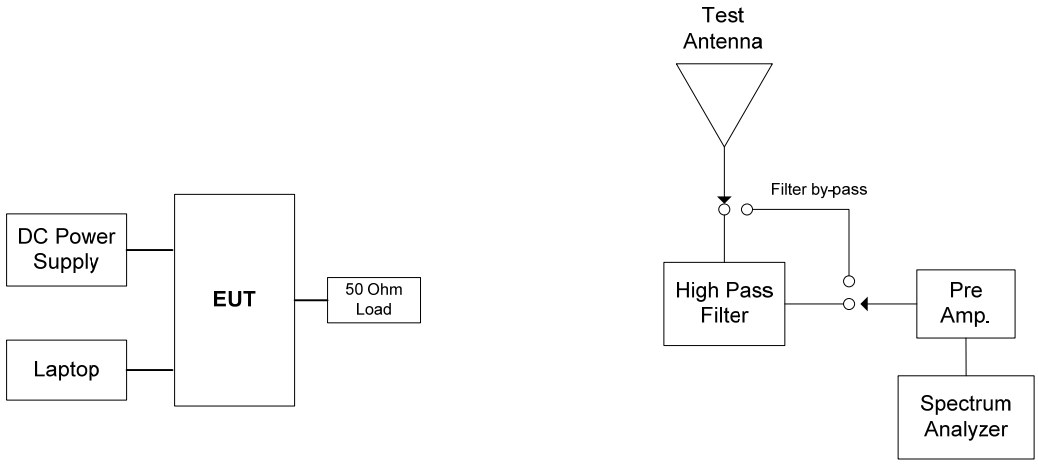
§ 90.210 (c)(3) On any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

§ 90.210 (f)(3) On any frequency beyond 3.75 kHz removed from the center of the authorized bandwidth $f_{d\leq}$ At least 55 + 10 log (P) dB.

5.5.2. Method of Measurements

See substitution test method specified in 8.2 of this report

5.5.3. Test Arrangement



5.5.4. Test Data

Remarks:

- The emissions were scanned from 30 MHz to 10th harmonics; all spurious emissions that are in excess of 20dB below the specified limit shall be recorded.
- Exploratory tests were conducted with modulations in the range of typical modes of operation to identify the worst-case modulation. There were no discernable differences detected. The high power setting with 9600 baud symbol rate was used to represents the worst-case test configuration for the final measurement.
- The more stringent limit will be applied for compliance.

Test Frequency (MHz):	216					
Limit (dBm):	-25					
Frequency (MHz)	**E-Field (dBµV/m)**	**EMI Detector (Peak/QP)**	**Antenna Polarization (H/V)**	**ERP (dBm)**	**Limit (dBm)**	**Margin (dB)**
30 - 3000	*	Peak	H/V	*	-25	*

* All harmonics and spurious emissions are more than 20 dB below the specified attenuation limit.

Test Frequency (MHz):	220					
Limit (dBm):	-25					
Frequency (MHz)	**E-Field (dBµV/m)**	**EMI Detector (Peak/QP)**	**Antenna Polarization (H/V)**	**ERP (dBm)**	**Limit (dBm)**	**Margin (dB)**
30 - 3000	*	Peak	H/V	*	-25	*

* All harmonics and spurious emissions are more than 20 dB below the specified attenuation limit.

Test Frequency (MHz):	222					
Limit (dBm):	-25					
Frequency (MHz)	**E-Field (dBµV/m)**	**EMI Detector (Peak/QP)**	**Antenna Polarization (H/V)**	**ERP (dBm)**	**Limit (dBm)**	**Margin (dB)**
30 - 3000	*	Peak	H/V	*	-25	*

* All harmonics and spurious emissions are more than 20 dB below the specified attenuation limit.

