

EMISSIONS TEST REPORT FOR A LOW POWER TRANSMITTER**I. GENERAL INFORMATION**

Requirement: Federal Communications Commissions
Test Requirements: 15.205, 15.207, 15.209, 15.247

Applicant: Sensus Metering Systems

FCC ID: **KCH520C**

II. DESCRIPTION OF EQUIPMENT UNDER TEST (EUT)

The Sensus FCC ID: **KCH520C** is a digital transmission system (DTS) operating under the requirements in FCC Part 15. The product is a water meter, part of a Cellnet network that transmits meter readings to a neighborhood hub/access point unit owned by the utility. The transmitter sends short bursts of data as required by the network, as little as once every 84 hours, as often as once every 15 seconds. The transmit times are pre-programmed and stored in the product's EEPROM. A lithium battery powers the EUT, the battery has an expected life of over 15 years.

The 520C operates in the U.S. ISM band between 902 and 928 MHz.

Transmitter Specification

TX Power	27.56 dBm max.
Frequency of operation	903.8-926.2 MHz
Data Rate	19.2656 Kbps in <25ms burst
6 dB bandwidth	1.15 MHz
Power source	lithium battery

III. TEST DATES AND TEST LOCATION

Testing was performed 20-21 October 2004. All tests were performed at:

Compliance Certification Services
561F Monterey Road
Morgan Hill, CA 95037

T.N. Cokenias
EMC Consultant/Agent for Sensus Metering Systems

29 October 2004

15.203 Antenna connector requirement

The antenna is permanently attached to the product. For antenna conducted tests, a unit was modified by disconnecting the printed circuit antenna and replacing it with a 50 ohm coaxial cable connection terminated at one end with an SMA connector.

15.204 Antenna description

The meter transceiver uses a printed circuit folded dipole antenna:

Antenna description	Gain
printed ckt antenna	2.2 dBi

TEST DATA and TEST PROCEDURES - CCS Laboratory**Radiated Emissions**

Test Requirement: 15.205, 15.247

Out of Band Measurements

Test Requirement: 15.247

Measurement Equipment Used:

Agilent 4440A Spectrum Analyzer, 9 kHz-26.5 GHz
 Chase Biconolog antenna
 EMCO 3115 Horn antenna, 1-18 GHz
 Miteq pre-amplifier, 1 – 26.5 GHz
 IFI High pass filter, fp = 1800 MHz

Radiated emissions generated by the transmitter portion of the EUT were measured.

1. The EUT was placed on a wooden table resting on a turntable on the test site. Two water meters were connected to the appropriate ports as typical loads.

The search antenna was placed 3m from the EUT. The EUT antenna was mounted vertically as per normal installation.

2. The turntable was slowly rotated to locate the direction of maximum emission at each emission falling in the restricted bands of 15.205.

3. Radiated emissions were investigated for a LOW channel, a MID channel, and HIGH channel. Emissions were investigated to the 10th harmonic.

4. Once maximum direction was determined, the search antenna was raised and lowered in both vertical and horizontal polarizations. The maximum readings so obtained are recorded in the data listed below.

Test Results: Worst case results are presented. Refer to data sheets below. Restricted band emissions meet 54 dBuV/m. Other undesired emissions from the transmitter meet the -20 dBc requirement in 15.247(c).

FCC Radiated Emissions Limits

Section 15.205 Restricted bands of operation.

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
0.495 - 0.505 (1)	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 -	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.52525	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	156.7 - 156.9	3260 - 3267	23.6 - 24.0
12.29 - 12.293	162.0125 - 167.17	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	167.72 - 173.2	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	240 - 285	3600 - 4400	(2)
13.36 - 13.41	322 - 335.4		

1 Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

2 Above 38.6

(b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

(c) Except as provided in paragraphs (d) and (e), regardless of the field strength limits specified elsewhere in this Subpart, the provisions of this Section apply to emissions from any intentional radiator.

Section 15.209 Radiated emission limits, general requirements.

(a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
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 **	3
88 - 216	150 **	3
216 - 960	200 **	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

(b) In the emission table above, the tighter limit applies at the band edges.

(c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other Sections within this Part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.

(d) The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

(e) The provisions in Sections 15.31, 15.33, and 15.35 for measuring emissions at distances other than the distances specified in the above table, determining the frequency range over which radiated emissions are to be measured, and limiting peak emissions apply to all devices operated under this Part.

10/22/04 High Frequency Measurement

Compliance Certification Services, Morgan Hill Open Field Site

Test Engr: Hitesh H. Solanki
 Project #: 04U2982-1
 Company: SENSUS
 EUT Descrip.: CELLNET MTU
 EUT M/N: 520C
 Test Target: FCC Class B
 Mode Oper: Tx, continuously

Test Equipment:

EMCO Horn 1-18GHz T60; S/N: 2238 @3m Hi Frequency Cables	Pre-amplifier 1-26GHz T34 HP 8449B	Pre-amplifier 26-40GHz	Horn > 18GHz
2 foot cable	3 foot cable	4 foot cable 4_Hitesh	12 foot cable 12_Hitesh
		HPF HPF_1.5GHz	Reject Filter

Peak Measurements
RBW=VBW=1MHz

Average Measurements
RBW=1MHz ; VBW=10Hz

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filtr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
1.807	3.0	68.3	67.7	27.0	2.4	-37.1	0.0	0.3	60.9	60.3	74	54	-13.1	6.3	V -20 dBc Limit Info. Only
2.711	3.0	55.5	53.4	29.2	3.0	-35.9	0.0	0.6	52.3	50.3	74	54	-21.7	-3.7	V
4.518	3.0	45.8	40.6	32.9	4.3	-34.2	0.0	0.6	49.3	44.1	74	54	-24.7	-9.9	V
5.423	3.0	48.2	43.6	34.0	4.9	-34.2	0.0	0.5	53.4	48.8	74	54	-20.6	-5.2	V
6.326	3.0	44.3	33.6	34.7	5.5	-34.1	0.0	0.5	50.9	40.2	74	54	-23.1	-13.8	V
Middle Channel															
1.829	3.0	60.0	58.4	27.1	2.4	-37.0	0.0	0.3	52.7	51.2	74	54	-21.3	-2.8	V
2.743	3.0	52.8	50.3	29.3	3.1	-35.9	0.0	0.6	49.8	47.3	74	54	-24.2	-6.7	V
4.572	3.0	46.0	40.5	32.9	4.3	-34.2	0.0	0.6	49.6	44.1	74	54	-24.4	-9.9	V
5.487	3.0	44.2	36.3	34.2	4.9	-34.2	0.0	0.5	49.6	41.7	74	54	-24.4	-12.3	V
6.401	3.0	42.5	36.0	34.8	5.6	-34.1	0.0	0.5	49.3	42.8	74	54	-24.7	-11.2	V
															V
															V
															V
															V
															V
															V
Low Channel Horizontal Ant. pol.															
1.807	3.0	65.9	65.3	27.0	2.4	-37.1	0.0	0.3	58.5	57.9	74	54	-15.5	3.9	V -20 dBc Limit Info. Only
2.711	3.0	53.3	51.2	29.2	3.0	-35.9	0.0	0.6	50.1	48.0	74	54	-23.9	-6.0	H
4.518	3.0	46.7	41.9	32.9	4.3	-34.2	0.0	0.6	50.2	45.4	74	54	-23.8	-8.6	H
5.422	3.0	46.3	35.1	34.0	4.9	-34.2	0.0	0.5	51.5	40.3	74	54	-22.5	-13.7	H
6.326	3.0	47.5	43.0	34.7	5.5	-34.1	0.0	0.5	54.1	49.6	74	54	-19.9	-4.4	H
Middle Channel															
1.829	3.0	62.3	61.4	27.1	2.4	-37.0	0.0	0.3	55.1	54.2	74	54	-18.9	0.2	V -20 dBc Limit Info. Only
2.743	3.0	53.7	51.4	29.3	3.1	-35.9	0.0	0.6	50.7	48.4	74	54	-23.3	-5.6	H
5.487	3.0	46.8	36.1	34.2	4.9	-34.2	0.0	0.5	52.2	41.4	74	54	-21.8	-12.6	H
6.401	3.0	42.9	37.3	34.8	5.6	-34.1	0.0	0.5	49.7	44.1	74	54	-24.3	-9.9	H
															H
															H
															H

f	Measurement Frequency	Amp	Preamp Gain	Avg Lim	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Pk Lim	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Avg Mar	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Pk Mar	Margin vs. Peak Limit
CL	Cable Loss	HPF	High Pass Filter		

10/22/04 **High Frequency Measurement**

Compliance Certification Services, Morgan Hill Open Field Site

Test Engr:	Hitesh H. Solanki
Project #:	04U2982-1
Company:	SENSUS
EUT Descrip.:	CELLNET MTU
EUT M/N:	520C
Test Target:	FCC Class B
Mode Oper:	Tx, continuously

Test Equipment:

EMCO Horn 1-18GHz		Pre-amplifier 1-26GHz		Pre-amplifier 26-40GHz		Horn > 18GHz	
Hi Frequency Cables							
2 foot cable		3 foot cable		4 foot cable		12 foot cable	
HPF		Reject Filter					

Peak Measurements
RBW=VBW=1MHz

Average Measurements
RBW=1MHz ; VBW=10Hz

[illegible]

f	Measurement Frequency	Amp	Preamp Gain	Avg Lim	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Pk Lim	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Avg Mar	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Pk Mar	Margin vs. Peak Limit
CL	Cable Loss	HPF	High Pass Filter		

Radiated Emissions

Test Requirement: 15.109

Measurement Equipment Used:

HP 8542E Receiver, 9 kHz - 2.9 GHz

Schaffner/Chase CBL6112B Bilog Antenna, 30 - 2000 MHz

Radiated emissions generated by the digital portion of the EUT were measured.

