



FCC/IC Test Report

FCC Part 95 and Industry Canada RSS-210

FOR: Spectrum Management LLC

Model Name: TracPac-GT GSM

Cellular Asset Recovery Device

FCC ID: NBI-MTAG216G

IC ID: 8207A-MTAG216G

47 CFR Part 95G for Low Power Radio Service (LPRS)

TEST REPORT #: EMC_SPECT_006_09001_FCC95G_rev1

DATE: 2009-12-04



**FCC listed
A2LA Accredited**

**IC recognized #
3462B**

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1 Assessment

The following is in compliance with the applicable criteria specified in FCC rules Parts 95G of Title 47 of the Code of Federal Regulations and Industry Canada Standards RSS 210 Issue 7 June 2007.

Company	Description	Model #
Spectrum Management LLC	Cellular Asset Recovery Device	TracPac-GT GSM

Responsible for Testing Laboratory:

2009-12-04	Compliance	Marc Douat (Test Lab Manager)	
Date	Section	Name	Signature

Responsible for the Report:

2009-12-04	Compliance	Satya Radhakrishna (EMC Project Engineer)	
Date	Section	Name	Signature

The test results of this test report relate exclusively to the test item specified in Section3. CETECOM Inc. USA 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. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of the CETECOM Inc USA.

2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the EMC Test Report

Company Name:	CETECOM Inc.
Department:	EMC
Address:	411 Dixon Landing Road Milpitas, CA 95035 U.S.A.
Telephone:	+1 (408) 586 6200
Fax:	+1 (408) 586 6299
Responsible Test Lab Manager:	Heiko Strehlow
Responsible Project Leader:	Satya Radhakrishna

2.2 Identification of the Client

Applicant's Name:	Spectrum Management LLC
Address Line 1:	2545 Tarpley Road
City/ Zip Code	Carrollton, TX/ 75006
Country:	USA
Contact Person:	Jim VanCleave
Phone No.:	469-574-2011
Fax:	469-574-2001
e-mail:	jvancleave@sm-ets.com

2.3 Identification of the Manufacturer

Applicant (Firm Name):	Spectrum Design Solutions Inc
Contact Person:	Chad Chryst
Telephone:	612-435-5531
Fax:	612-435-0736
Address Line 1:	110 North 5th Street
Address Line 2:	Floor 3
City:	Minneapolis
State:	MN
Postal Code:	55403
Country:	United States
e-mail:	chad.chryst@spectrumdsi.com

3 Equipment under Test (EUT)

3.1 Specification of the Equipment under Test

Marketing Name:	TracPac-GT
Model No:	TracPac-GT GSM
Product Type:	Cellular Asset Recovery Device
Hardware Revision :	Module: 2.0.1 Unit:1.0
Software Revision :	Module: R71A0GG Unit:1.0
FCC-ID:	NBI-MTAG216G
IC-ID :	8207A-MTAG216G
Frequency:	216.0125MHz to 216.9875MHz (LPRS band channels 1 through 40 (25 KHz spacing))
Type(s) of Modulation:	ASK, 50%
Output Power	10.42 dBm(conducted); -6.124 dBm(ERP)
Number of channels:	40
Antenna Type/Gain :	Dipole/ -14.4 dBi Gain
Equipment Classification:	☐ Fixed ☐ Vehicular ☐ Portable ☒ Mobile
Power Supply:	3.7V Li Ion Battery
Temperature Range:	Tested from -30 to 50°C

3.2 Identification of the Equipment Under Test (EUT)

EUT #	TYPE	MANF.	MODEL
1	Cellular Asset Recovery Device	Spectrum Design Solutions Inc.	TracPac-GT GSM

4 Subject Of Investigation

The objective of the measurements done by Cetecom Inc. was to measure the performance of the EUT as specified by requirements listed in FCC rules Part 95G for Low Power Radio Service (LPRS) of Title 47 of the Code of Federal Regulations and Industry Canada rules RSS-210 Issue 7.

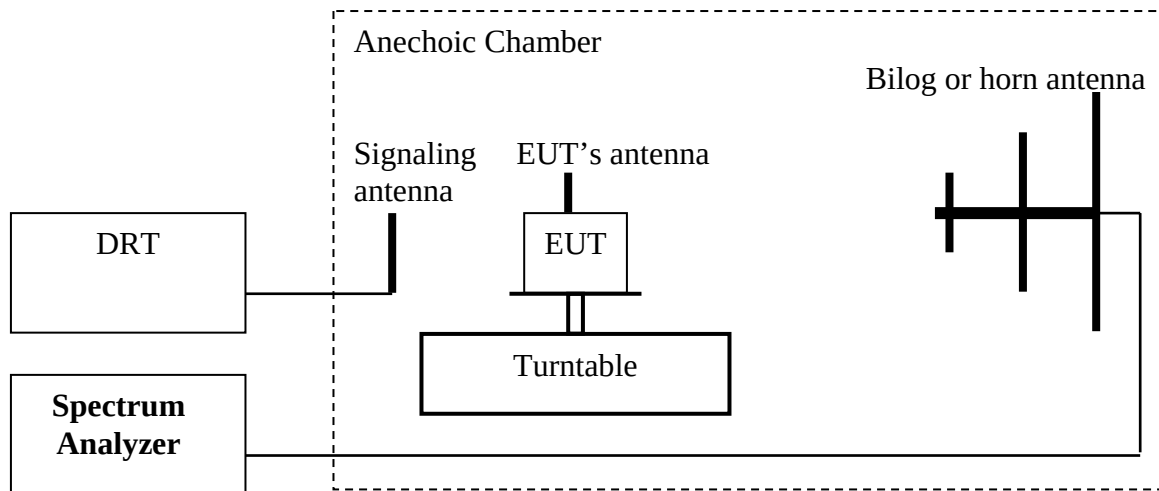
This test report is to support a request for new equipment authorization under the FCC ID: NBI-MTAG216G and IC ID: 8207A-MTAG216G.

All testing was performed on the product referred to in Section 3 as EUT. This test report contains full radiated and conducted testing results as per FCC95G and tests according to RSS-210.

5 Measurements

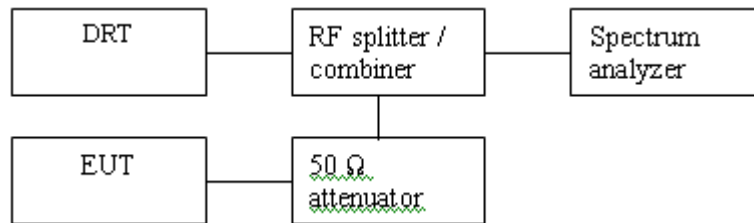
5.1 Radiated Measurement Procedure

Ref: TIA-603C 2004 -2.2.17.2 Effective Radiated Power (ERP) or Effective Isotropic Radiated Power (EIRP)



1. Connect the equipment as shown in the above diagram with the EUT's antenna in a vertical orientation.
 2. Adjust the settings of the Digital RadioCommunication Tester (DRT) to set the EUT to its maximum power at the required channel.
 3. Set the spectrum analyzer to the channel frequency. Set the analyzer to measure peak hold with the required settings.
 4. Rotate the EUT 360°. Record the peak level in dBm (**LVL**).
 5. Replace the EUT with a vertically polarized half wave dipole or known gain antenna. The center of the antenna should be at the same location as the center of the EUT's antenna.
 6. Connect the antenna to a signal generator with known output power and record the path loss in dB (**LOSS**). **LOSS** = Generator Output Power (dBm) – Analyzer reading (dBm).
 7. Determine the ERP using the following equation:
ERP (dBm) = LVL (dBm) + LOSS (dB)
 8. Determine the EIRP using the following equation:
EIRP (dBm) = ERP (dBm) + 2.14 (dB)
 9. Measurements are to be performed with the EUT set to the low, middle and high channels.
- Spectrum analyzer settings: RBW=VBW=3MHz**

5.2 Conducted Measurement Procedure



1. Connect the equipment as shown in the above diagram.
2. Adjust the settings of the Digital RadioCommunication Tester (DRT) to set the EUT to its maximum power at the required channel.
3. Measurements are to be performed with the EUT set to the low, middle and high channels.

5.3 Maximum transmitter power

FCC CFR 4795.639(e) – The maximum transmitter output power authorized for LPRS stations is 100 mW. Note: Conducted measurements were performed. The ERP is calculated from the conducted value and antenna gain.

§ Industry Canada RSS 210

Annex 4 - Medical Telemetry, Wireless Microphones, Auditory Assistance, Goods Tracking and Law Enforcement: A4.3 216-217 MHz (Auditory Assistance, Medical Telemetry, Goods Tracking and Law Enforcement)

This band is channelized and available for one-way voice and two-way data transmission, for the usages mentioned in the sub-title. The peak output power will not exceed 100 mW or 160 mW e.i.r.p.

5.3.1 Test Conditions:

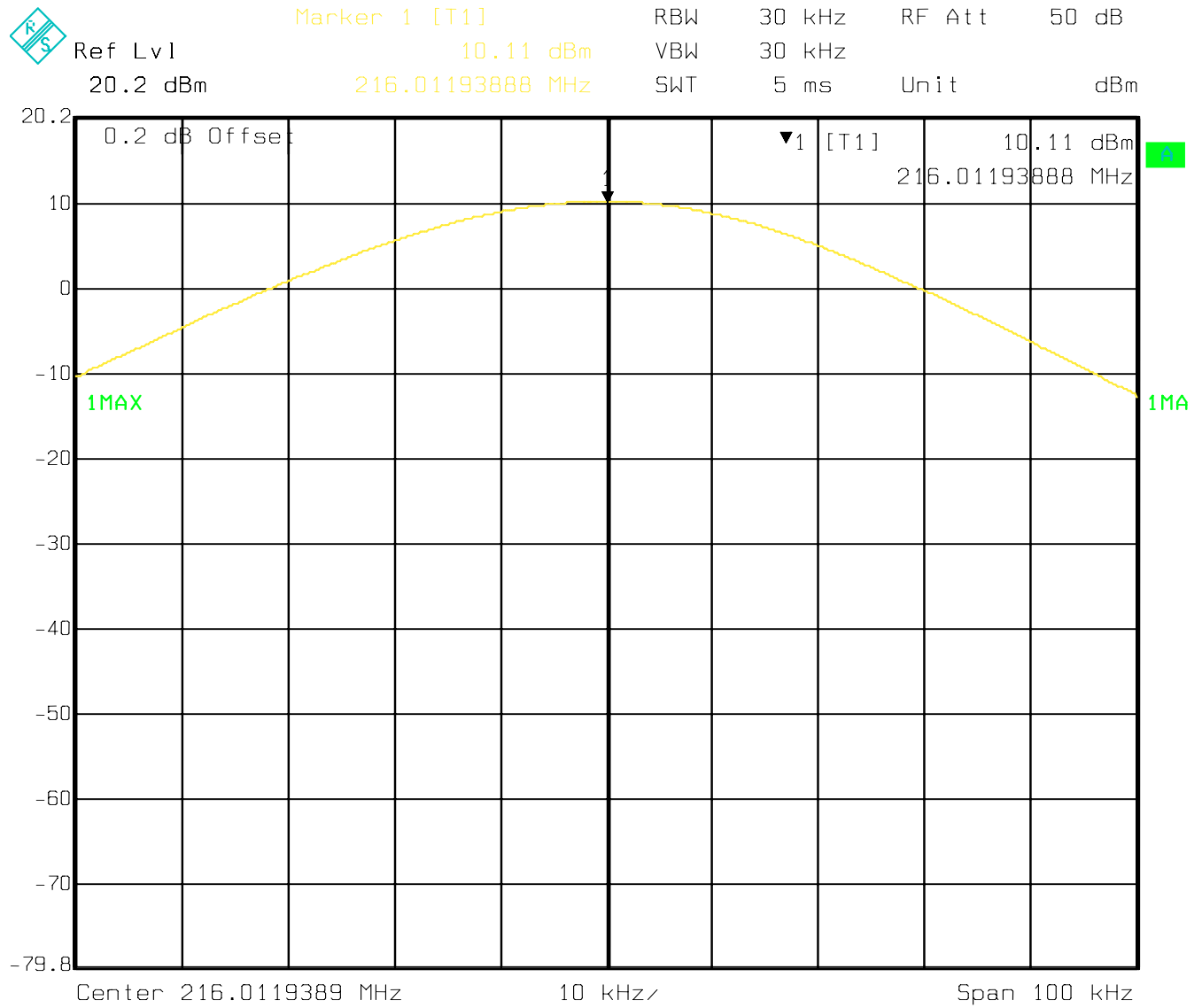
T_{nom}: 23°C; V_{nom}: 3.7 V

5.3.2 Test Result:

Maximum Transmitter Power- Conducted Limit: 20 dBm

Frequency (MHz)	Maximum Transmitter Power- Conducted (dBm)
216.0125	10.11
216.4875	10.02
216.9875	10.42