5.6. FREQUECNY STABILITY [§§ 2.1055, 80.209 & 90.213]

5.6.1. Limits

See § 80.209

Frequency Band	Coast Stations	Ship Stations
216–220 MHz	5 ppm	5 ppm

See § 90.213

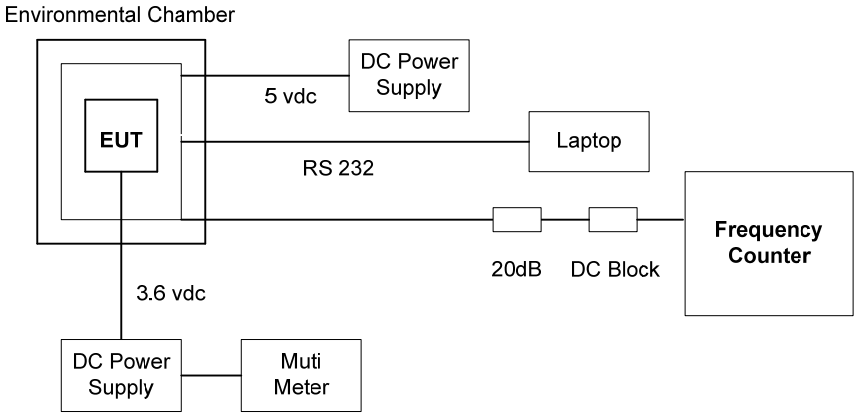
Frequency Range (MHz)	Minimum Frequency Stability (ppm)		
	Fixed and Base Stations	Mobile Stations	
		> 2 W	≤ 2 W
216–220	1 .0	--	1 .0
220–222 [1]	0.1	1.5	1.5

[1] Mobile units may utilize synchronizing signals from associated base stations to achieve the specified carrier stability.

5.6.2. Method of Measurements

Refer to Section 8.3 of this report for measurement details

5.6.3. Test Arrangement



5.6.4. Test Data

Center Frequency:	217 MHz
Full Power Level:	33 dBm
Frequency Tolerance Limit (Worst Case):	±1 ppm or 217 Hz
Max. Frequency Tolerance Measured:	+57 Hz or 0.26 ppm
Input Voltage Rating:	3.6 VDC

Ambient Temperature (°C)	**Frequency Drift (Hz)**		
	Supply Voltage (Nominal) 3.6 VDC	**Supply Voltage (Lowest Operating Voltage) 3.2 VDC**	**Supply Voltage (Highest Operating Voltage) 3.8 VDC**
-30	+57		
-20	+22	--	--
-10	+42	--	--
0	+22	--	--
+10	+31	--	--
+20	+21	+14	+10
+30	+27	--	--
+40	+9	--	--
+50	+39	--	--

5.7. EXPOSURE OF HUMANS TO RF FIELD [[§§ 1.1310 & 2.1091]

The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation.

FCC 47 CFR § 1.1310:

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*($900/f^2$)	6
30–300	61.4	0.163	1.0	6
300–1500	.....	.....	f/300	6
1500–100,000	.....	.....	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*($180/f^2$)	30
30–300	27.5	0.073	0.2	30
300–1500	.....	.....	f/1500	30
1500–100,000	.....	.....	1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

5.7.1. Method of Measurements

See RSS-102 & FCC 47 CFR §§ 1.1310, 2.1091

In order to demonstrate compliance with MPE requirements, the following information is typically needed:

(1) Calculation that estimates the minimum separation distance (20 cm or more) between an antenna and persons required to satisfy power density limits defined for free space.
(2) Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement
(3) Any caution statements and/or warning labels that are necessary in order to comply with the exposure limits
(4) Any other RF exposure related issues that may affect MPE compliance

Calculation Method of RF Safety Distance:

$$S = \frac{P \cdot G}{4 \cdot \pi \cdot r^2} = \frac{EIRP}{4 \cdot \pi \cdot r^2}$$

Where: P: power input to the antenna in mW
EIRP: Equivalent (effective) isotropic radiated power
S: power density mW/cm^2
G: numeric gain of antenna relative to isotropic radiator
r: distance to centre of radiation in cm

5.7.2. RF Evaluation

Evaluation of RF Exposure Compliance Requirements	
RF Exposure Requirements	**Compliance with FCC Rules**
*Minimum calculated separation distance between antenna and persons required: 141 cm ≈ 1.4 m	Manufacturer' instruction for separation distance between antenna and persons required: See the user's manual for information.
Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement	Antenna installation and device operating instructions shall be provided to installers to maintain and ensure compliance with RF exposure requirements.
Caution statements and/or warning labels that are necessary in order to comply with the exposure limits	Refer to User's Manual for RF Exposure Information.
Any other RF exposure related issues that may affect MPE compliance	None.