1. The EUT was placed on a wooden table resting on a turntable on the open air test site. The search antenna was placed 3m from the EUT. The EUT antenna was mounted vertically as per normal installation. The EUT was set to transmit continuously on the MID channel.
2. The turntable was slowly rotated to locate the direction of maximum emission at each emission falling in the restricted bands of 15.205.
3. Once maximum direction was determined, the search antenna was raised and lowered in both vertical and horizontal polarizations. The maximum readings so obtained are recorded in the data listed below.

Test Results: EUT meets requirements. All transmitter emissions in the 30-1000 MHz band are at least 20 below the carrier:

$$E, \text{ dBuV/m at 3m} = 95.24 + P, \text{ dBm} + G, \text{ dBi}$$

where P is TX power, G is TX antenna gain.

From antenna conducted data below, maximum power in 100 kHz = 22.44 dBm

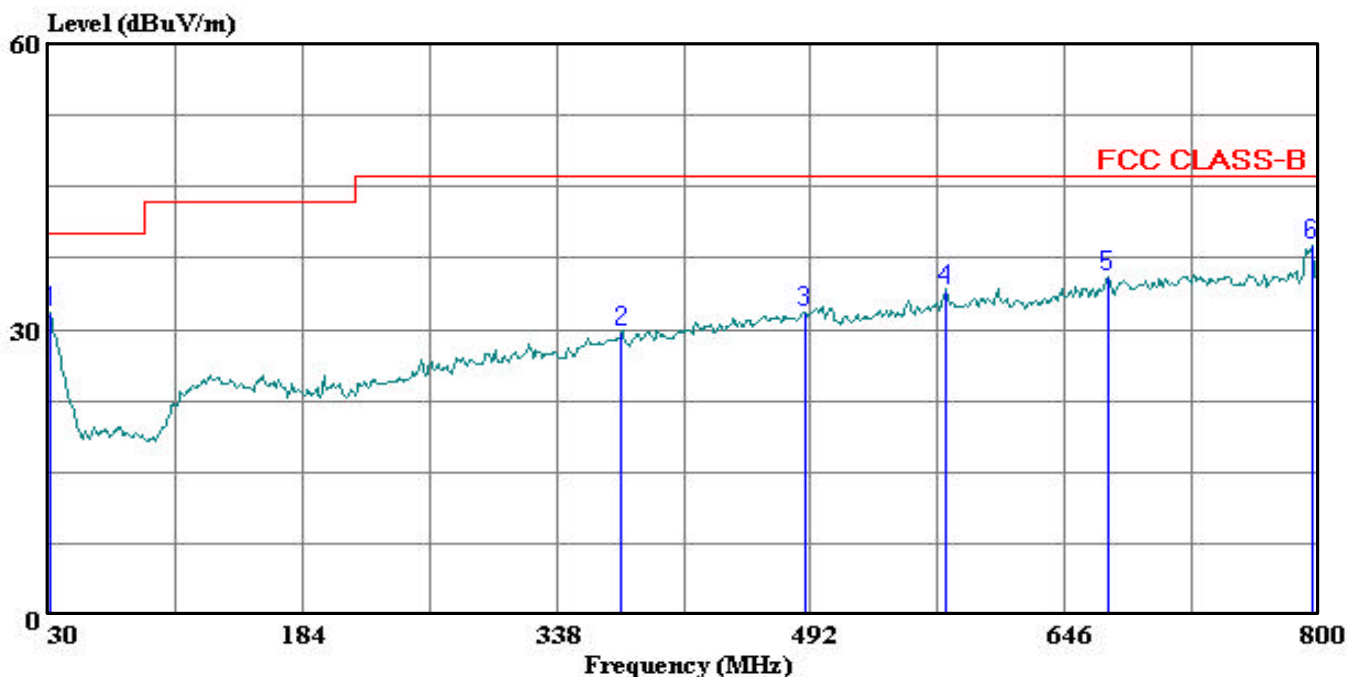
$$\text{Carrier field strength} = (95.24 + 22.44 + 2.2) = 119.88 \text{ dBuV/m}$$

Transmitter emissions in the 960-1240 MHz restricted band must meet the general limits in Section 15.209 of the rules (same as 15.109 limits 30-1000 MHz, red line on data sheets). All transmitter emissions located in the restricted bands below 1 GHz meet the limit

Refer to data graphs and spreadsheets below.

Data#: 2 File#: 04U2982.EMI

Date: 10-20-2004 Time: 14:59:02



(Auxiliary ATC)

Trace: 1

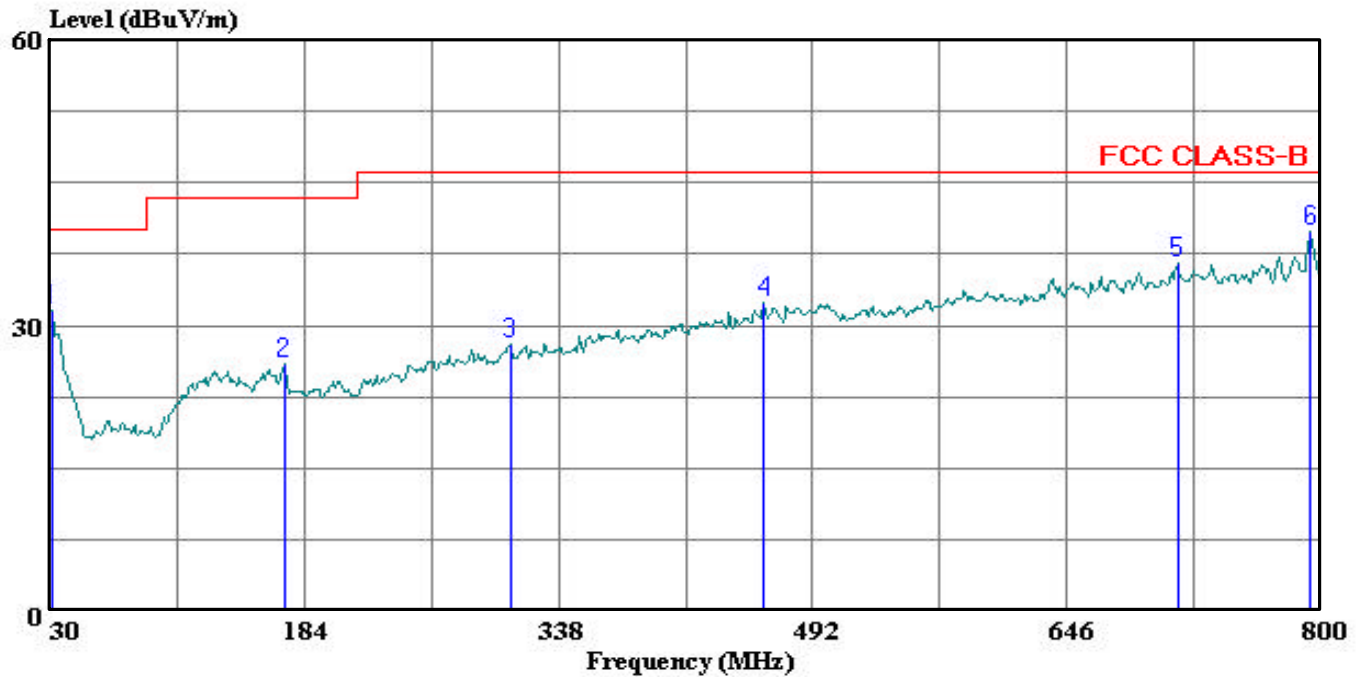
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Condition: FCC CLASS-B HORIZONTAL
Test Operator: : Hitesh H. Solanki
Project #: : 04U2982-1
Company: : SENSUS
EUT: : CELLNET MTU
Model No: : 520C
Configuration: : EUT
Target of Test: : FCC CLASS B
Mode of Operation: TX AT MIDDLE CHANNEL (917.58 MHz)