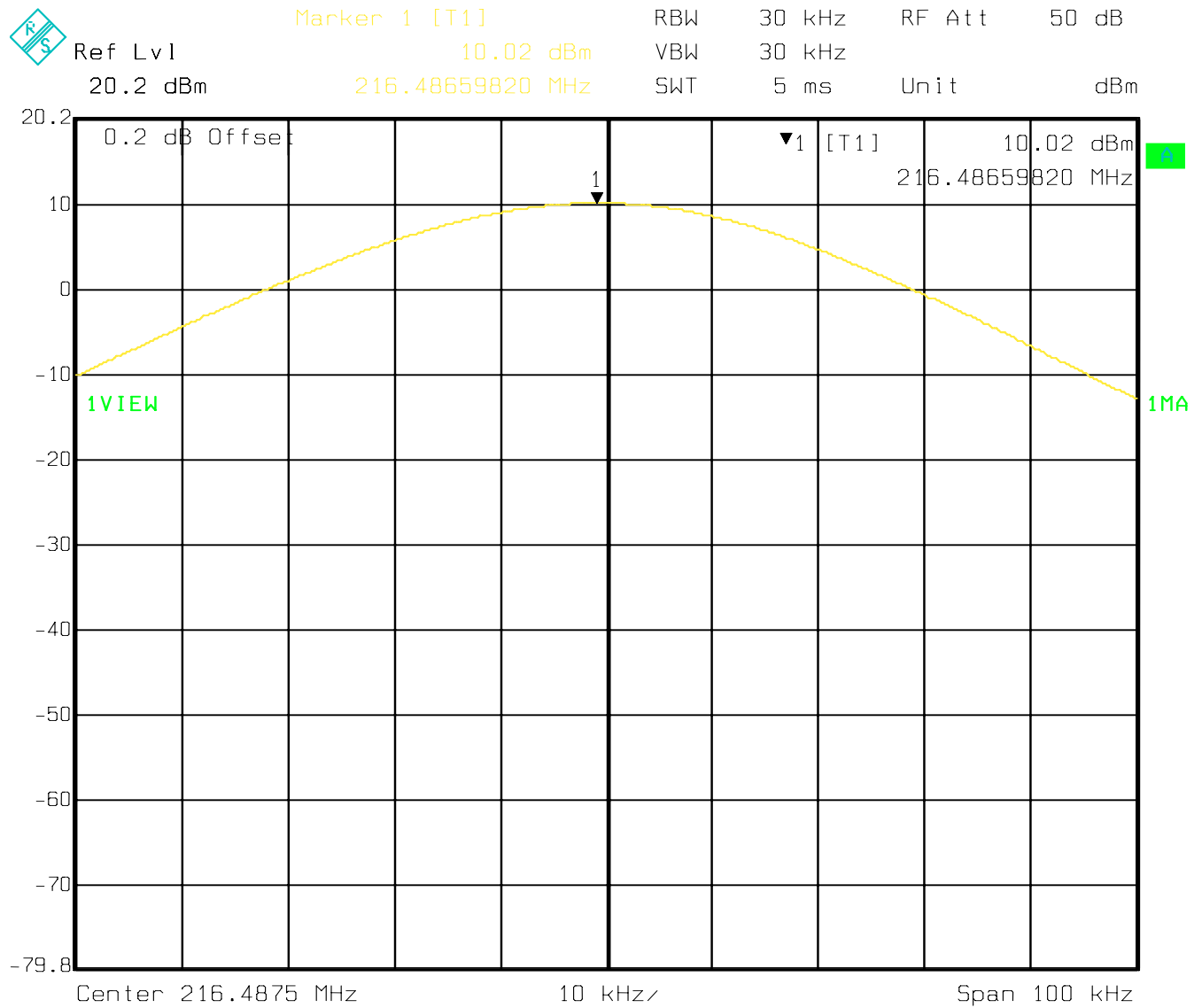
PLOT 5.3 A
Channel 1: 216.0125 MHz Conducted Output Power



Date: 22.OCT.2009 11:16:23

PLOT 5.3B

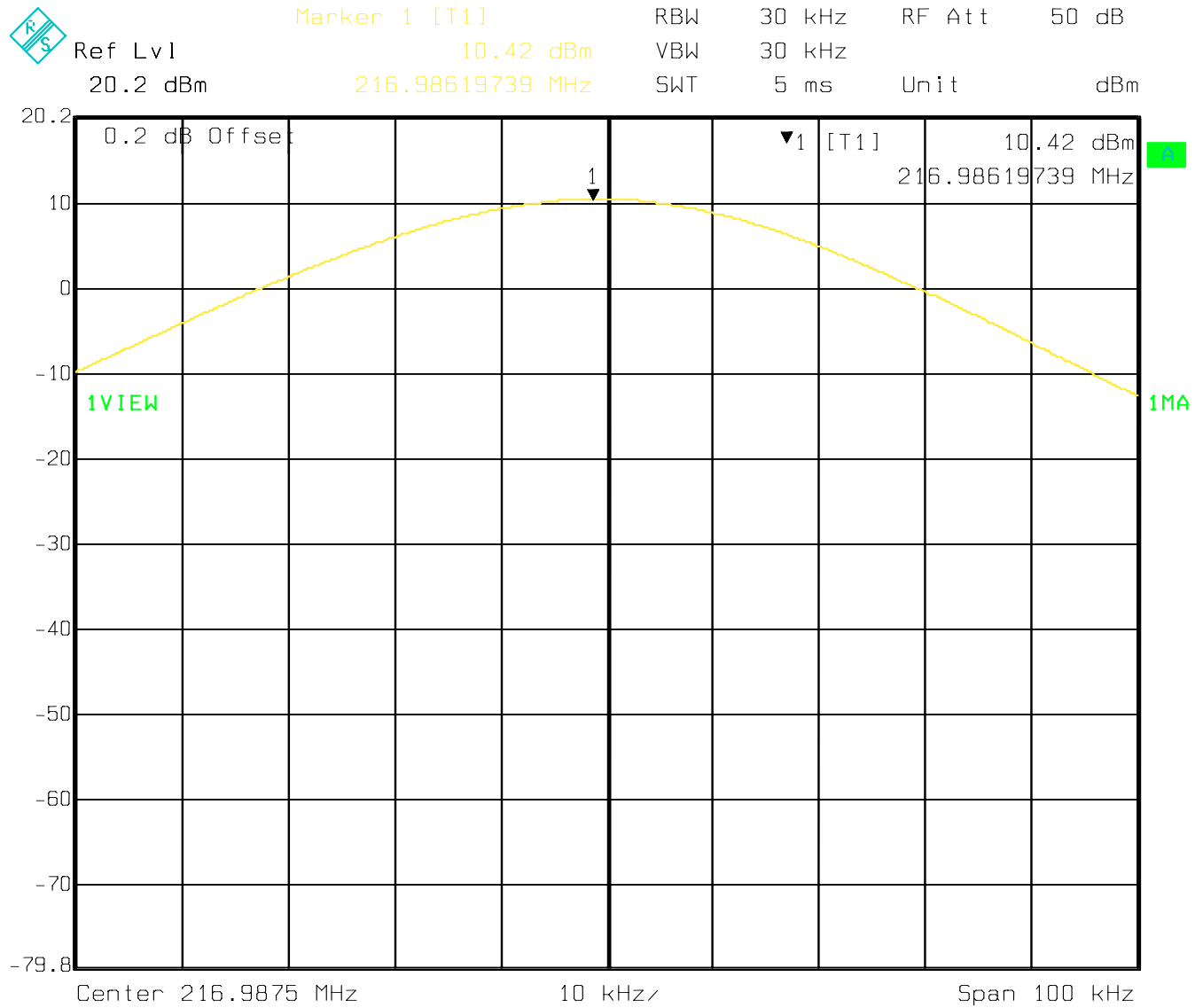
Channel 20: 216.4875 MHz Conducted Output Power



Date: 22.OCT.2009 11:20:40

PLOT 5.3C

Channel 40: 216.9875 MHz Conducted Output Power



Date: 22.OCT.2009 11:19:16

Effective radiated power

*Antenna Gain=-14.4 dBi

ERP= conducted power+ Gain – 2.14 **E.I.R.P limit: 22.04 dBm**

Frequency (MHz)	EIRP (dBm)	ERP (dBm)
216.0125	-4.294	-6.434
216.4875	-4.384	-6.524
216.9875	-3.984	-6.124

*Note: The TracPac GT-GSM is a tracking device placed in a stack of currency notes. Antenna efficiency compromise was made in order to physically fit the VHF antenna within the confines of the currency package.

5.4 Occupied Bandwidth and Unwanted Radiation

FCC CFR 47 § 95.633 Emission bandwidth

(d) (2) The channel bandwidth for standard band frequencies is 25 kHz.

FCC CFR 47 § 95.635 Unwanted radiation

(c) For transmitters designed to operate in the LPRS, emissions shall be attenuated in accordance with the following:

(1) Emissions for LPRS transmitters operating on standard band channels (25 kHz) shall be attenuated below the unmodulated carrier in accordance with the following:

(i) Emissions 12.5 kHz to 22.5 kHz away from the channel center frequency: at least 30 dB; and

(ii) Emissions more than 22.5 kHz away from the channel center frequency: at least $43 + 10\log(\text{carrier power in watts})$ dB.

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Annex 4 - Medical Telemetry, Wireless Microphones, Auditory Assistance, Goods Tracking and Law Enforcement: A4.3 216-217 MHz (Auditory Assistance, Medical Telemetry, Goods Tracking and Law Enforcement)

This band is channelized and available for one-way voice and two-way data transmission, for the usages mentioned in the sub-title. The peak output power will not exceed 100 mW or 160 mW e.i.r.p.

Law enforcement agencies have exclusive use of the sub-band 216.45-216.50 MHz. Auditory assistance, medical telemetry, goods tracking and law enforcement agencies have shared use of the rest of the band 216-217 MHz (i.e. 216-216.45 and 216.50-217 MHz). The channel plan is given in the following table.