*The minimum separation distance between the antenna and bodies of users are calculated using the following formula:

RF EXPOSURE DISTANCE LIMITS

$$r = \sqrt{\frac{P \cdot G}{4 \cdot \pi \cdot S}} = \sqrt{\frac{EIRP}{4 \cdot \pi \cdot S}}$$

S = 0.2 mW/cm^2
EIRP = 47 dBm = $10^{47/10}$ mW = 50119 mW (Worst Case)

(Minimum Safe Distance, r) = $\sqrt{\frac{EIRP}{4 \cdot \pi \cdot S}} = \sqrt{\frac{50119}{4 \cdot \pi \cdot (0.2)}} \approx 141 cm$

EXHIBIT 6. TEST EQUIPMENT LIST

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range	Cal. Due Date
Attenuator	Weinschel	46-20-34	BM1347	DC – 18 GHz	Cal on use
DC Block	Hewlett Packard	11742A	12460	0.045 – 26.5 GHz	Cal on use
Power Meter	Hewlett Packard	436A	2016A07747	10 kHz – 50 GHz, sensor dependent	11 Nov 2012
Power Sensor	Hewlett Packard	8481A	2237A33409	10 MHz – 18 GHz	11 Nov 2012
DC Power Supply	Tenma	72-7295	490300297	1 - 40vdc	Cal on use
DC Power Supply	Tenma	72-7295	490300270	1 - 40vdc	Cal on use
Modulation Analyzer	Hewlett Packard	8910B	3226A04606	150 kHz – 1300 MHz	12 Jan 2013
Spectrum Analyzer	Rohde & Schwarz	FSEK30	100077	20Hz–40 GHz	27 Sep 2012
High Pass Filter	Mini-Circuit	SHP-300	10427	Cut off 200 MHz	Cal on use
Spectrum Analyzer	Rohde & Schwarz	ESU40	100037	20 Hz – 40 GHz	19 Mar 2013
RF Amplifier	Hewlett Packard	84498	3008A00769	1 – 26.5 GHz	01 Dec 2012
RF Amplifier	AH System	PAM-0118	225	20 MHz – 18 GHz	16 Mar 2013
Horn Antenna	EMCO	3155	6570	1 – 18 GHz	02 April 2013
Biconi-Log Antenna	EMCO	3142C	00034792	26 – 3000 MHz	04 May 2013
Signal Generator	Hewlett Packard	83752B	3610A00457	0.01-20 GHz	14 Dec 2012
RF Amplifier	Com-Power	PA-103A	161243	10 – 1000 MHz	01 Dec 2012
Horn Antenna	EMCO	3155	5955	1 – 18 GHz	20 Feb 2013
Dipole Antenna	EMCO	3121-DB4	434	400 – 1000 MHz	06 Jan 2014
Attenuator	Weinschel	4M	ES157	1 – 18 GHz	Cal on use
Frequency Counter	EIP	545A	02683	10 Hz – 18 GHz	01 Mar 2013
Multimeter	Keithley	2000	0592806	100nV to 1kV	27 Feb 2013
Environmental Chamber	Envirotronics	SSH32C	11994847-S-11059	-60 to 177 degree C	06 Aug 2012

EXHIBIT 7. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of CISPR 16-4-2 @ IEC:2003 and JCGM 100:2008 (GUM 1995) – Guide to the Expression of Uncertainty in Measurement.

7.1. LINE CONDUCTED EMISSION MEASUREMENT UNCERTAINTY

	Line Conducted Emission Measurement Uncertainty (150 kHz – 30 MHz):	**Measured**	**Limit**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)}$	**± 1.57**	**± 1.8**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 3.14**	**± 3.6**

7.2. RADIATED EMISSION MEASUREMENT UNCERTAINTY

	Radiated Emission Measurement Uncertainty @ 3m, Horizontal (30-1000 MHz):	**Measured**	**Limit**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)}$	**± 2.15**	**± 2.6**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 4.30**	**± 5.2**

	Radiated Emission Measurement Uncertainty @ 3m, Vertical (30-1000 MHz):	**Measured**	**Limit**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)}$	**± 2.39**	**± 2.6**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 4.78**	**± 5.2**

	Radiated Emission Measurement Uncertainty @ 3 m, Horizontal & Vertical (1 – 18 GHz):	**Measured**	**Limit**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)}$	**± 1.87**	**Under consideration**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 3.75**	**Under consideration**

EXHIBIT 8. MEASUREMENT METHODS

8.1. CONDUCTED POWER MEASUREMENTS

The following shall be applied to the combination(s) of the radio device and its intended antenna(e).