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	Freq	Remark	Read Level	Factor	Level	Limit Line	Over Limit
	MHz		dBuV	dB	dBuV/m	dBuV/m	dB
1	31.540	Peak	9.12	22.63	31.75	40.00	-8.25
2	377.270	Peak	11.63	18.01	29.63	46.00	-16.37
3	488.150	Peak	11.01	20.71	31.72	46.00	-14.28
4	573.620	Peak	11.86	22.19	34.05	46.00	-11.96
5	672.180	Peak	11.87	23.68	35.55	46.00	-10.45
6	795.380	Peak	13.56	25.31	38.87	46.00	-7.13

Data#: 4 File#: 04U2982.EMI Date: 10-20-2004 Time: 15:03:21



(Auxiliary ATC)

Trace: 3

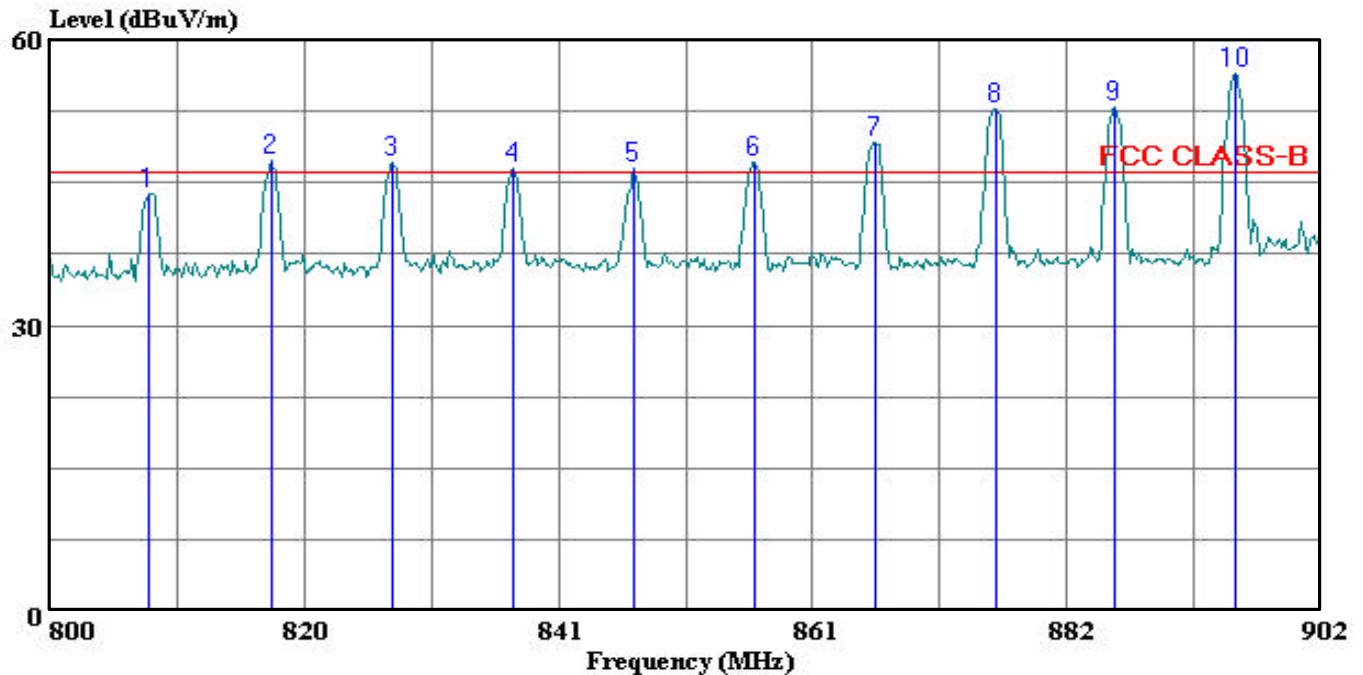
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Condition: FCC CLASS-B VERTICAL
Test Operator: : Hitesh H. Solanki
Project #: : 04U2982-1
Company: : SENSUS
EUT: : CELLNET MTU
Model No: : 520C
Configuration: : EUT
Target of Test: : FCC CLASS B
Mode of Operation: TX AT MIDDLE CHANNEL (917.58 MHz)

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	Freq	Remark	Read Level	Factor	Level	Limit Line	Over Limit
	MHz		dBuV	dB	dBuV/m	dBuV/m	dB
1	30.770	Peak	8.27	23.23	31.50	40.00	-8.50
2	171.680	Peak	12.11	13.79	25.91	43.50	-17.59
3	308.740	Peak	11.66	16.45	28.11	46.00	-17.89
4	462.740	Peak	12.33	20.13	32.46	46.00	-13.54
5	712.990	Peak	12.39	24.24	36.64	46.00	-9.36
6	793.840	Peak	14.54	25.28	39.82	46.00	-6.18

Data#: 9 File#: 04U2982.EMI Date: 10-20-2004 Time: 15:30:06



(Aux ATC)

Trace: 8

Ref Trace:

Condition: FCC CLASS-B HORIZONTAL
Test Operator: : Hitesh H. Solanki
Project #: : 04U2982-1
Company: : SENSUS
EUT: : CELLNET MTU
Model No: : 520C
Configuration: : EUT
Target of Test: : FCC CLASS B
Mode of Operation: TX AT MIDDLE CHANNEL (917.58 MHz)

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	Freq	Remark	Read Level	Factor	Level	Limit Line	Over Limit
	MHz		dBuV	dB	dBuV/m	dBuV/m	dB
1	807.854	Peak	18.30	25.46	43.76	46.00	-2.24
2 *	817.748	Peak	21.70	25.55	47.26	46.00	1.26
3 *	827.438	Peak	21.48	25.63	47.11	46.00	1.11
4 *	837.128	Peak	20.75	25.74	46.49	46.00	0.49
5 *	846.818	Peak	20.67	25.87	46.54	46.00	0.54
6 *	856.508	Peak	21.29	25.92	47.21	46.00	1.21
7 *	866.198	Peak	23.31	25.96	49.27	46.00	3.27
8 *	875.888	Peak	26.66	26.11	52.77	46.00	6.77
9 *	885.374	Peak	26.74	26.29	53.03	46.00	7.03

Data#: 9

File#: 04U2982.EMI

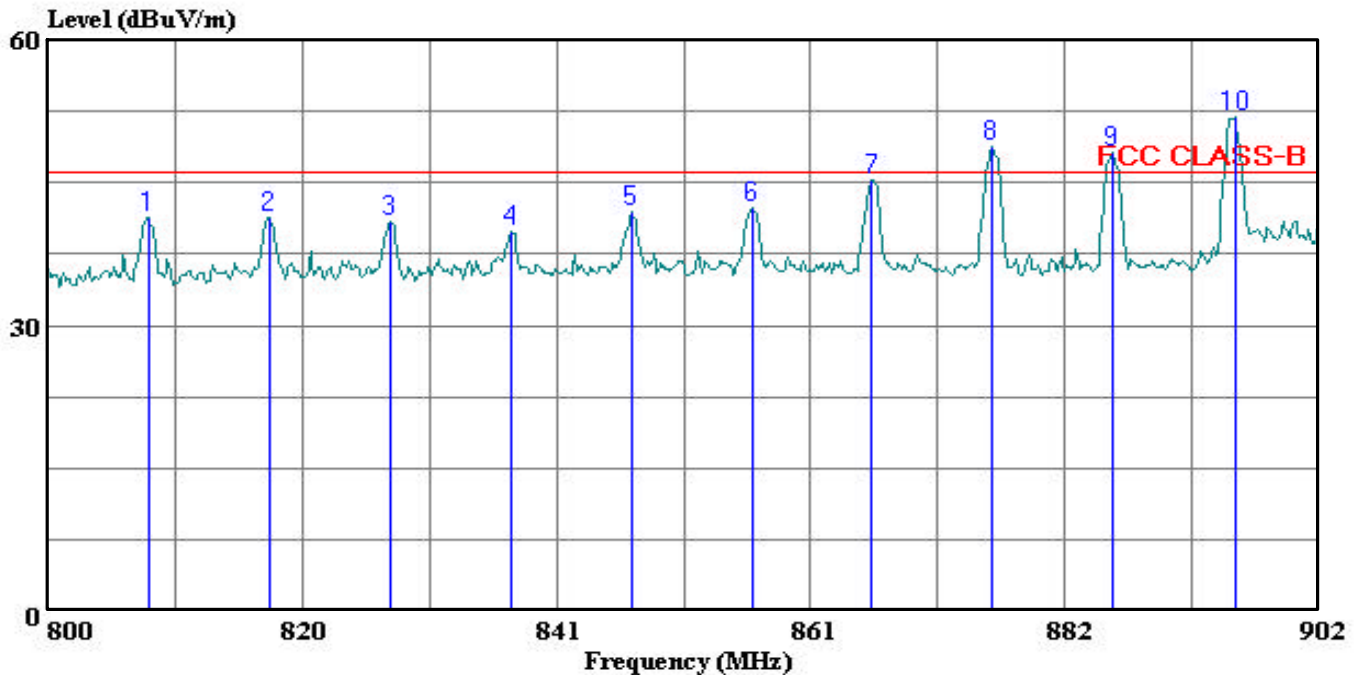
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Time: 15:30:06