All transmissions are subject to a no-interference, no-protection basis, especially with respect to TV channel 13 (of 210-216 MHz). It is therefore advisable to avoid the band 216-216.3 MHz where channel 13's sound carrier image frequency is located. Furthermore, the output power should be as low as possible for successful communication.

Section 2.2 concerning restricted frequency bands do not apply to the above devices (medical telemetry) in health care institutions. However, Industry Canada may, if found necessary, impose more attenuation than masks A to D for some restricted bands.

The requirements for the band 216-217 MHz are summarized in the table below.

Channel Spacing (kHz)	Centre Frequencies	Frequencies Stability (ppm)	Unwanted Emissions
5	$215.9975 + 0.005n$, $n = 1 \text{ to } 200$	± 1.5	Mask A
12.5	$215.99375 + 0.0125n$, $n = 1 \text{ to } 80$	± 5.0	Mask B
25	$215.9875 + 0.025n$, $n = 1 \text{ to } 40$	± 50	Mask C
50	$215.975 + 0.05n$, $n = 1 \text{ to } 20$	± 50	Mask D

Mask C

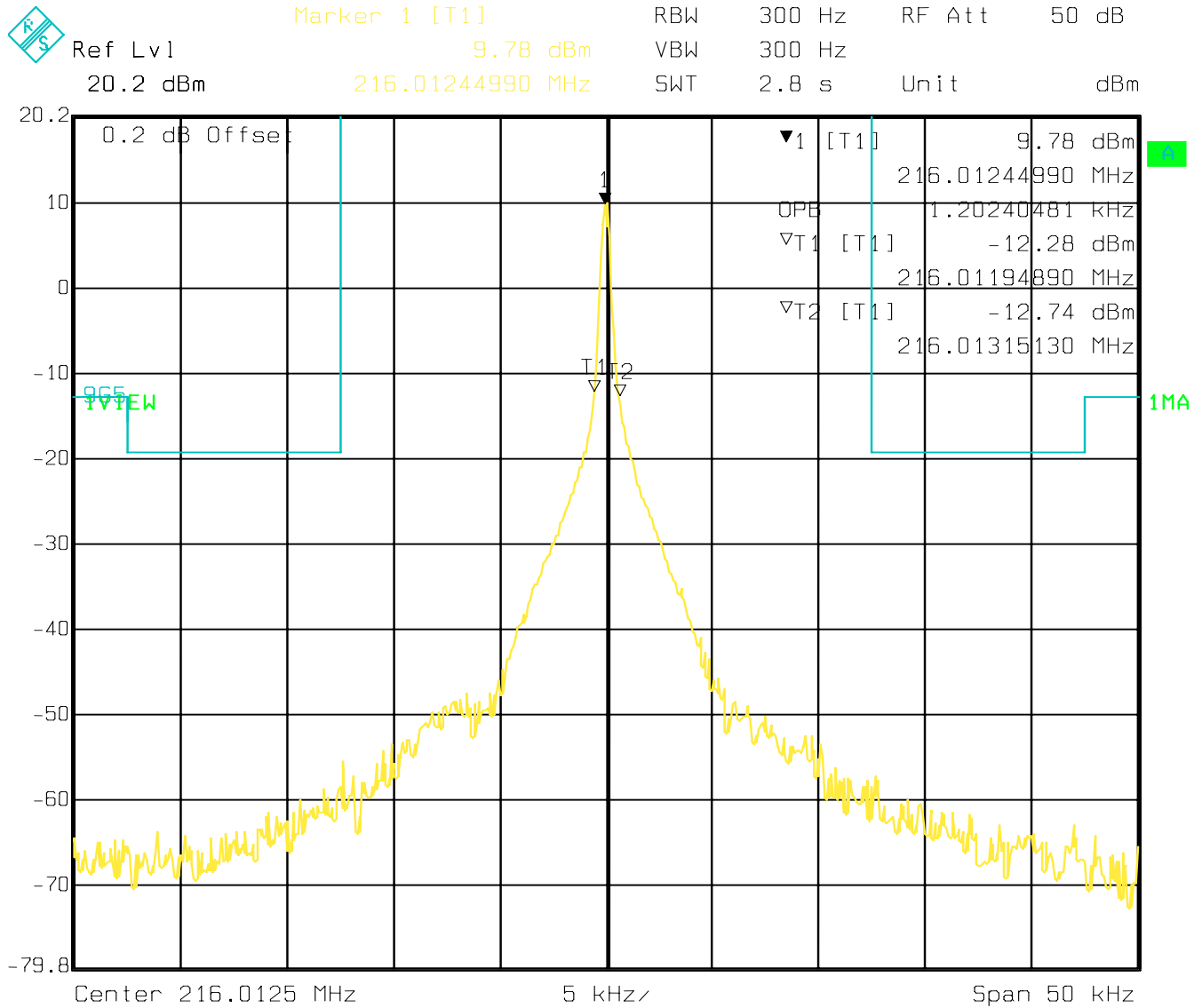
- (a) At least 30 dB; for emissions 12.5 kHz to 22.5 kHz removed from the channel centre frequency; and
 (b) At least $55 + 10 \log_{10}(P)$ dB or to Table 2 limits, whichever is less stringent; for emissions more than 22.5 kHz removed from the channel centre frequency.

5.4.1 Test Result:

Occupied Bandwidth (kHz)		
Frequency (MHz)		
216.0125	216.4875	216.9875
1.2024	1.2024	1.2024