- I f the RF level is user adjustable, all measurements shall be made with the highest power level available to the user for that combination.
- The following method of measurement shall apply to both conducted and radiated measurements.
  - The radiated measurements are performed at the Ultratech Calibrated Open Field Test Site.
  - The measurement shall be performed using normal operation of the equipment with modulation.

- Test procedure shall be as follows:

Step 1: Duty Cycle measurements if the transmitter's transmission is transient

- Using a EMI Receiver with the frequency span set to 0 Hz and the sweep time set at a suitable value to capture the envelope peaks and the duty cycle of the transmitter output signal;
- The duty cycle of the transmitter, x = Tx on / (Tx on + Tx off) with 0<x<1, is measure and recorded in the test report. For the purpose of testing, the equipment shall be operated with a duty cycle that is equal or more than 0.1.

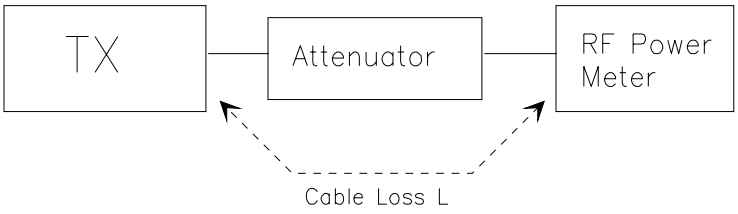
Step 2: Calculation of Average EIRP. See Figure 1

- The average output power of the transmitter shall be determined using a wideband, calibrated RF average power meter with the power sensor with an integration period that exceeds the repetition period of the transmitter by a factor 5 or more. The observed value shall be recorded as "A" (in dBm);
- The e.i.r.p. shall be calculated from the above measured power output "A", the observed duty cycle x, and the applicable antenna assembly gain "G" in dBi, according to the formula:

EIRP = A + G + 10log(1/x)

{ X = 1 for continuous transmission => 10log(1/x) = 0 dB }

Figure 1.



8.2. RADIATED POWER MEASUREMENTS (ERP & EIRP) USING SUBSTITUTION METHOD

8.2.1. Maximizing RF Emission Level (E-Field)

(a) The measurements was performed with full rf output power and modulation.
(b) Test was performed at listed 3m open area test site (listed with FCC, IC, ITI, NVLAP, ACA & VCCI).
(c) The transmitter under test was placed at the specified height on a non-conducting turntable (80 cm height)
(d) The BICONILOG antenna (20 MHz to 1 GHz) or HORN antenna (1 GHz to 18 GHz) was used for measuring.
(e) Load an appropriate correction factors file in EMI Receiver for correcting the field strength reading level

Total Correction Factor recorded in the EMI Receiver = Cable Loss + Antenna Factor
E (dBuV/m) = Reading (dBuV) + Total Correction Factor (dB/m)

(f) Set the EMI Receiver and #2 as follows:

Center Frequency:	test frequency
Resolution BW:	100 kHz
Video BW:	same
Detector Mode:	positive
Average:	off
Span:	3 x the signal bandwidth

(g) The test antenna was lowered or raised from 1 to 4 meters until the maximum signal level was detected.
(h) The transmitter was rotated through 360^{o} about a vertical axis until a higher maximum signal was received.
(i) The test antenna was lowered or raised again from 1 to 4 meters until a maximum was obtained. This level was recorded.
(j) The recorded reading was corrected to the true field strength level by adding the antenna factor, cable loss and subtracting the pre-amplifier gain.
(k) The above steps were repeated with both transmitters' antenna and test receiving antenna placed in vertical and horizontal polarization. Both readings with the antennas placed in vertical and horizontal polarization shall be recorded.
(l) Repeat for all different test signal frequencies

8.2.2. Measuring the EIRP of Spurious/Harmonic Emissions using Substitution Method

(a) Set the EMI Receiver (for measuring E-Field) and Receiver #2 (for measuring EIRP) as follows:

Center Frequency:	equal to the signal source
Resolution BW:	100 kHz
Video BW:	VBW > RBW
Detector Mode:	positive
Average:	off
Span:	3 x the signal bandwidth

(b) Load an appropriate correction factors file in EMI Receiver for correcting the field strength reading level

Total Correction Factor recorded in the EMI Receiver = Cable Loss + Antenna Factor
E (dBuV/m) = Reading (dBuV) + Total Correction Factor (dB/m)

(c) Select the frequency and E-field levels obtained in the Section 8.2.1 for ERP/EIRP measurements.
(d) Substitute the EUT by a signal generator and one of the following transmitting antenna (substitution antenna):
- DIPOLE antenna for frequency from 30-1000 MHz or
- HORN antenna for frequency above 1 GHz }.