Page: 2

	Freq	Remark	Read Level	Factor	Level	Limit Line	Over Limit
	MHz		dBuV	dB	dBuV/m	dBuV/m	dB
10 *	895.064	Peak	30.04	26.49	56.53	46.00	10.53

Data#: 7 File#: 04U2982.EMI Date: 10-20-2004 Time: 15:27:20



(Auxil ATC)

Trace: 6

Ref Trace:

Condition: FCC CLASS-B VERTICAL
Test Operator: : Hitesh H. Solanki
Project #: : 04U2982-1
Company: : SENSUS
EUT: : CELLNET MTU
Model No: : 520C
Configuration: : EUT
Target of Test: : FCC CLASS B
Mode of Operation: TX AT MIDDLE CHANNEL (917.58 MHz)

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	Freq	Remark	Read Level	Factor	Level	Limit Line	Over Limit
	MHz		dBuV	dB	dBuV/m	dBuV/m	dB
1	808.058	Peak	15.85	25.46	41.31	46.00	-4.69
2	817.748	Peak	15.87	25.55	41.43	46.00	-4.57
3	827.438	Peak	15.38	25.63	41.01	46.00	-4.99
4	837.128	Peak	14.19	25.74	39.93	46.00	-6.07
5	846.818	Peak	16.03	25.87	41.90	46.00	-4.10
6	856.508	Peak	16.39	25.92	42.31	46.00	-3.69
7	866.096	Peak	19.28	25.96	45.24	46.00	-0.76
8 *	875.684	Peak	22.70	26.10	48.80	46.00	2.80
9 *	885.374	Peak	21.85	26.29	48.14	46.00	2.14

Data#: 7

File#: 04U2982.EMI

Date: 10-20-2004

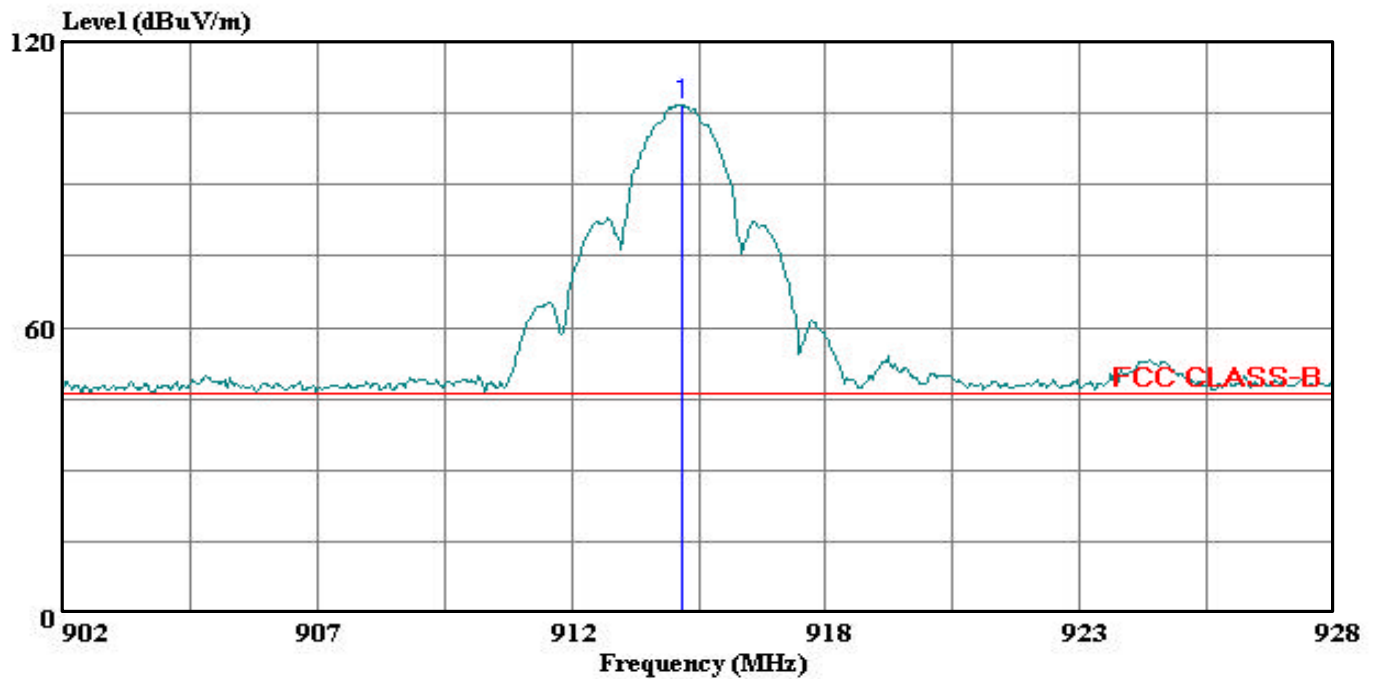
Time: 15:27:20

Page: 2

	Freq	Remark	Read Level	Factor	Level	Limit Line	Over Limit
	MHz		dBuV	dB	dBuV/m	dBuV/m	dB
10 *	895.268	Peak	25.50	26.49	51.99	46.00	5.99

Data#: 19 File#: 04U2982.EMI

Date: 10-20-2004 Time: 15:43:54



(Aux ATC)

Trace: 18

Ref Trace:

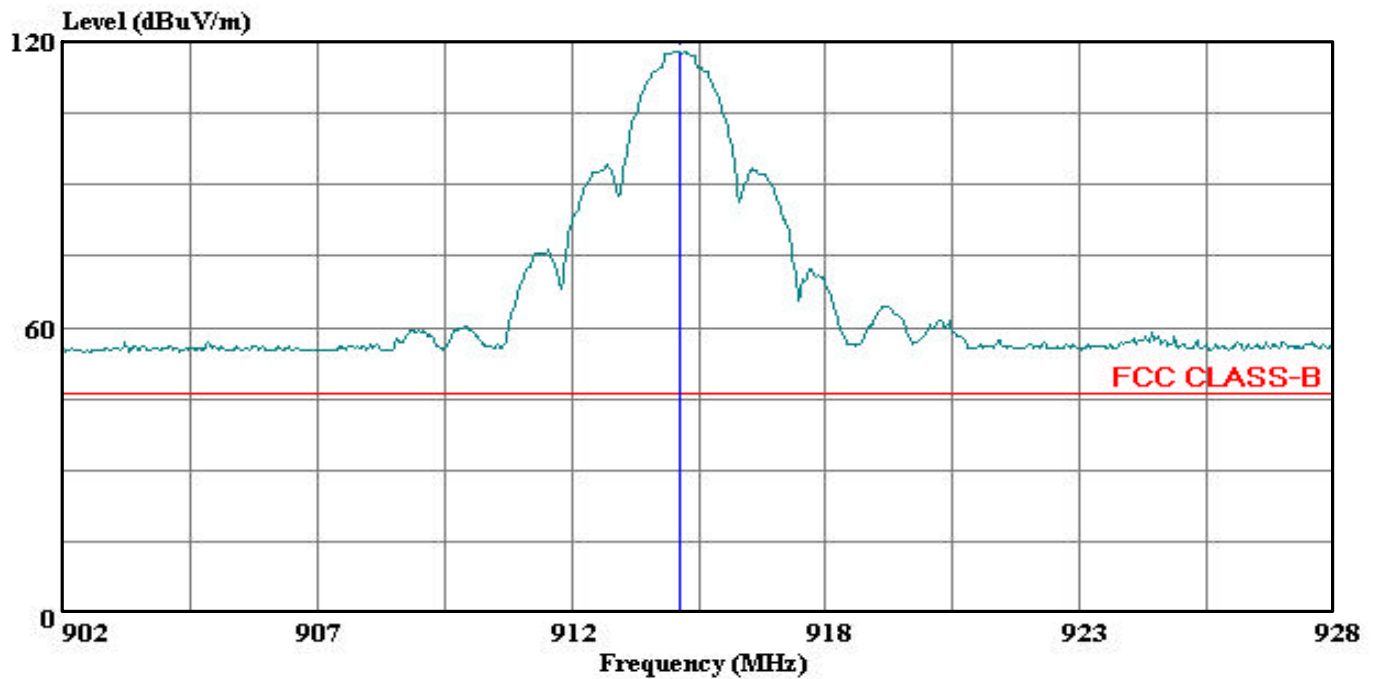
Condition: FCC CLASS-B HORIZONTAL
Test Operator: : Hitesh H. Solanki
Project #: : 04U2982-1
Company: : SENSUS
EUT: : CELLNET MTU
Model No: : 520C
Configuration: : EUT
Target of Test: : FCC CLASS B
Mode of Operation: TX AT MIDDLE CHANNEL (917.58 MHz)