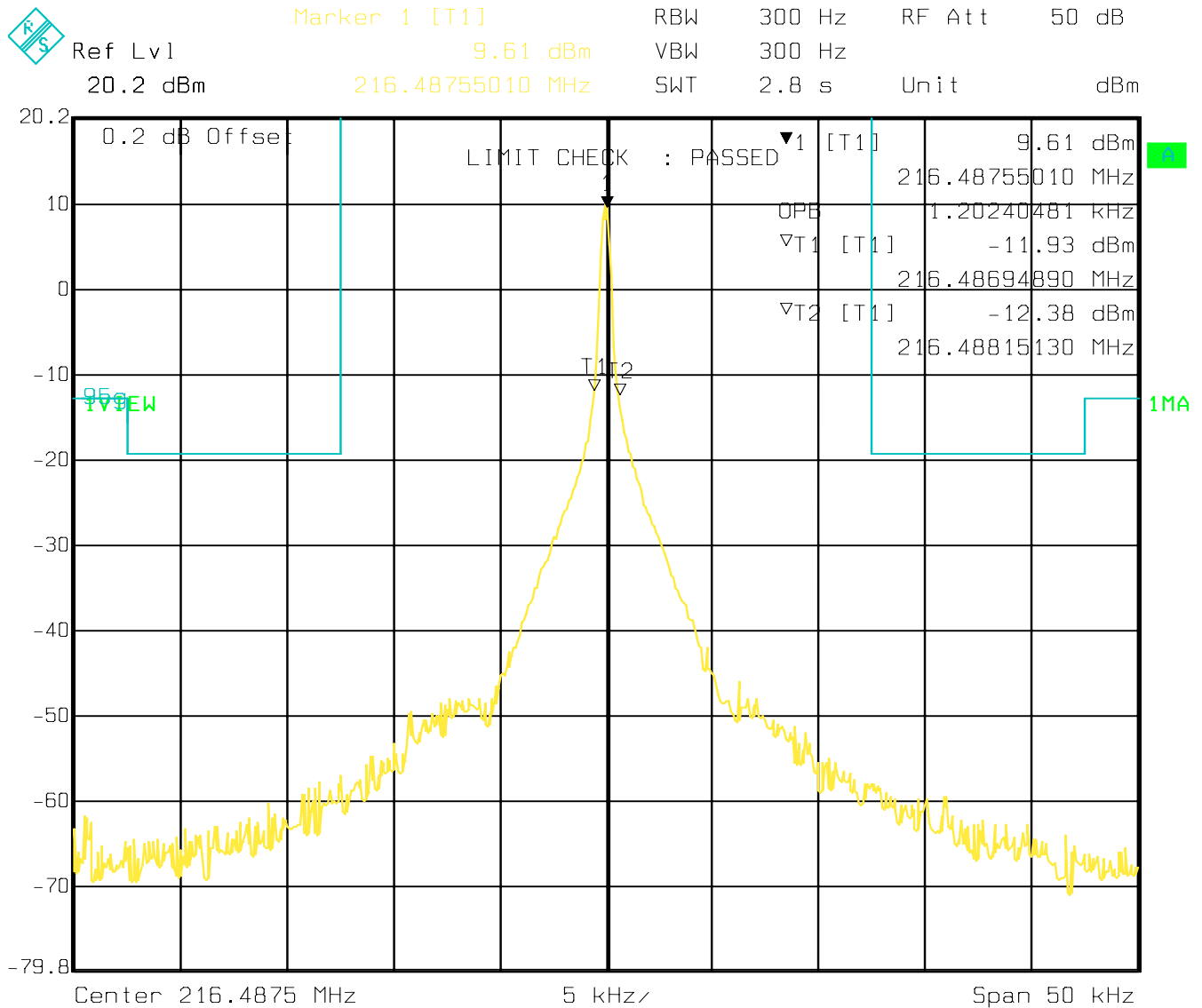
RBW=VBW=300 Hz

PLOT 5.4A
CH1: 216.0125 MHz



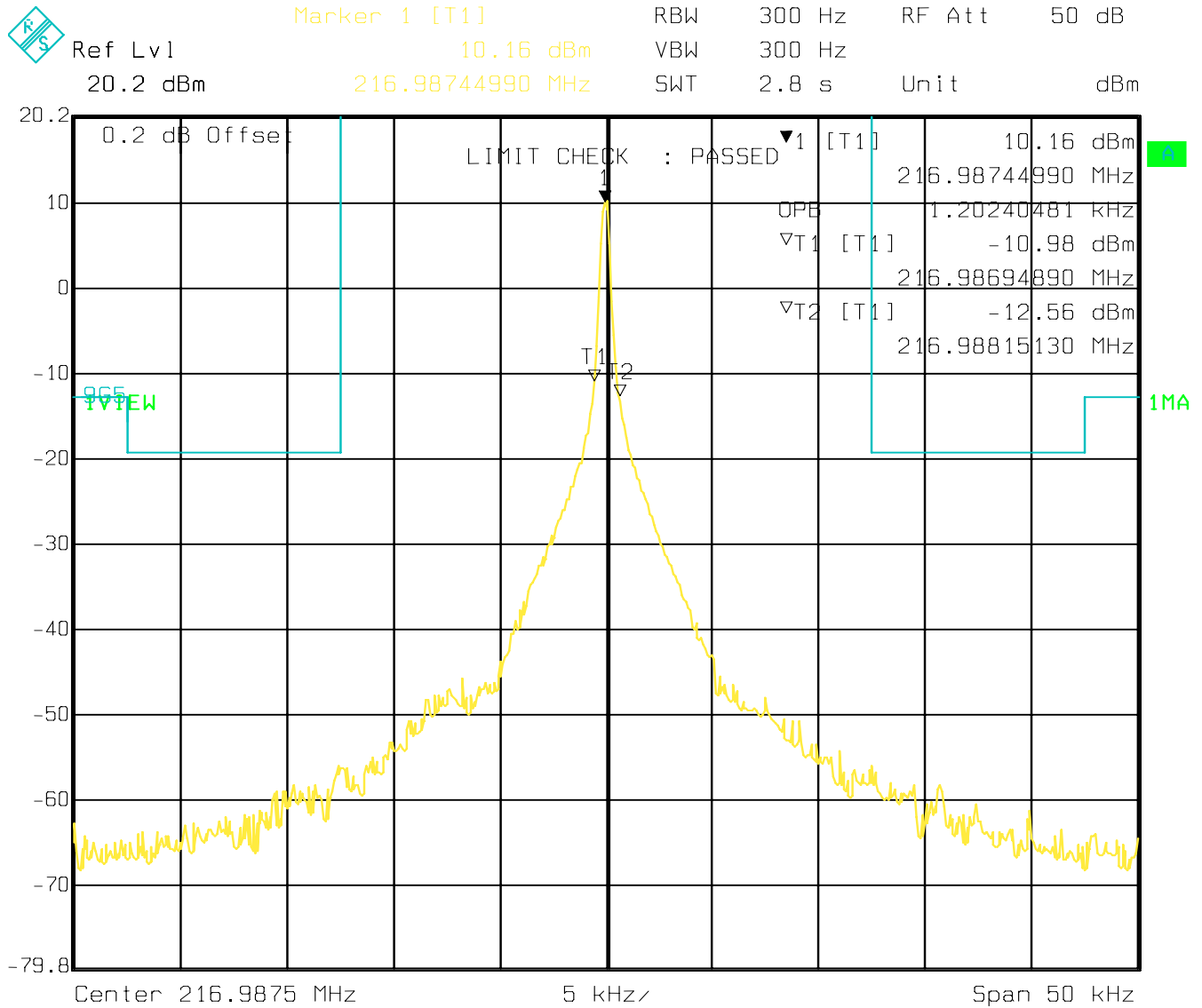
Date: 22.OCT.2009 11:51:45

PLOT 5.4B
CH20: 216.4875 MHz



Date: 22.OCT.2009 11:30:06

PLOT 5.4C
CH40: 216.9875 MHz



Date: 22.OCT.2009 11:58:56

5.5 Spurious Emissions Conducted

FCC CFR 47: 2.1051 Measurements required: Spurious emissions at antenna terminals.

The radio frequency voltage or power 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 each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in FCC 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

FCC CFR 47: 95.635 Unwanted radiation

(c) For transmitters designed to operate in the LPRS, emissions shall be attenuated in accordance with the following:

(1) Emissions for LPRS transmitters operating on standard band channels (25 kHz) shall be attenuated below the unmodulated carrier in accordance with the following:

(i) Emissions 12.5 kHz to 22.5 kHz away from the channel center frequency: at least 30 dB; and

(ii) Emissions more than 22.5 kHz away from the channel center frequency: at least $43 + 10\log(\text{carrier power in watts})$ dB.

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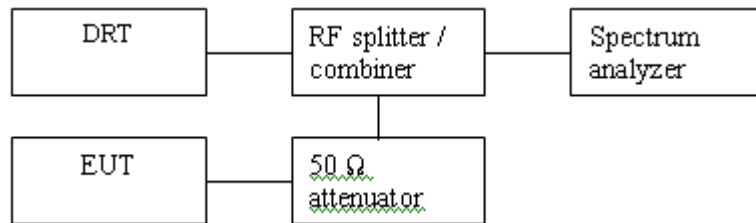
Annex 4 -: A4.3 216-217 MHz (Auditory Assistance, Medical Telemetry, Goods Tracking and Law Enforcement)

For unwanted emissions, Mask C applies to this device.

Mask C

- (a) At least 30 dB; for emissions 12.5 kHz to 22.5 kHz removed from the channel centre frequency; and
- (b) At least $55 + 10 \log_{10}(P)$ dB or to Table 2 limits, whichever is less stringent; for emissions more than 22.5 kHz removed from the channel centre frequency.

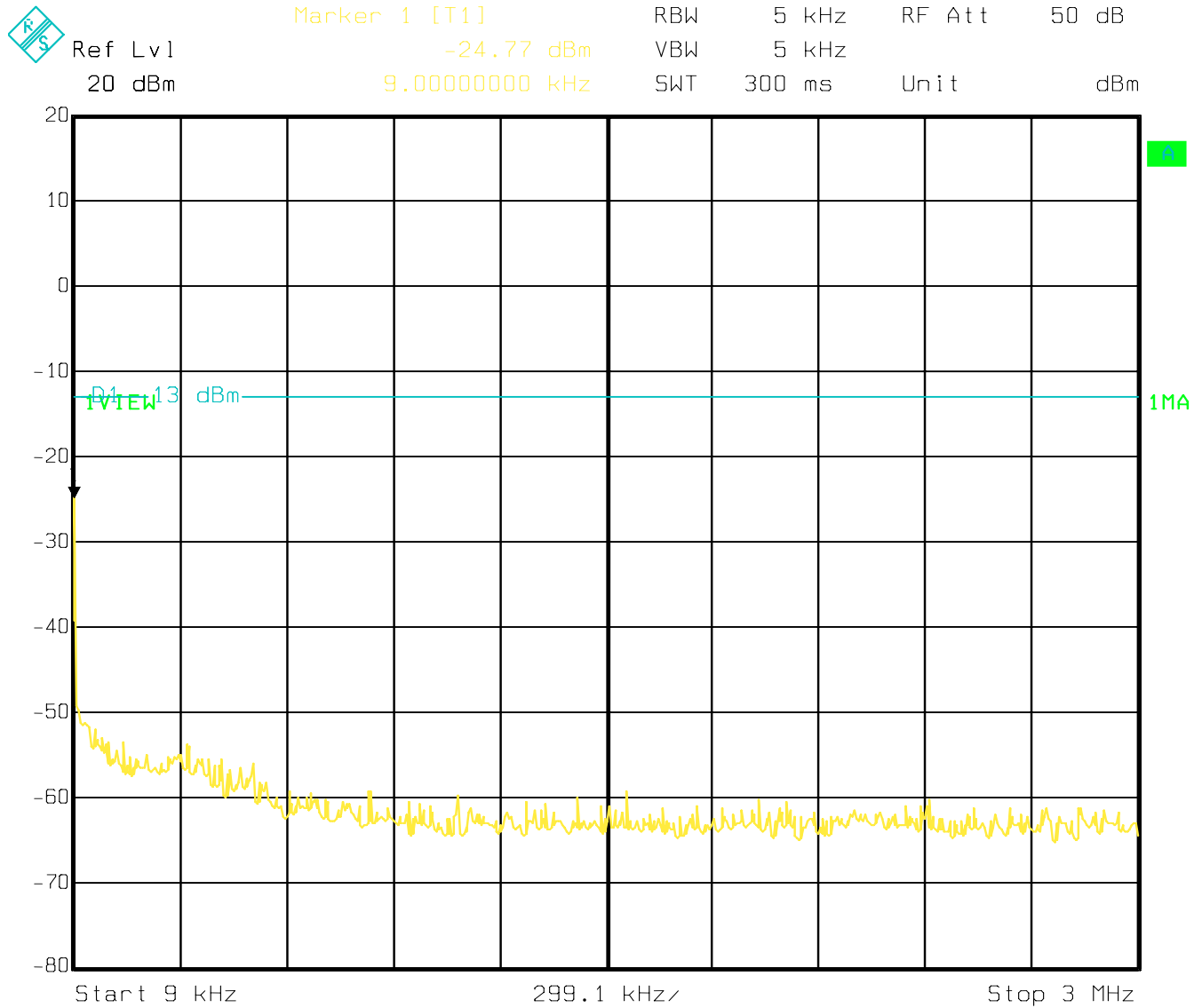
5.5.1 Conducted Measurement Procedure



4. Connect the equipment as shown in the above diagram.
5. Adjust the settings of the Digital Radio Communication Tester (DRT) to set the EUT to its maximum power at the required channel.
6. Measurements are to be performed with the EUT set to the low, middle and high channels.