(e) Mount the transmitting antenna at 1.5 meter high from the ground plane.
(f) Use one of the following antenna as a receiving antenna:
- DIPOLE antenna for frequency from 30-1000 MHz or
- HORN antenna for frequency above 1 GHz }.

(g) If the DIPOLE antenna is used, tune it's elements to the frequency as specified in the calibration manual.
(h) Adjust both transmitting and receiving antenna in a VERTICAL polarization.
(i) Tune the EMI Receivers to the test frequency.
(j) Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.
(k) The transmitter was rotated through 360^{o} about a vertical axis until a higher maximum signal was received.
(l) Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.
(m) Adjust input signal to the substitution antenna until an equal or a known related level to that detected from the transmitter was obtained in the test receiver.
(n) Record the power level read from the Average Power Meter and calculate the ERP/EIRP as follows:

P = P1 - L1 = (P2 + L2) – L1 = P3 + A + L2 - L1
EIRP = P + G1 = P3 + L2 - L1 + A + G1
ERP = EIRP – 2.15 dB
Total Correction factor in EMI Receiver # 2 = L2 – L1 + G1

Where: P: Actual RF Power fed into the substitution antenna port after corrected.
P1: Power output from the signal generator
P2: Power measured at attenuator A input
P3: Power reading on the Average Power Meter
EIRP: EIRP after correction
ERP: ERP after correction

(o) Adjust both transmitting and receiving antenna in a HORIZONTAL polarization, then repeat step (k) to (o)
(p) Repeat step (d) to (o) for different test frequency
(q) Repeat steps (c) to (j) with the substitution antenna oriented in horizontal polarization.
(r) Actual gain of the EUT's antenna is the difference of the measured EIRP and measured RF power at the RF port. Correct the antenna gain if necessary.

Figure 2

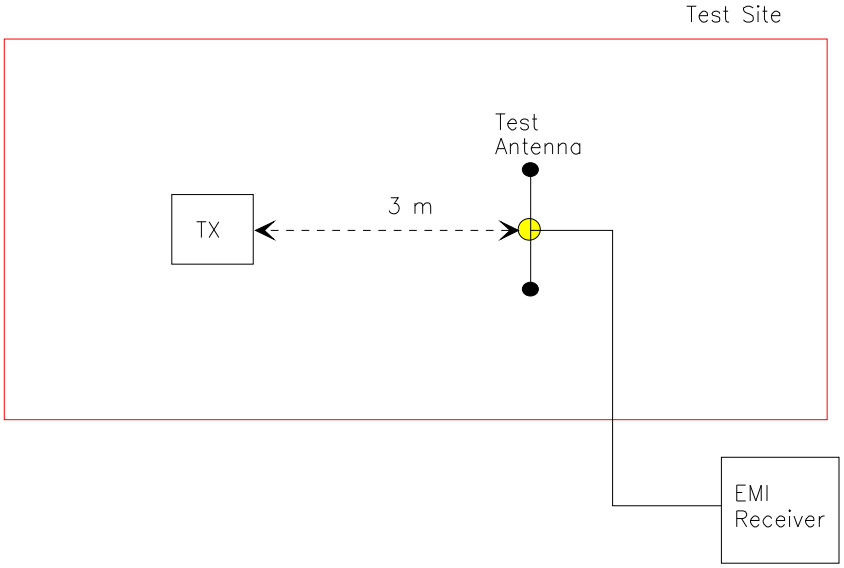
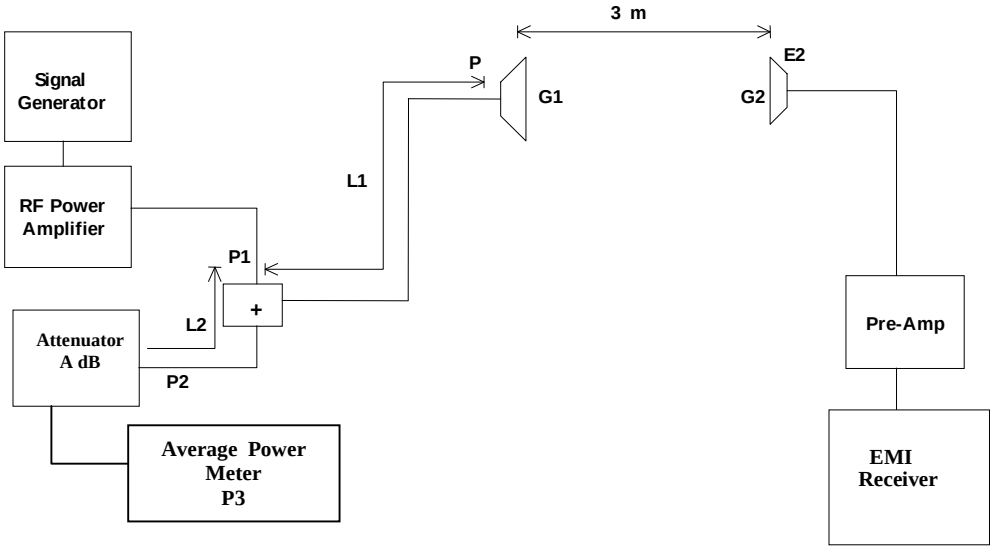