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	Freq	Remark	Read Level	Factor	Level	Limit Line	Over Limit
	MHz		dBuV	dB	dBuV/m	dBuV/m	dB
1 *	914.662	Peak	79.85	26.94	106.79	46.00	60.79

Data#: 16 File#: 04U2982.EMI

Date: 10-20-2004 Time: 15:41:45



(Aux ATC)

Trace: 15

Ref Trace:

Condition: FCC CLASS-B VERTICAL

Test Operator: : Hitesh H. Solanki

Project #: : 04U2982-1

Company: : SENSUS

EUT: : CELLNET MTU

Model No: : 520C

Configuration: : EUT

Target of Test: : FCC CLASS B

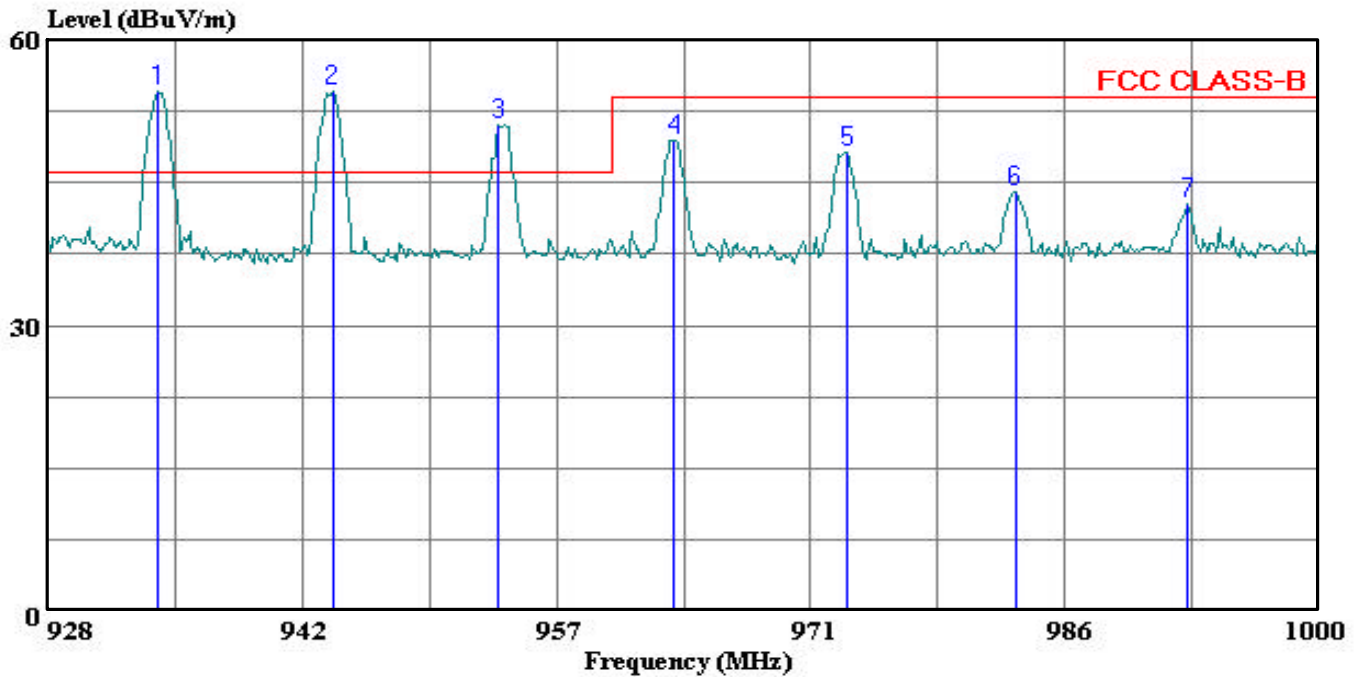
Mode of Operation: TX AT MIDDLE CHANNEL (917.58 MHz)

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	Freq	Remark	Read Level	Factor	Level	Limit Line	Over Limit
	MHz		dBuV	dB	dBuV/m	dBuV/m	dB
1 *	914.636	Peak	90.88	26.94	117.82	46.00	71.82

Data#: 11 File#: 04U2982.EMI

Date: 10-20-2004 Time: 15:32:44



(Auxiliary ATC)

Trace: 10

Ref Trace:

Condition: FCC CLASS-B HORIZONTAL

Test Operator: : Hitesh H. Solanki

Project #: : 04U2982-1

Company: : SENSUS

EUT: : CELLNET MTU

Model No: : 520C

Configuration: : EUT

Target of Test: : FCC CLASS B

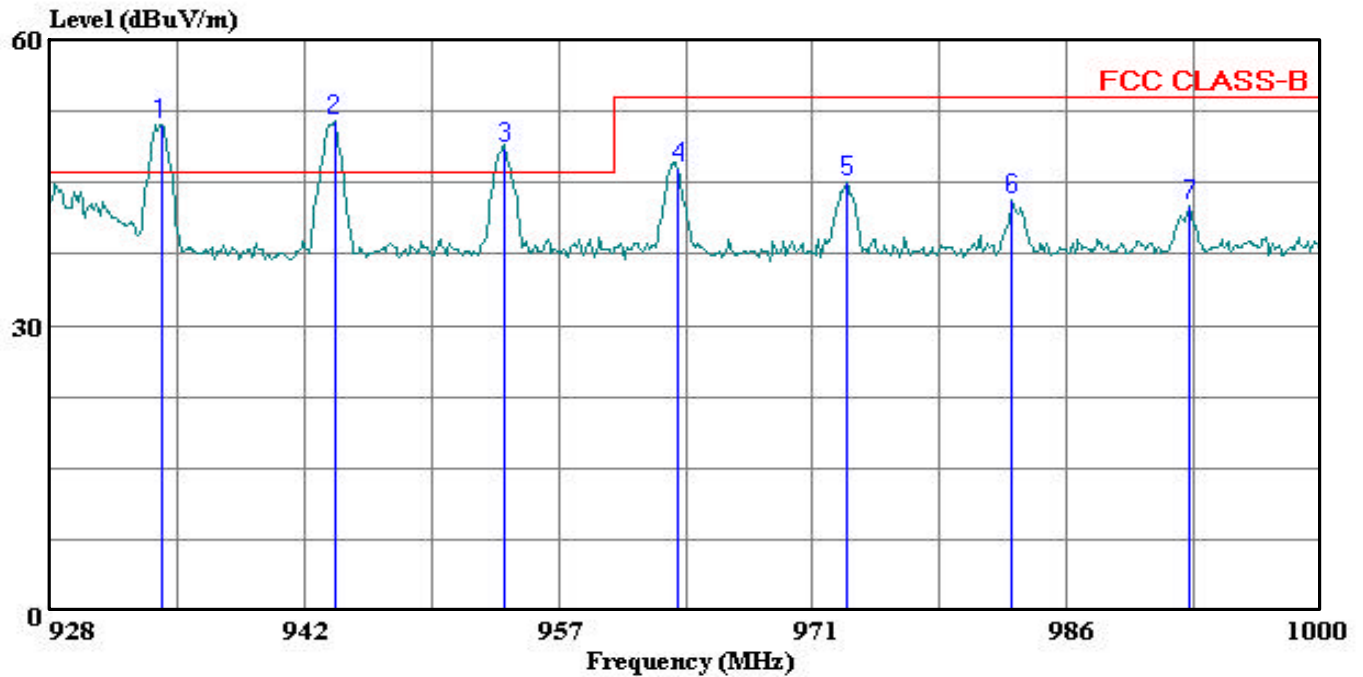
Mode of Operation: TX AT MIDDLE CHANNEL (917.58 MHz)

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			Read		Limit	Over
Freq	Remark	Level	Factor	Level	Line	Limit
MHz		dBuV	dB	dBuV/m	dBuV/m	dB
1 *	934.264 Peak	27.39	27.19	54.58	46.00	8.58
2 *	944.128 Peak	27.39	27.24	54.63	46.00	8.63
3 *	953.488 Peak	23.69	27.29	50.98	46.00	4.98
4	963.496 Peak	21.98	27.42	49.40	54.00	-4.60
5	973.288 Peak	20.69	27.44	48.13	54.00	-5.87
6	982.792 Peak	16.41	27.62	44.04	54.00	-9.96
7	992.584 Peak	15.03	27.84	42.87	54.00	-11.13