PLOT 5.5A

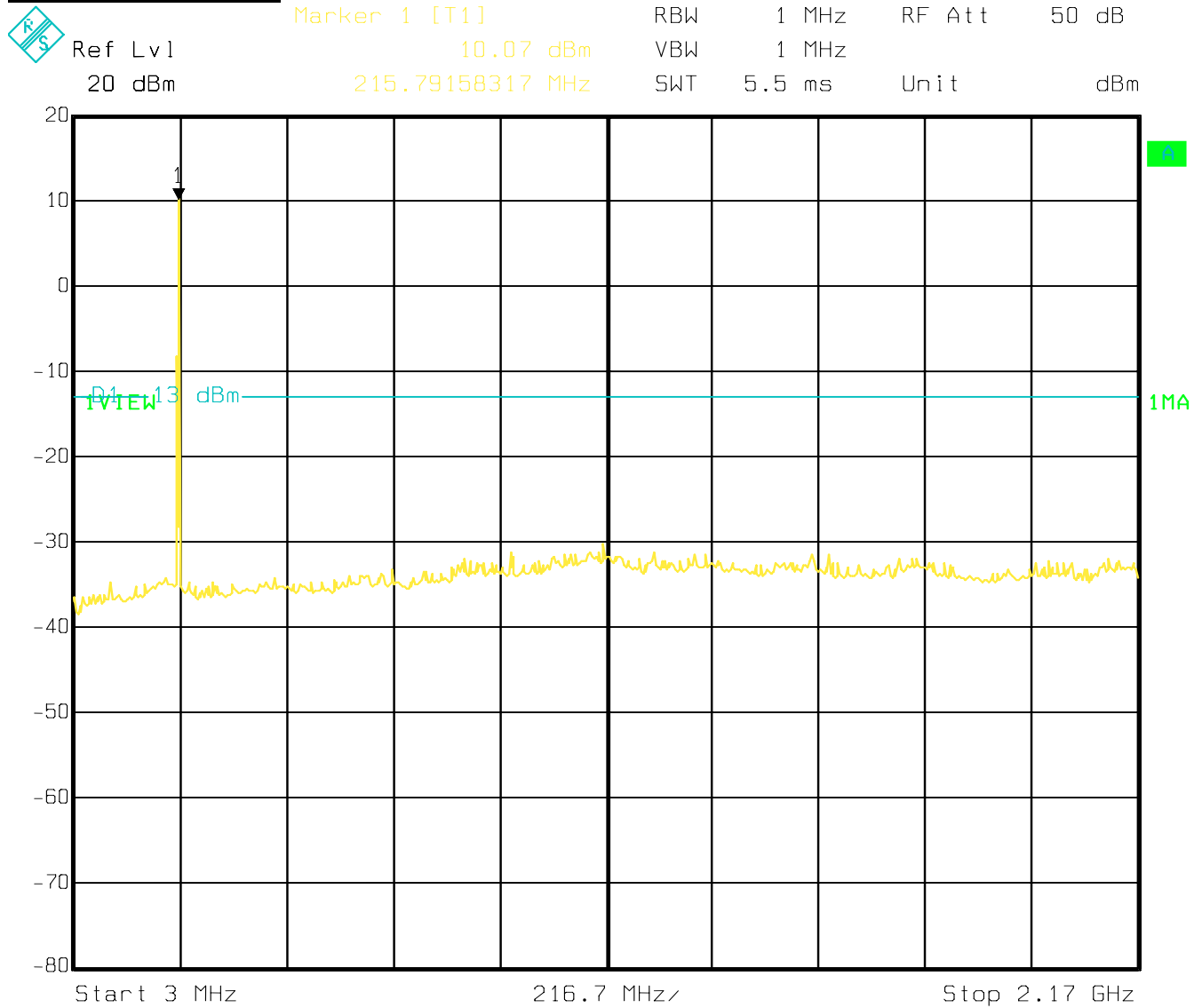
9 kHz-3 MHz



Date: 22.OCT.2009 12:11:44

PLOT 5.5B

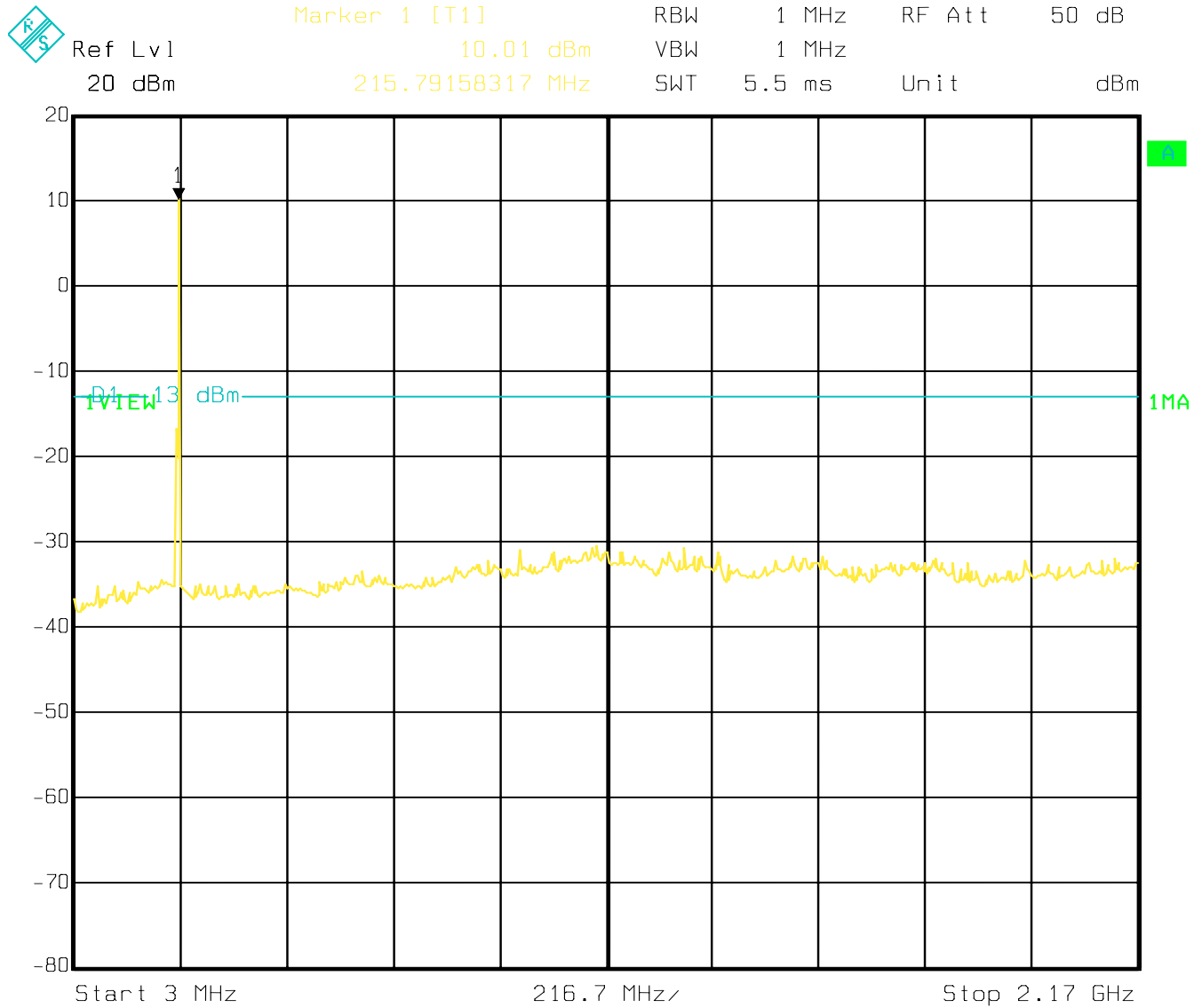
3MHz-2.17GHz: CH1



Date: 22.OCT.2009 12:09:09

PLOT 5.5C

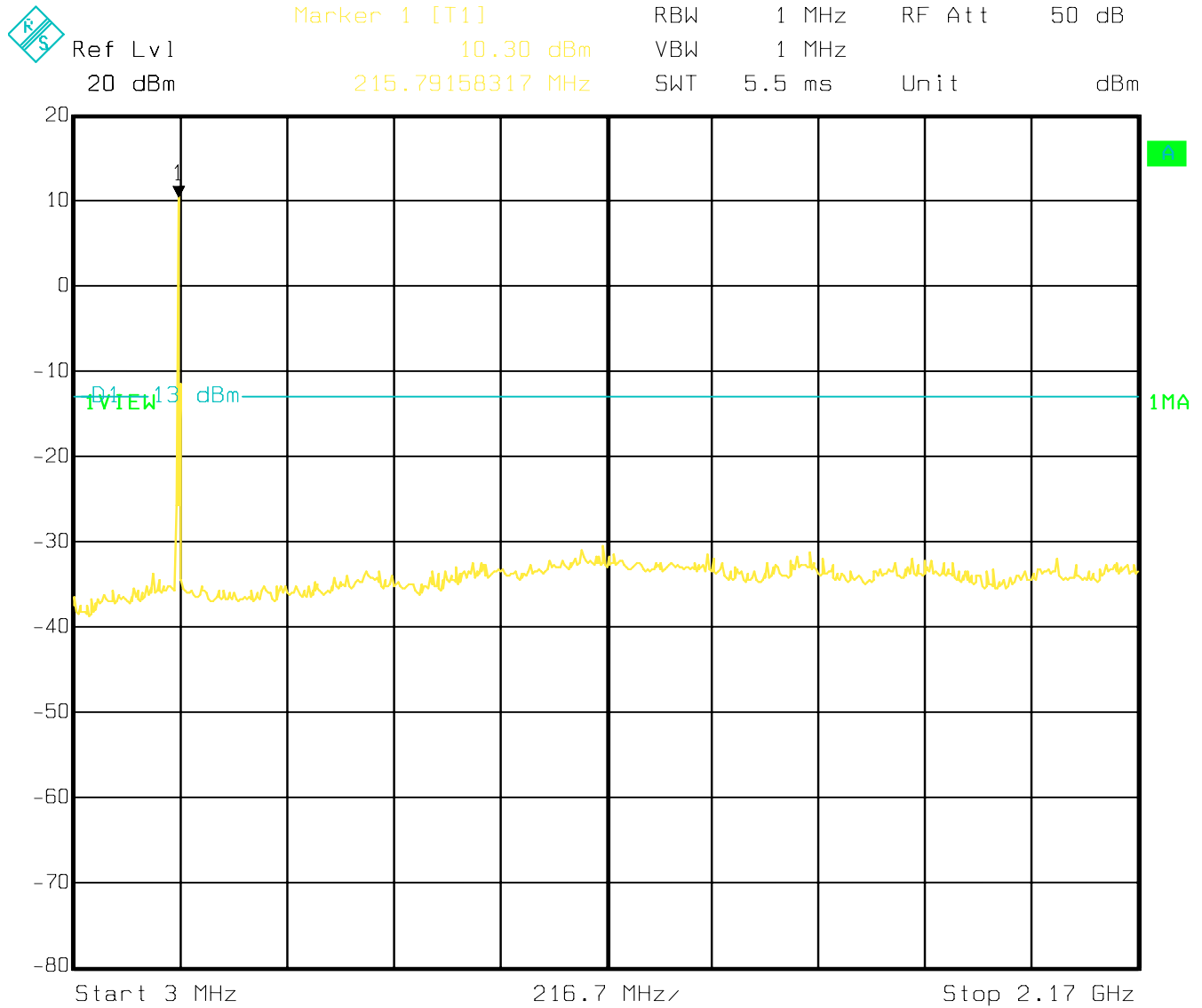
3MHz-2.17GHz: CH20



Date: 22.OCT.2009 12:07:53

PLOT 5.5D

3MHz-2.17GHz: CH40



Date: 22.OCT.2009 12:06:31

5.6 Transmitter Spurious Emissions Radiated

FCC CFR 47: 2.1053 Measurements required: Field strength of spurious radiation.

(a) Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission.

FCC CFR 47: 95.635 Unwanted radiation

(c) For transmitters designed to operate in the LPRS, emissions shall be attenuated in accordance with the following:

(1) Emissions for LPRS transmitters operating on standard band channels (25 kHz) shall be attenuated below the unmodulated carrier in accordance with the following:

(i) Emissions 12.5 kHz to 22.5 kHz away from the channel center frequency: at least 30 dB; and

(ii) Emissions more than 22.5 kHz away from the channel center frequency: at least $43 + 10\log$ (carrier power in watts) dB.

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Annex 4 -: A4.3 216-217 MHz (Auditory Assistance, Medical Telemetry, Goods Tracking and Law Enforcement)

For unwanted emissions, Mask C applies to this device.

Mask C

(a) At least 30 dB; for emissions 12.5 kHz to 22.5 kHz removed from the channel centre frequency; and

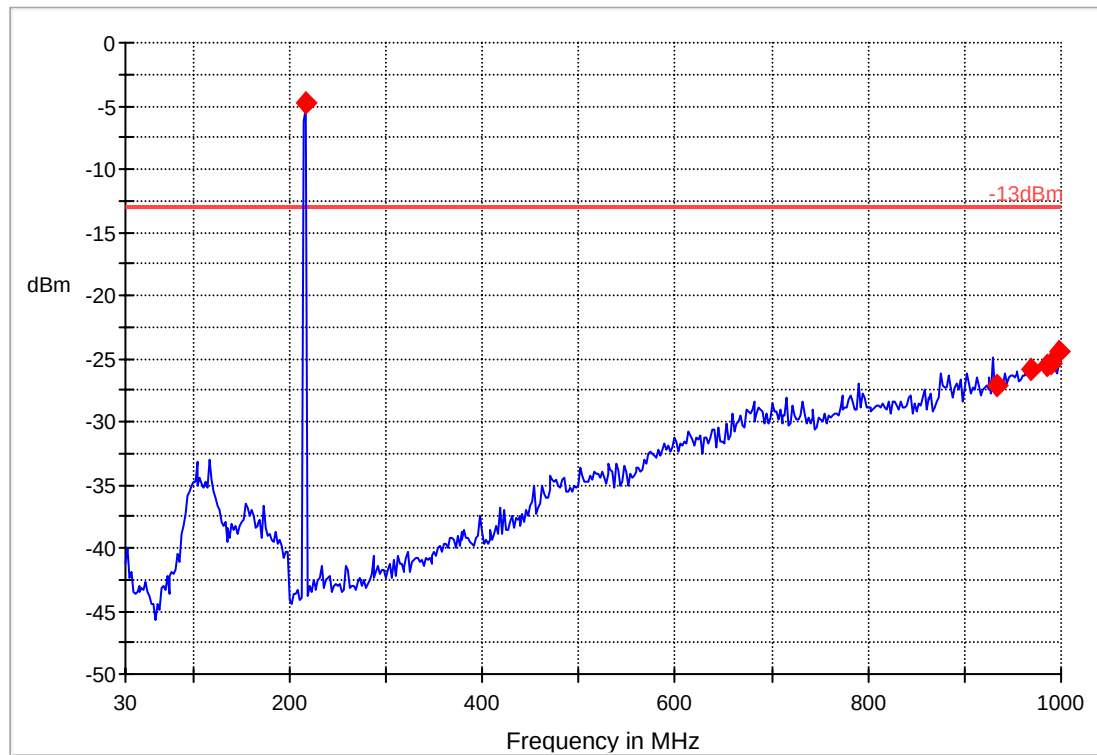
(b) At least $55 + 10 \log_{10}(P)$ dB or to Table 2 limits, whichever is less stringent; for emissions more than 22.5 kHz removed from the channel centre frequency.