Figure 3



8.3. FREQUENCY STABILITY

Refer to § 2.1055.

(a) The frequency stability shall be measured with variation of ambient temperature as follows: From -30 to +50 centigrade except that specified in subparagraph (2) & (3) of this paragraph.

(b) Frequency measurements shall be made at extremes of the specified temperature range and at intervals of not more than 10 centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short-term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stability circuitry need be subjected to the temperature variation test.

(d) The frequency stability supply shall be measured with variation of primary supply voltage as follows:

(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

(2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.

(3) The supply voltage shall be measured at the input to the cable normally provide with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

(e) When deemed necessary, the Commission may require tests of frequency stability under conditions in addition to those specifically set out in paragraphs (a), (b), (c) and (d) of this section. (For example, measurements showing the effect of proximity to large metal objects, or of various types of antennas, may be required for portable equipment).

8.4. EMISSION MASK

Voice or Digital Modulation Through a Voice Input Port @ 2.1049(c)(i):- The transmitter was modulated by a 2.5 KHz tone signal at an input level 16 dB greater than that required to produce 50% modulation (e.g.: ±2.5 KHz peak deviation at 1 KHz modulating frequency). The input level was established at the frequency of maximum response of the audio modulating circuit.

Digital Modulation Through a Data Input Port @ 2.1049(h):- Transmitters employing digital modulation techniques - when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment will be operated. The signal shall be applied through any filter networks, pseudo-random generators or other devices required in normal service. Additionally, the Emission Masks shall be shown for operation with any devices used for modifying the spectrum when such devices are operational at the discretion of the user.

The following EMI Receiver bandwidth shall be used for measurement of Emission Mask/Out-of-Band Emission Measurements:

For 25 kHz Channel Spacing: RBW = 300 Hz
For 12.5 kHz or 6.25 kHz Channel Spacings: RBW = 100 Hz

The all cases the Video Bandwidth shall be equal or greater than the measuring bandwidth.

8.5. SPURIOUS EMISSIONS (CONDUCTED)

With transmitter modulation characteristics described in Out-of-Band Emissions measurements @ 2.1049, the transmitter spurious and harmonic emissions were scanned. The spurious and harmonic emissions were measured with the EMI Receiver controls set as RBW = 30 kHz minimum , VBW ≥ RBW and SWEEP TIME = AUTO). The transmitter was operated at a full rated power output, and modulated as follows:

FCC 47 CFR 2.1057 - Frequency Spectrum to be investigated: The spectrum was investigated from the lowest radio generated in the equipment up to at least the 10^{th} harmonic of the carrier frequency or to the highest frequency practicable in the present state of the art of measuring techniques, whichever is lower. Particular attention should be paid to harmonics and subharmonics of the carrier frequency. Radiation at the frequencies of multiplier stages should be checked. The
amplitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be reported.

FCC 47 CFR 2.1051 - Spurious Emissions at Antenna Terminal: The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of the harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.