Data#: 13 File#: 04U2982.EMI

Date: 10-20-2004 Time: 15:34:56



(Auxiliary ATC)

Trace: 12

Ref Trace:

Condition: FCC CLASS-B VERTICAL

Test Operator: : Hitesh H. Solanki

Project #: : 04U2982-1

Company: : SENSUS

EUT: : CELLNET MTU

Model No: : 520C

Configuration: : EUT

Target of Test: : FCC CLASS B

Mode of Operation: TX AT MIDDLE CHANNEL (917.58 MHz)

Page: 1

			Read		Limit	Over
Freq	Remark	Level	Factor	Level	Line	Limit
MHz		dBuV	dB	dBuV/m	dBuV/m	dB
1 *	934.336 Peak	23.86	27.19	51.04	46.00	5.04
2 *	944.128 Peak	24.34	27.24	51.58	46.00	5.58
3 *	953.776 Peak	21.25	27.30	48.55	46.00	2.55
4	963.568 Peak	19.00	27.42	46.42	54.00	-7.58
5	973.144 Peak	17.53	27.44	44.97	54.00	-9.03
6	982.504 Peak	15.50	27.62	43.12	54.00	-10.88
7	992.584 Peak	14.72	27.84	42.56	54.00	-11.44

AC Line Conducted Emissions
Test Requirement: 15.107, 15.207

Measurement Equipment Used:

Rhode & Schwarz EMI Receiver ESHS-20
Fischer Custom Communication LISN, FCC-LISN-50/250-25-2

Test Procedure

1. The EUT was placed on a wooden table 40 cm from a vertical ground plane and approximately 80 cm above the horizontal ground plane on the floor. The EUT was set to transmit in normally.
2. Line conducted data was recorded for both NEUTRAL and HOT lines.

Test Results

NOT APPLICABLE. EUT battery powered only.

6dB Bandwidth for DTS
Test Requirement: 15.247

Measurement Equipment Used:

Agilent 4440A Spectrum Analyzer, 9 kHz-26.5 GHz
10 dB attenuator
1 ft coax cable, 1 dB loss max.

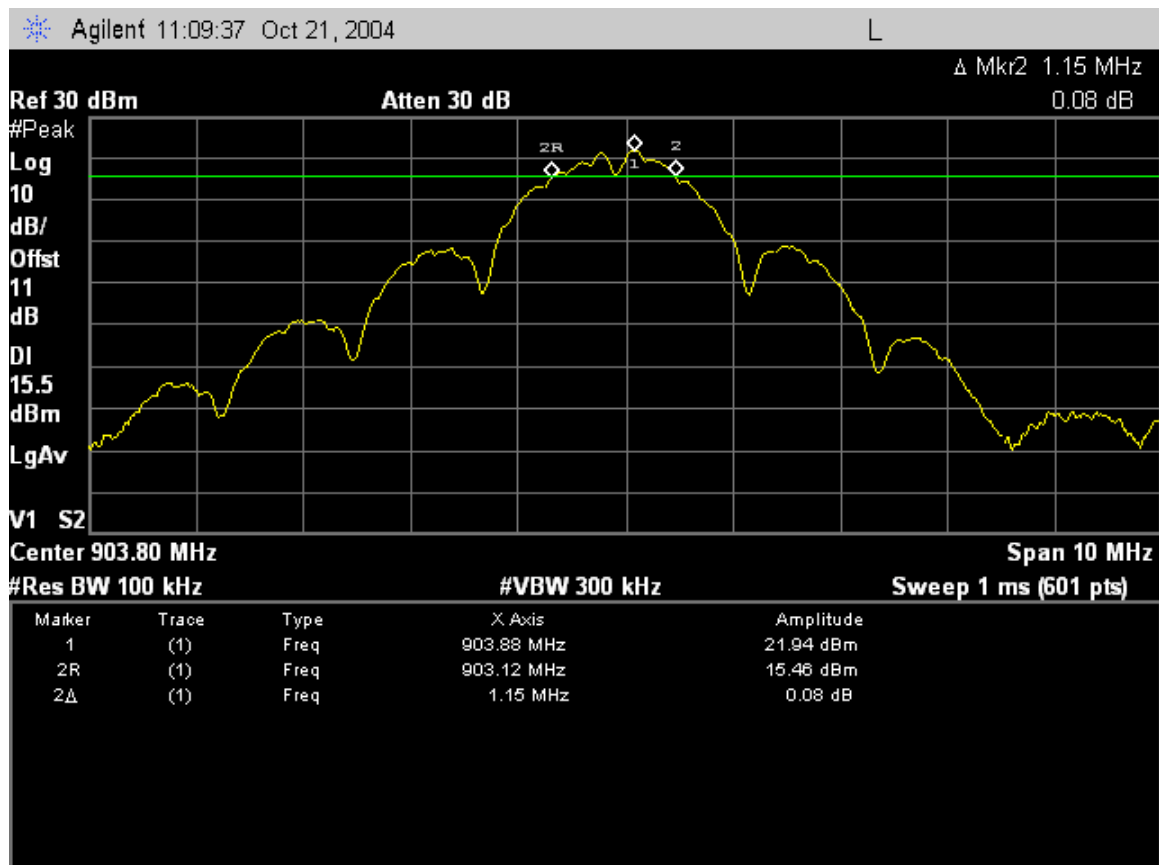
Test Procedures

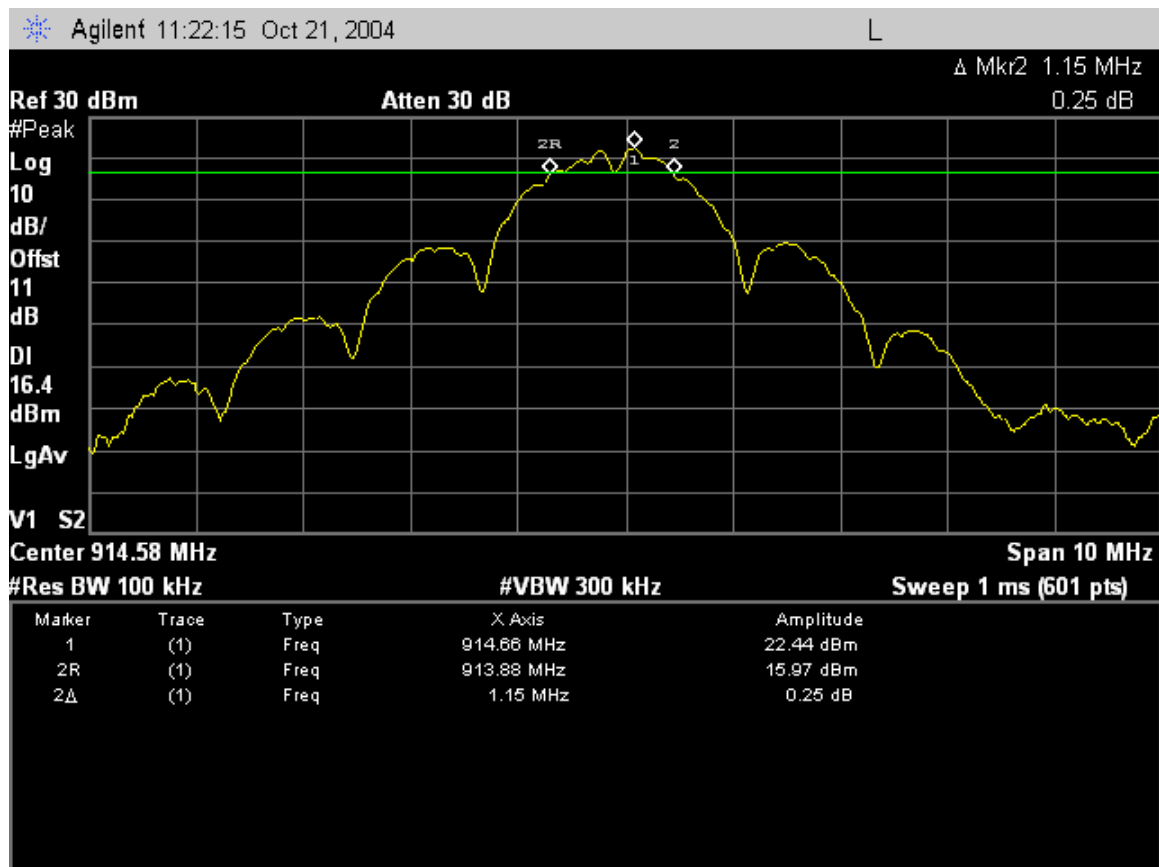
A modified EUT with a coaxial cable attached to the radio antenna port was configured on a test bench. The cable's SMA connector was connected to the spectrum analyzer. The EUT transmission was continuous at 903.8 MHz (LOW channel). While the transmitter broadcast a steady stream of digital data, the analyzer MAX HOLD function was used to capture the envelope of the transmission occupied bandwidth.