PLOT 5.6A

Note: Device transmitting at CH1, 216.0125 MHz. Marker placed on the transmit signal.

Final Result 1

Frequency (MHz)	MaxPeak (dBm)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBm)
216.016382	-4.7	20.000	100.000	119.0	H	202.0	-84.3	-8.3	-13.0
933.887274	-27.2	20.000	100.000	120.0	H	165.0	-70.0	14.2	-13.0
969.042134	-25.9	20.000	100.000	170.0	H	1.0	-69.6	12.9	-13.0
985.208655	-25.5	20.000	100.000	120.0	V	160.0	-69.1	12.5	-13.0
989.888106	-25.3	20.000	100.000	153.0	V	87.0	-68.9	12.3	-13.0
996.983968	-24.5	20.000	100.000	120.0	V	112.0	-68.6	11.5	-13.0



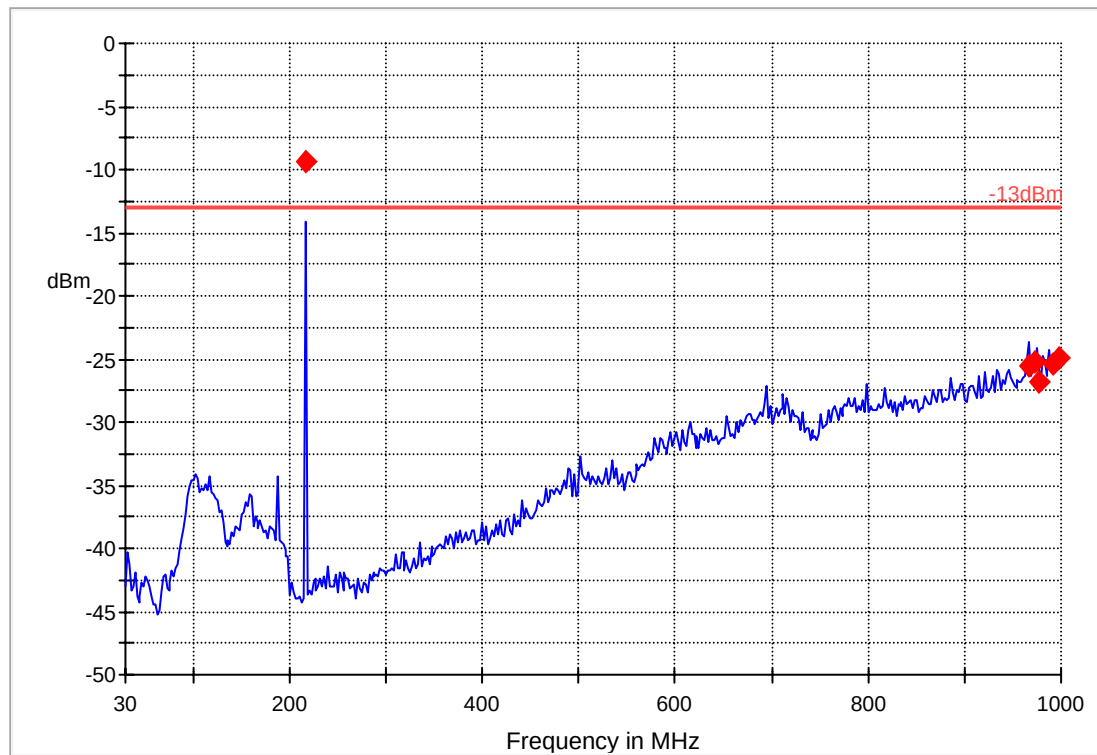
— Preview Result 1 ◆ Final Result 1

PLOT 5.6 B

Note: Device transmitting at CH20, 216.4875 MHz. Marker placed on the transmit signal.

Final Result 1

Frequency (MHz)	MaxPeak (dBm)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBm)
216.489517	-9.4	20.000	100.000	120.0	H	249.0	-84.2	-3.6	-13.0
967.351173	-25.5	20.000	100.000	170.0	H	195.0	-69.6	12.5	-13.0
972.102262	-25.3	20.000	100.000	120.0	H	255.0	-69.5	12.3	-13.0
976.621036	-26.8	20.000	100.000	170.0	H	279.0	-69.5	13.8	-13.0
991.614502	-25.5	20.000	100.000	170.0	V	22.0	-68.8	12.5	-13.0
997.671855	-24.9	20.000	100.000	146.0	V	292.0	-68.6	11.9	-13.0



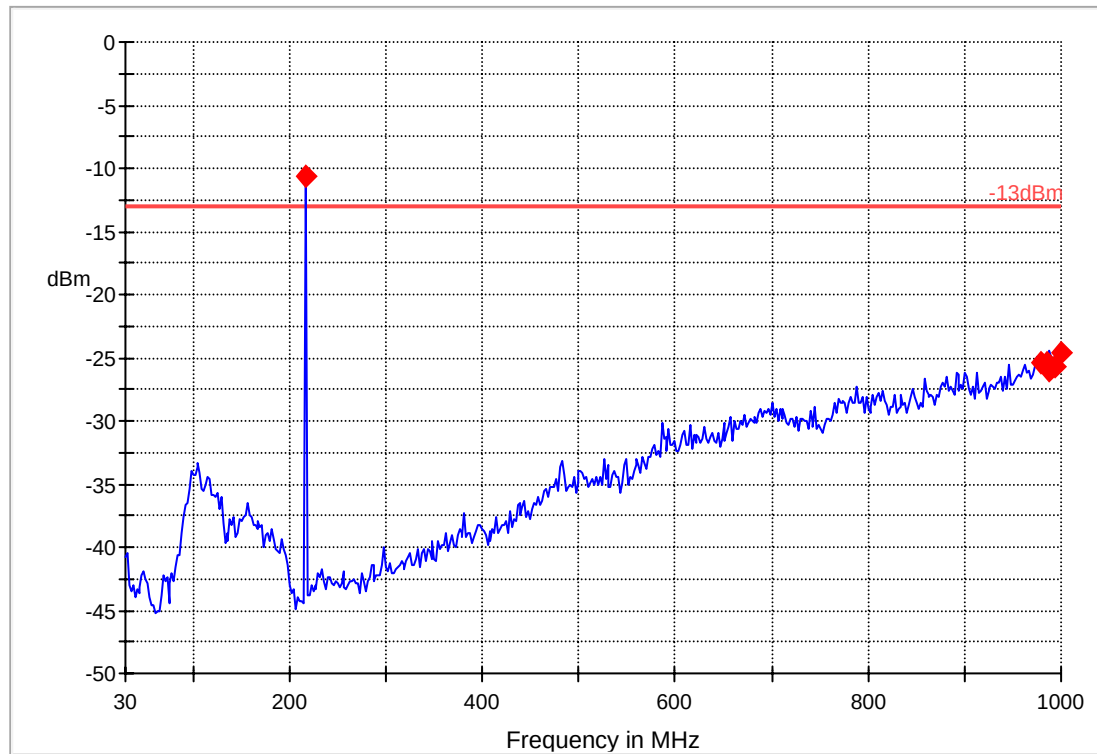
— Preview Result 1 ◆ Final Result 1

PLOT 5.6 C

Note: Device transmitting at CH40, 216.9875 MHz. Marker placed on the transmit signal.

Final Result 1

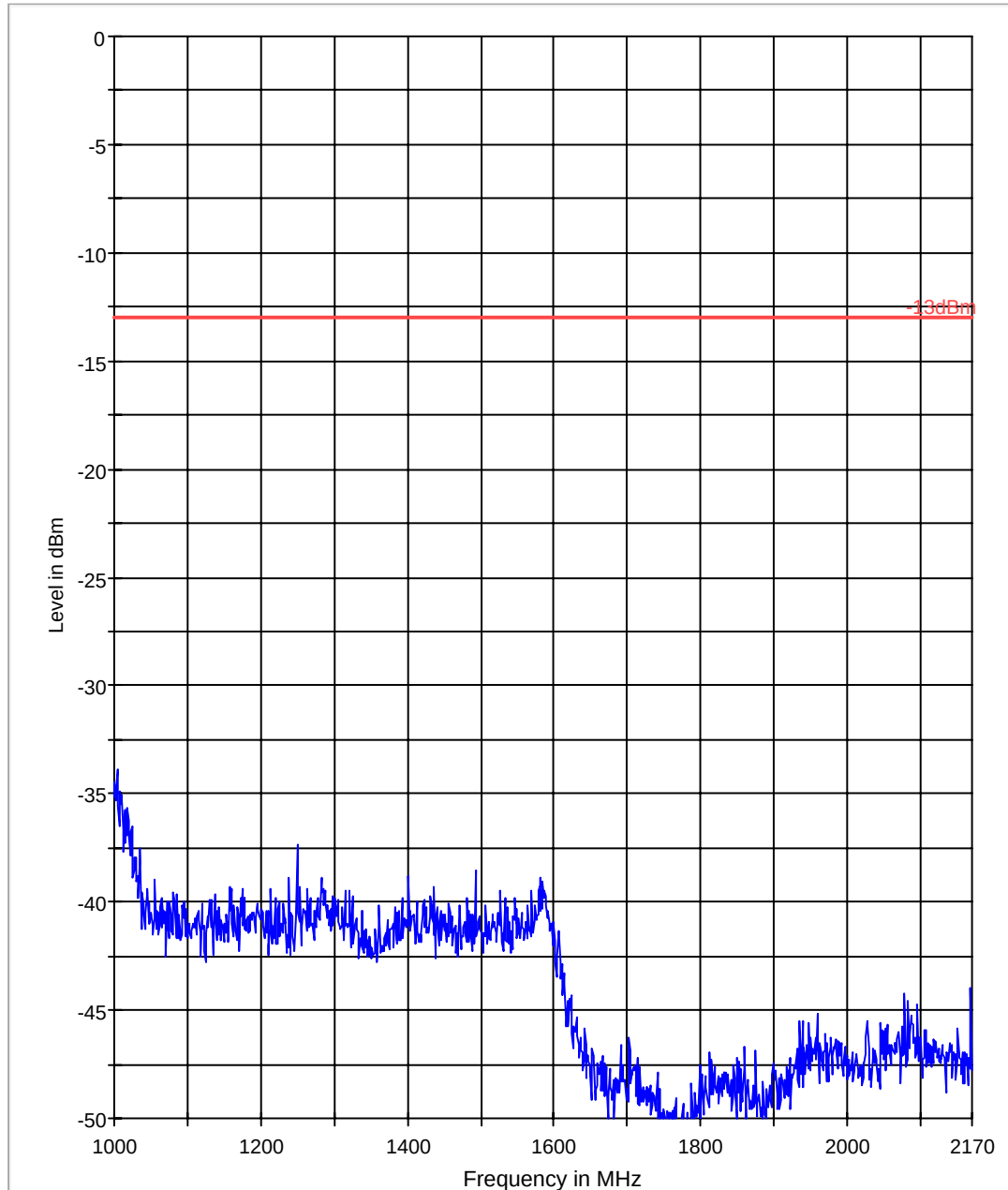
Frequency (MHz)	MaxPeak (dBm)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBm)
216.988695	-10.6	20.000	100.000	144.0	V	0.0	-83.1	-2.4	-13.0
978.255177	-25.5	20.000	100.000	120.0	V	93.0	-69.4	12.5	-13.0
984.717373	-25.3	20.000	100.000	120.0	V	112.0	-69.1	12.3	-13.0
987.633574	-26.0	20.000	100.000	170.0	V	7.0	-69.0	13.0	-13.0
994.081892	-25.7	20.000	100.000	170.0	V	262.0	-68.7	12.7	-13.0
999.408818	-24.6	20.000	100.000	170.0	V	261.0	-68.5	11.6	-13.0



PLOT 5.6 D

Note: Device transmitting at CH20, 216.4875 MHz.