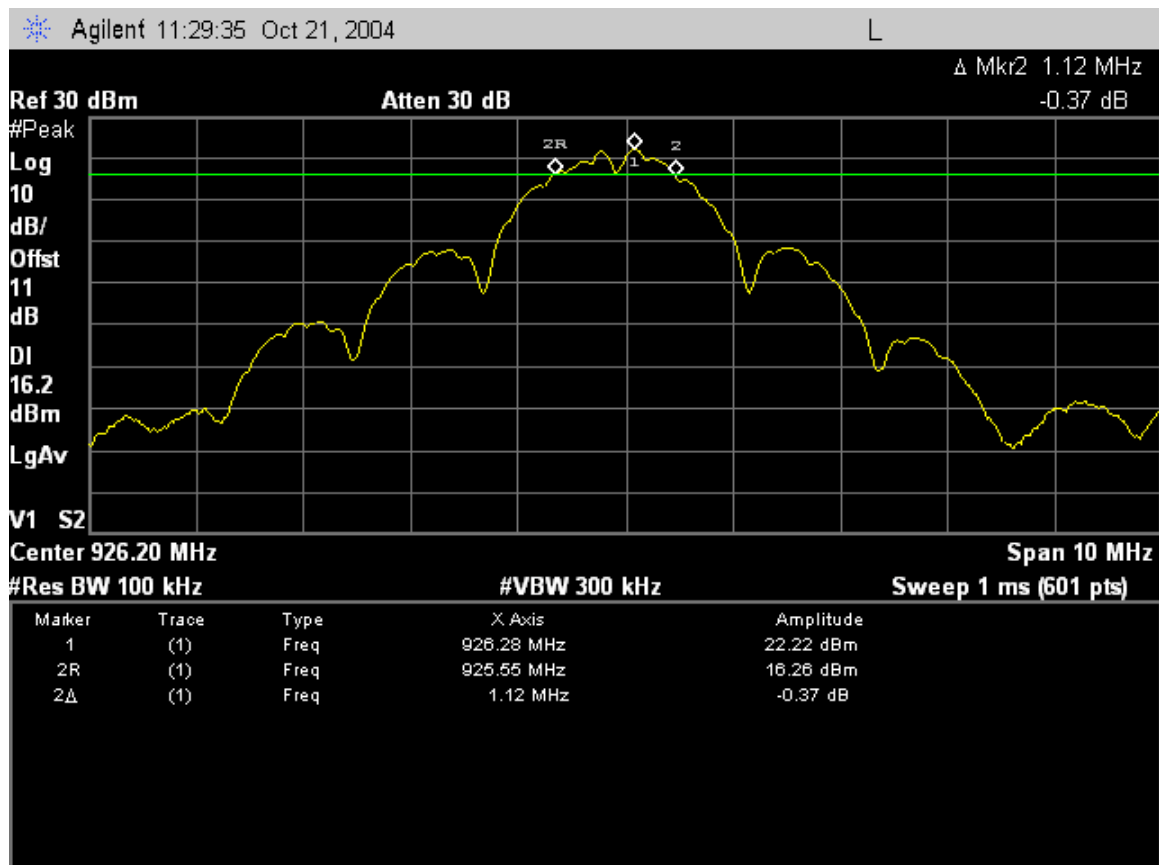
Test was repeated for MID and HIGH channels.

Test Results: Measured approximately 1.1 MHz 6 dB BW. Refer to data sheets below.

15.247 6dB Channel Bandwidth LOW channel



15.247 6 dB Channel Bandwidth MID channel

15.247 6 dB Channel Bandwidth HIGH channel

99% Bandwidth

Test Requirement: RSS-210 (Canada Only, FCC Information Only)

Measurement Equipment Used:

Agilent 4440A Spectrum Analyzer, 9 kHz-26.5 GHz
10 dB attenuator
1 ft coax cable, 1 dB loss max.

Limit

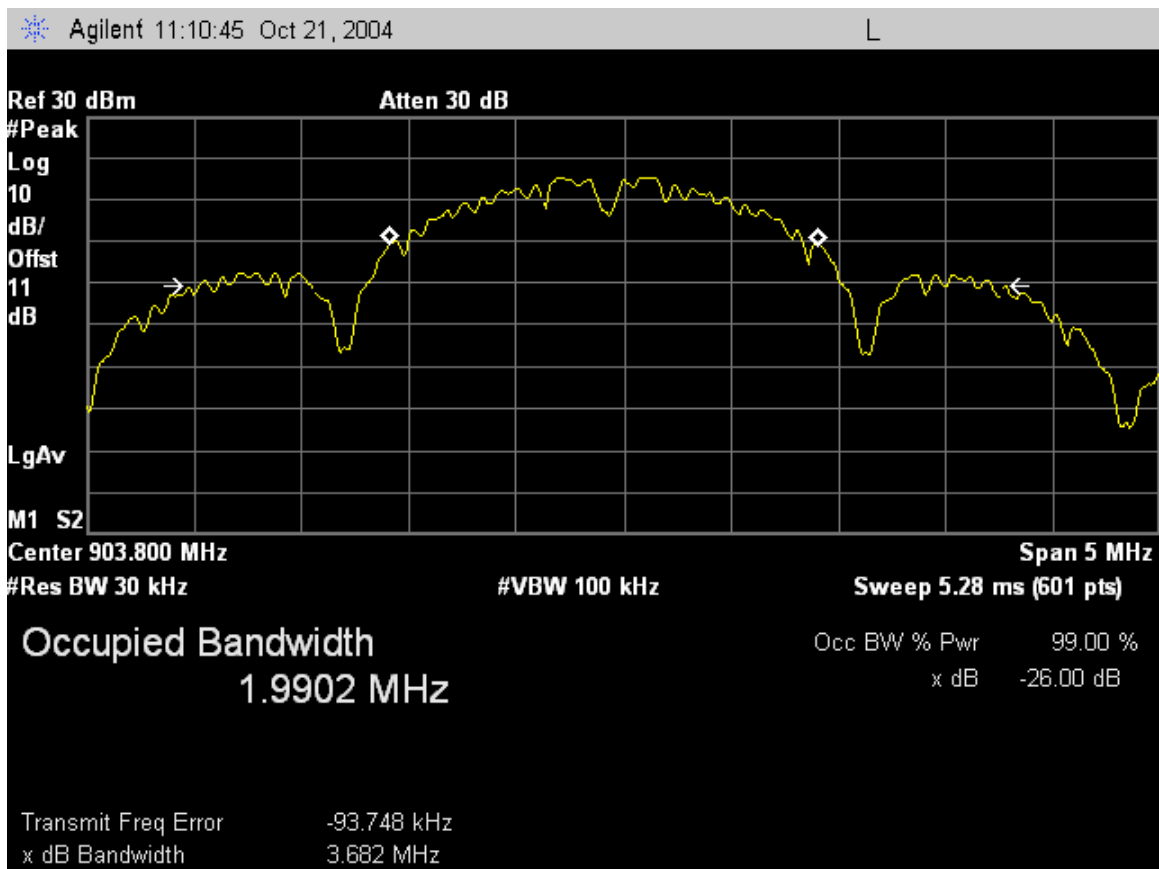
None: for reporting purposes only.