FCC 95G 1-2.17GHz



— -13dBm.LimitLine — Preview Result 1

5.7 Receiver Spurious Emissions- Radiated

Table 2: General Field Strength Limits for Transmitters and Receivers at Frequencies Above 30 MHz ^(Note)

Frequency (MHz)	Field Strength microvolts/m at 3 metres (watts, e.i.r.p.)	
	Transmitters	Receivers
30-88	100 (3 nW)	100 (3 nW)
88-216	150 (6.8 nW)	150 (6.8 nW)
216-960	200 (12 nW)	200 (12 nW)
Above 960	500 (75 nW)	500 (75 nW)

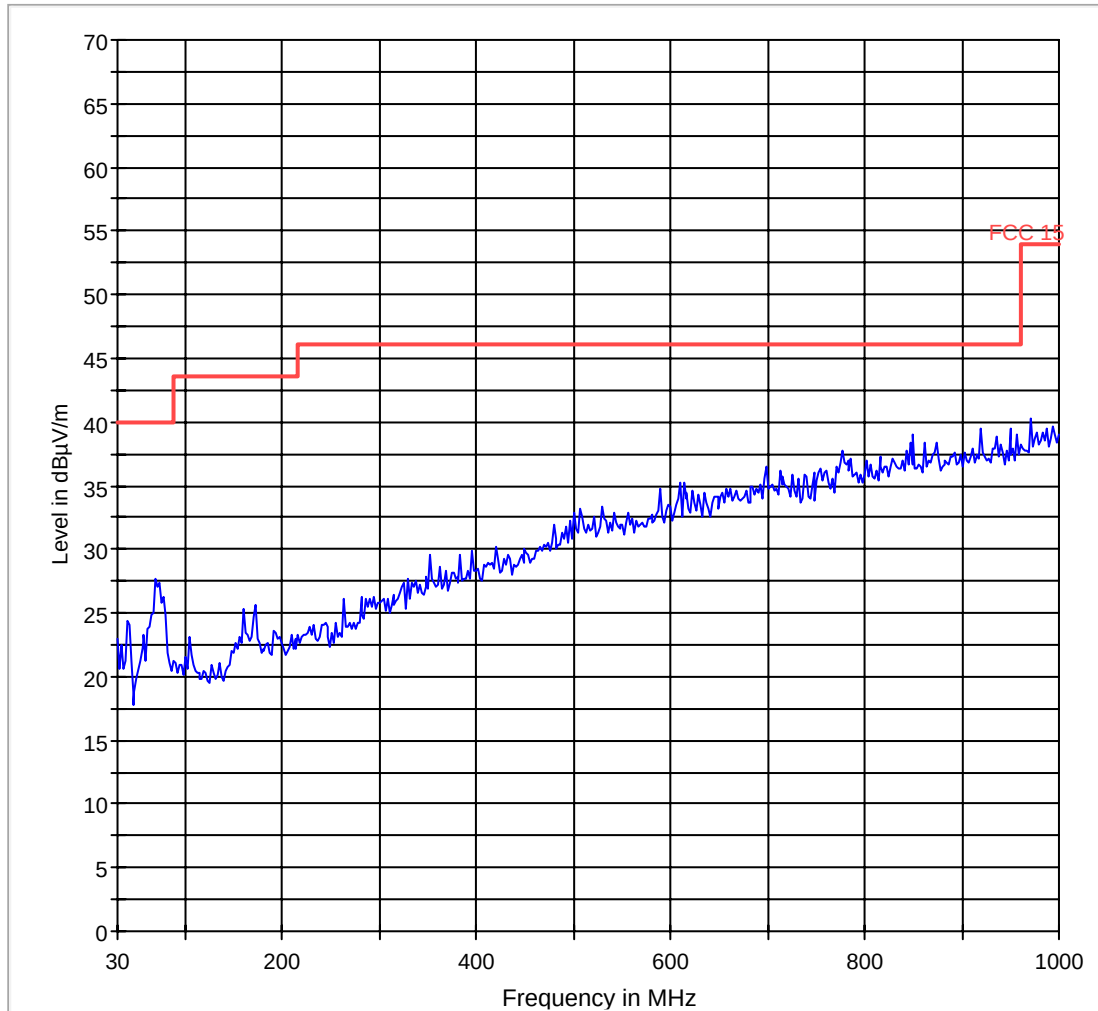
Note: Transmitting devices are not permitted in Table 1 bands or in TV bands (54-72 MHz, 76-88 MHz, 174-216 MHz, 470-608 MHz, and 614-806 MHz). Prohibition of operation in TV bands does not apply to momentary devices, or to medical telemetry devices in the band 174-216 MHz, and to perimeter protection systems in the bands 54-72 and 76-88 MHz. The perimeter protection devices are to meet Table 3 field strengths limits.

PLOT 5.7 A

Note: Plot contains results of both horizontal and vertical antenna polarization.

Resolution Bandwidth: 1MHz Video Bandwidth: 1MHz

FCC 15 30-1000MHz



— FCC 15.LimitLine — Preview Result 1

PLOT 5.7 B

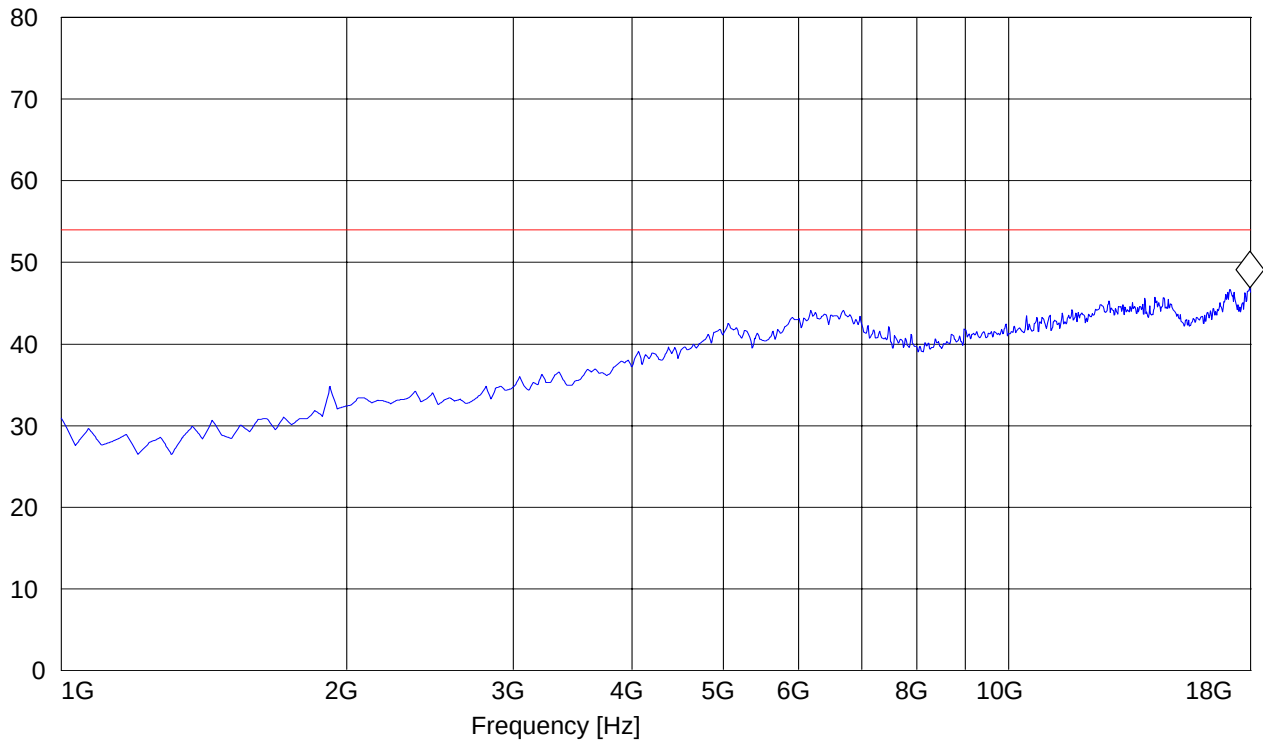
EUT / Description: TracPac GT-GSM
Customer: Spectrum Design
Operation Mode: GSM 1900 idle
ANT Orientation: : H
EUT Orientation:: H
Test Engineer: Chris
Voltage: Internal Battery
Comments::

SWEEP TABLE: "CANADA RE_1-18G"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
1.0 GHz	18.0 GHz	MaxPeak	Coupled	1 MHz	#326horn_AF_horz

Marker: 17.965931864 GHz 46.84 dB μ V/m

Level [dB μ V/m]



5.8 Frequency Stability

FCC CFR 47: 95.629 LPRS transmitter frequencies.

(a) LPRS transmitters may operate on any frequency listed in paragraphs (b), (c), and (d) of this section. Channels 19, 20, 50, and 151–160 are available exclusively for law enforcement tracking purposes. AMTS transmissions are limited to the 216.750–217.000 MHz band for low power point-to-point network control communications by AMTS coast stations. Other AMTS transmissions in the 216–217 MHz band are prohibited.

(b) *Standard band channels.*

(1) The following table indicates standard band frequencies. The channel bandwidth is 25 kHz.

(2) LPRS transmitters operating on standard band channels must be maintained within a frequency stability of 50 parts per million.

§ Industry Canada RSS 210

Annex 4 -: A4.3 216-217 MHz (Auditory Assistance, Medical Telemetry, Goods Tracking and Law Enforcement)

Standard Limit: **50 ppm**

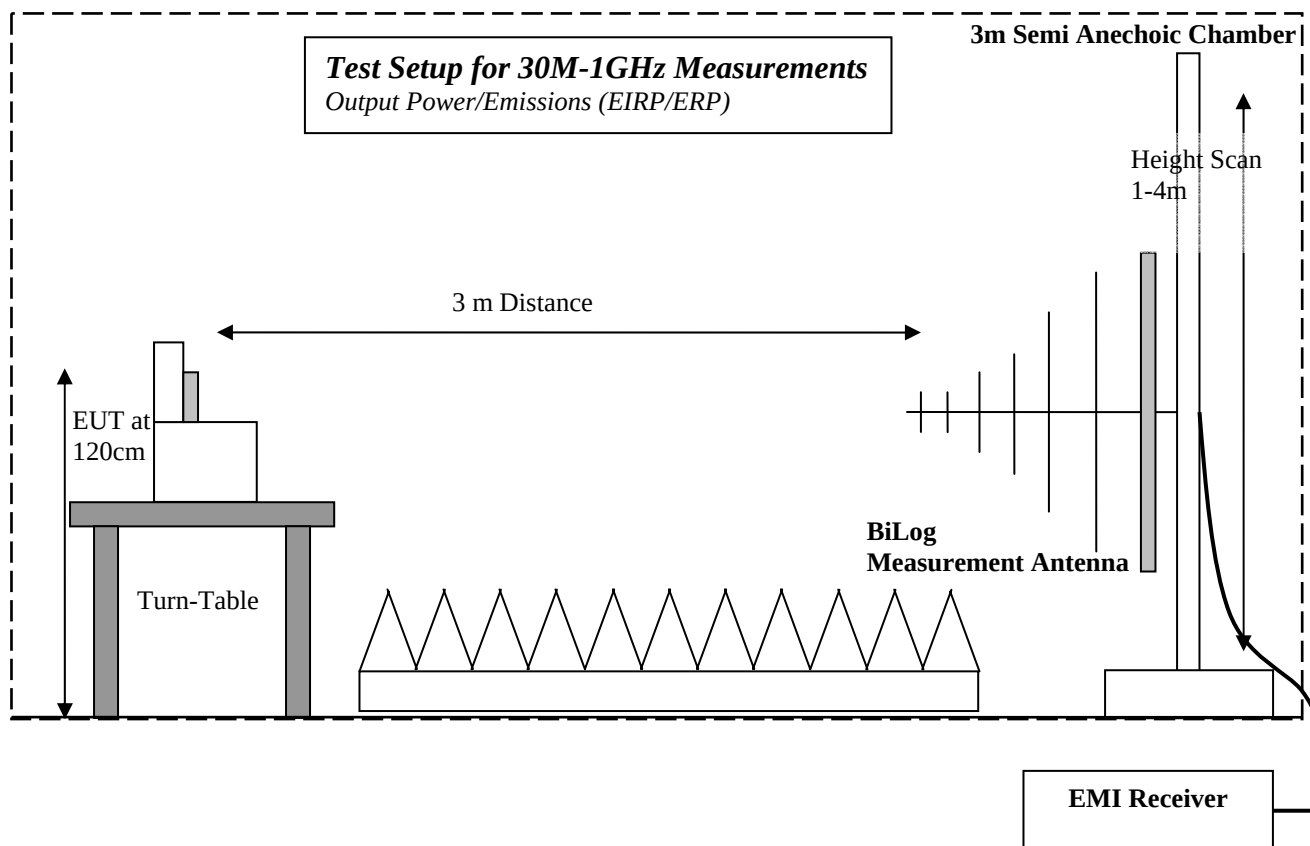
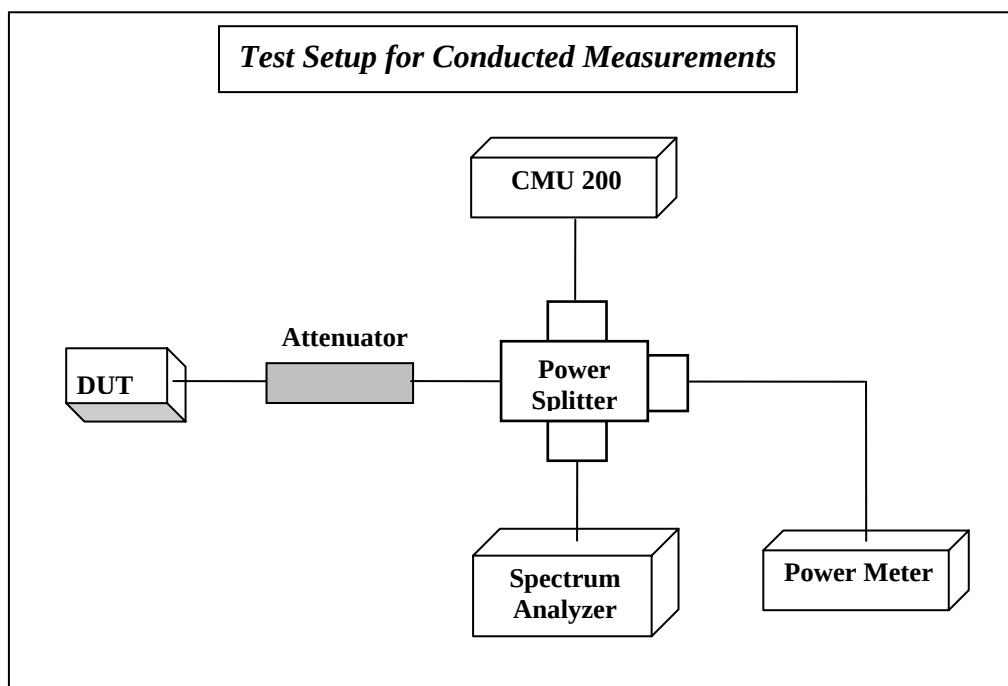
Reference Frequency: 216.4875 MHz

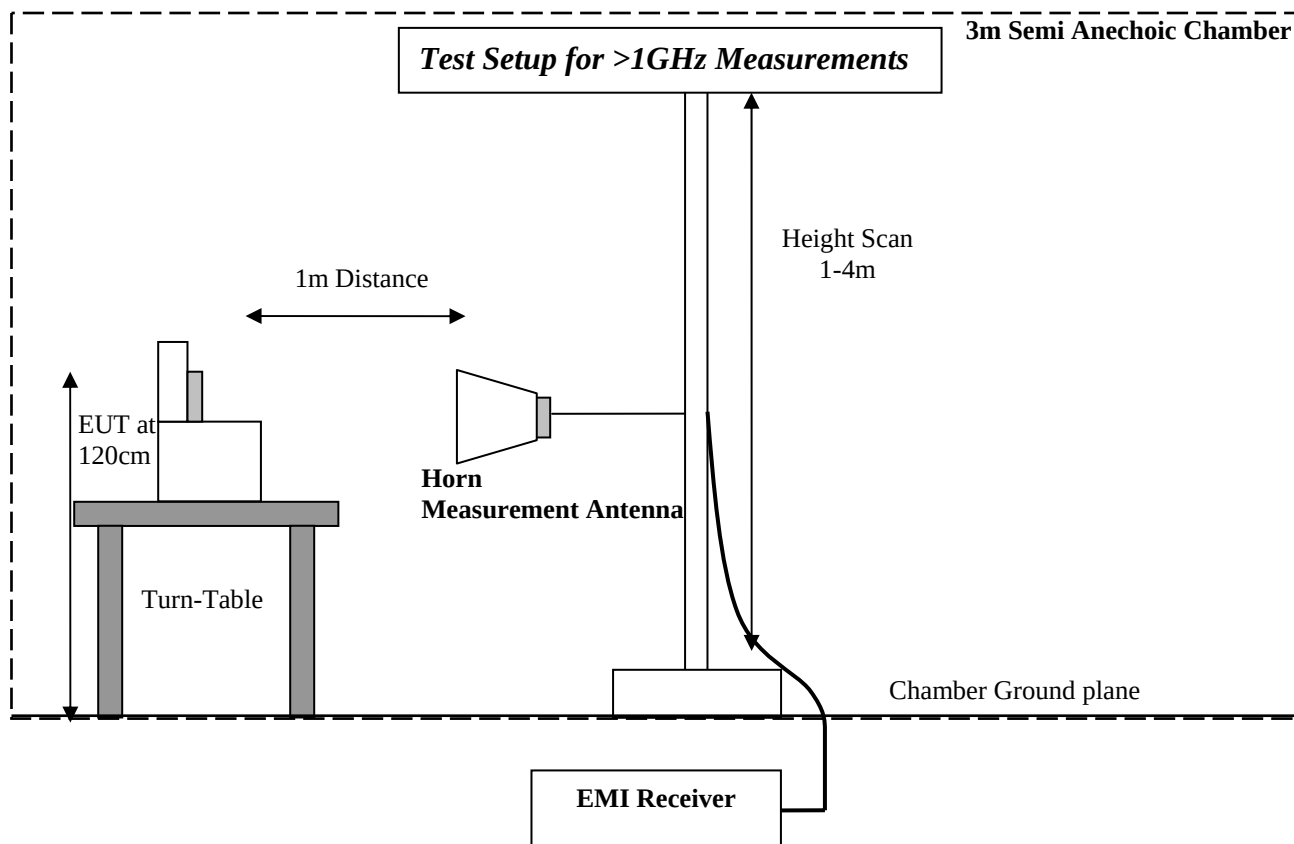
Temp(°C)	Measured Frequency (MHz)	Test Voltage(V)	Frequency Error(Hz)	Limit (+/-Hz)	Drift (ppm)
20	216.4873958	3.145	104.2	10824.375	0.481321092
20	216.48747395	3.7	26.05	10824.375	0.120330273
20	216.4874479	4.255	52.1	10824.375	0.240660546
50	216.4873958	3.7	104.2	10824.375	0.481321092
40	216.4873951	3.7	104.9	10824.375	0.484554536
30	216.4874614	3.7	38.6	10824.375	0.178301288
20	216.4874619	3.7	38.1	10824.375	0.175991685
10	216.4874354	3.7	64.6	10824.375	0.298400601
0	216.4873833	3.7	116.7	10824.375	0.539061147
-10	216.4873312	3.7	168.8	10824.375	0.779721693
-20	216.4873051	3.7	194.9	10824.375	0.900282926
-30	216.4873057	3.7	194.3	10824.375	0.897511404

6 Test Equipment and Ancillaries used for tests

No	Instrument/Ancillary	Type	Manufacturer	Serial No.	Cal Due	Interval
01	Spectrum Analyzer	ESIB 40	Rohde & Schwarz	100107	May 2010	1 year
02	Spectrum Analyzer	FSEM 30	Rohde & Schwarz	100017	May 2010	1 year
03	Signal Generator	SMY02	Rohde & Schwarz	836878/011	May 2010	1 year
04	Power-Meter	NRVD	Rohde & Schwarz	0857.8008.02	May 2010	1 year
05	Biconilog Antenna	3141	EMCO	0005-1186	June 2010	1 year
06	Horn Antenna (1-18GHz)	SAS-200/571	AH Systems	325	June 2010	1 year
07	Horn Antenna (18-26.5GHz)	3160-09	EMCO	1240	June 2010	1 year
08	Power Splitter	11667B	Hewlett Packard	645348	n/a	n/a
09	Climatic Chamber	VT4004	Voltsch	G1115	May 2010	1 year
10	High Pass Filter	5HC2700	Trilithic Inc.	9926013	n/a	n/a
11	High Pass Filter	4HC1600	Trilithic Inc.	9922307	n/a	n/a
12	Pre-Amplifier	JS4-00102600	Miteq	00616	May 2010	1 year
13	Power Sensor	URV5-Z2	Rohde & Schwarz	DE30807	May 2010	1 year
14	Digital Radio Comm. Tester	CMD-55	Rohde & Schwarz	847958/008	May 2010	1 year
15	Universal Radio Comm. Tester	CMU 200	Rohde & Schwarz	832221/06	May 2010	1 year
16	LISN	ESH3-Z5	Rohde & Schwarz	836679/003	May 2010	1 year
17	Loop Antenna	6512	EMCO	00049838	July 2010	2 years

7 BLOCK DIAGRAMS





8 Revision History

2009-11-12:

EMC_SPECT_006_09001_FCC95G: Original report

2009-12-04:

EMC_SPECT_006_09001_FCC95G_rev1: (replaces report# **EMC_SPECT_006_09001_FCC95G**); recalculated ERP and EIRP with measured antenna gain.