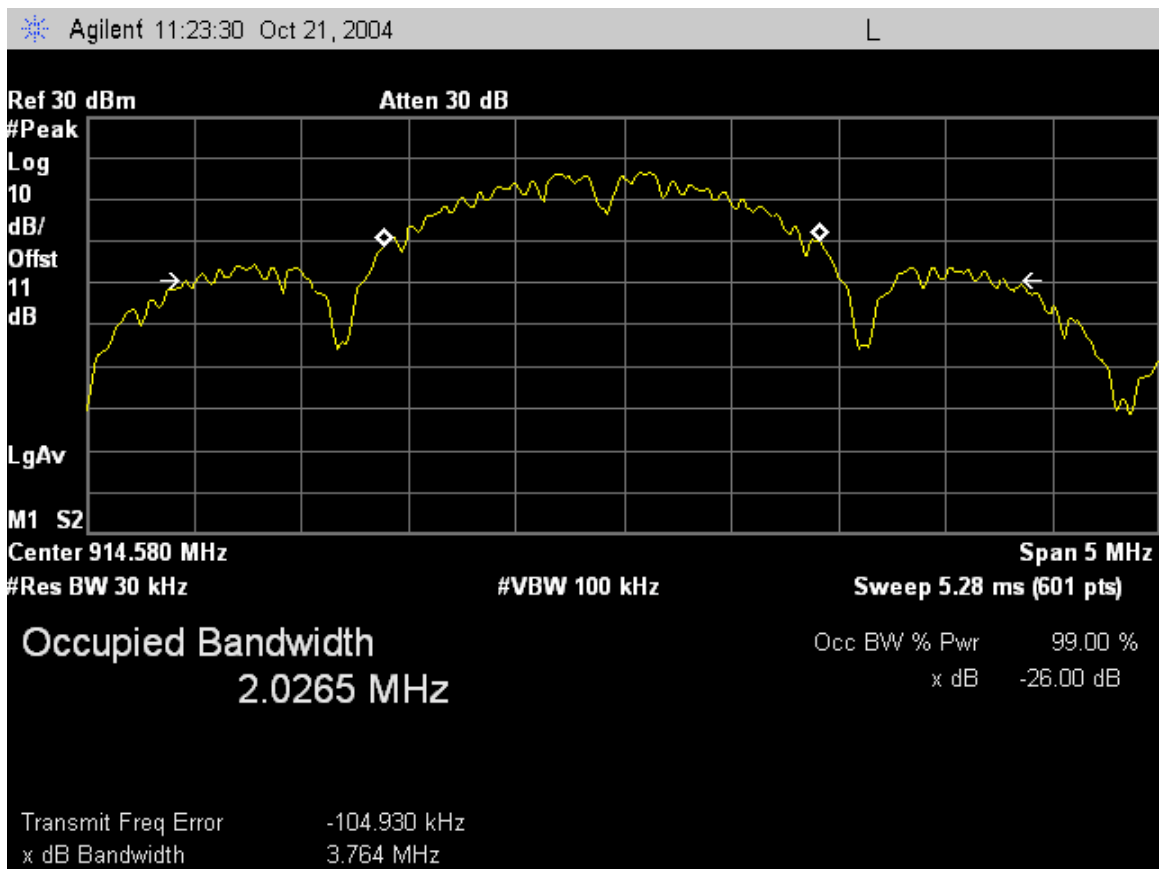
Test Procedure

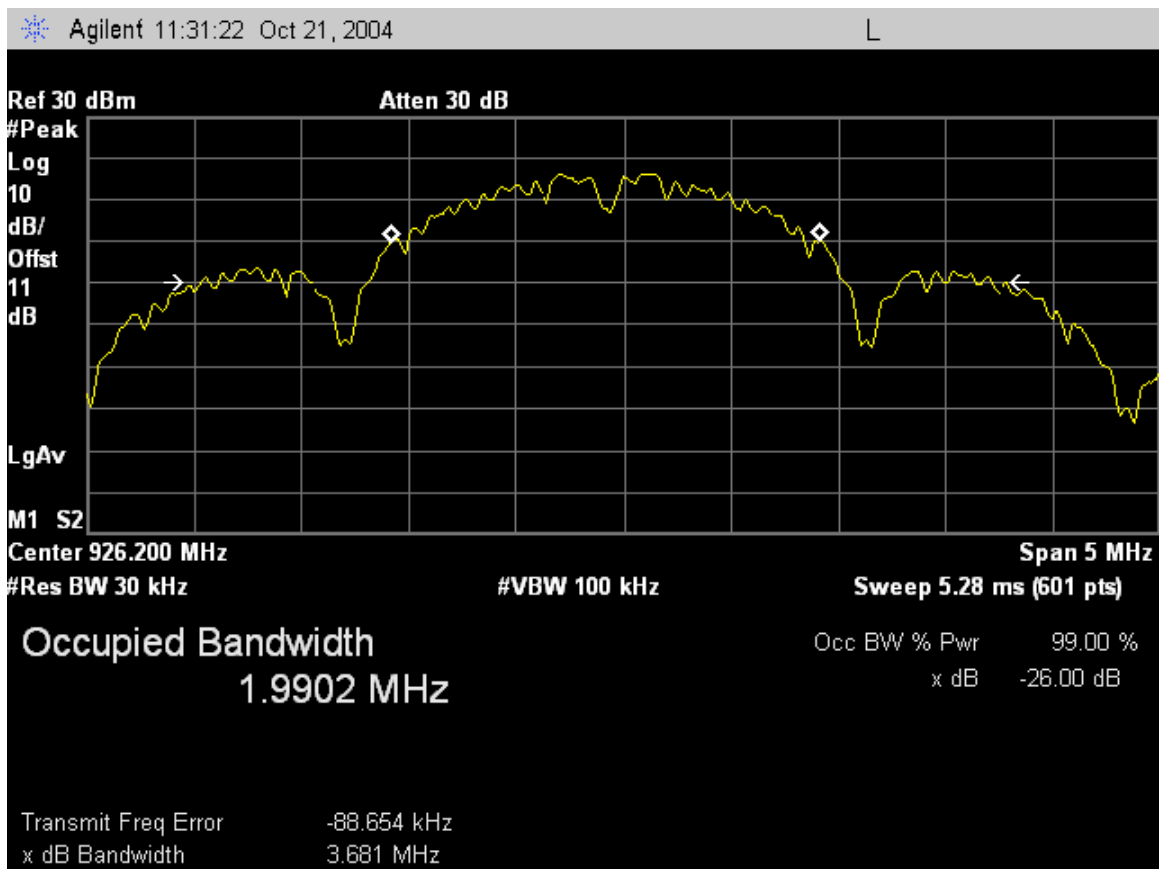
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

Test Results

Refer to spectrum analyzer charts below.

99% Bandwidth LOW Channel

99% Bandwidth MID Channel

99% Bandwidth HIGH Channel

RF Power Output**Test Requirement: 15.247****Measurement Equipment Used:****Measurement Equipment Used:**

Agilent 4440A Spectrum Analyzer, 9 kHz-26.5 GHz
 10 dB attenuator
 1 ft coax cable, 1 dB loss max.

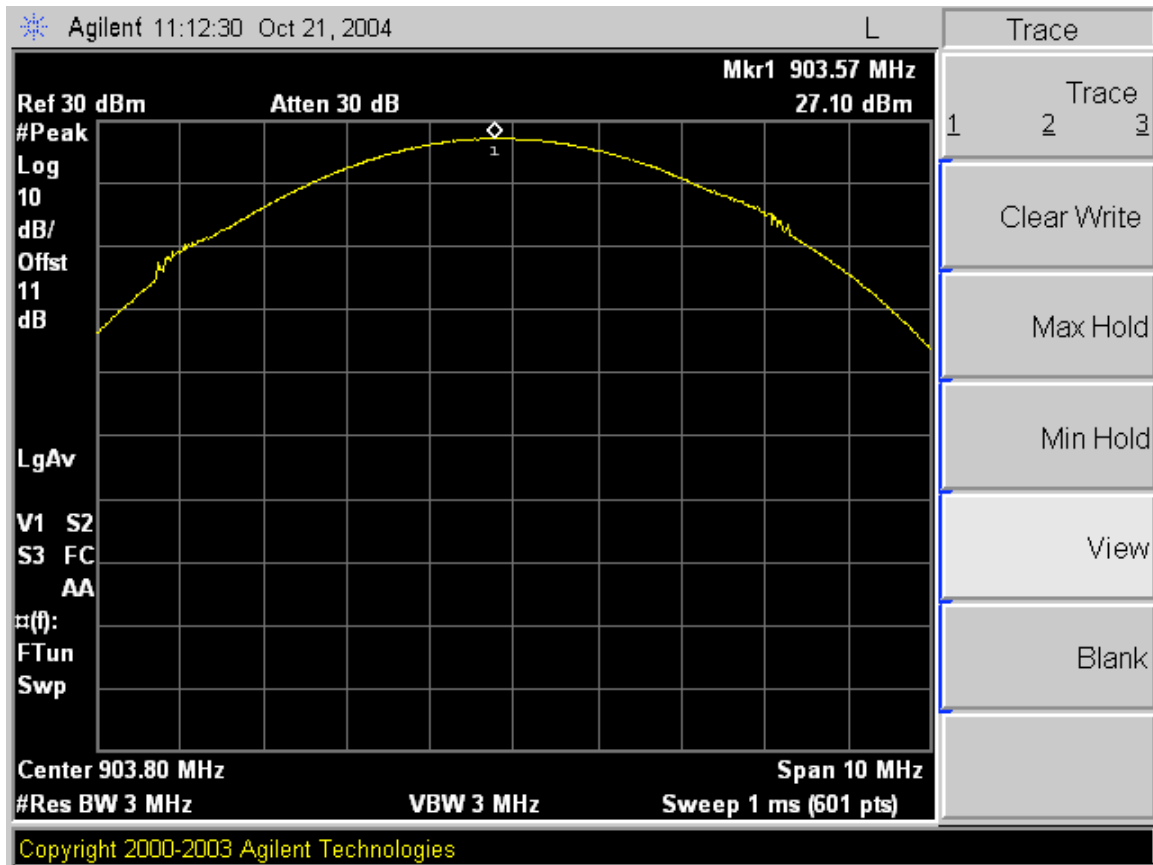
Test Procedures

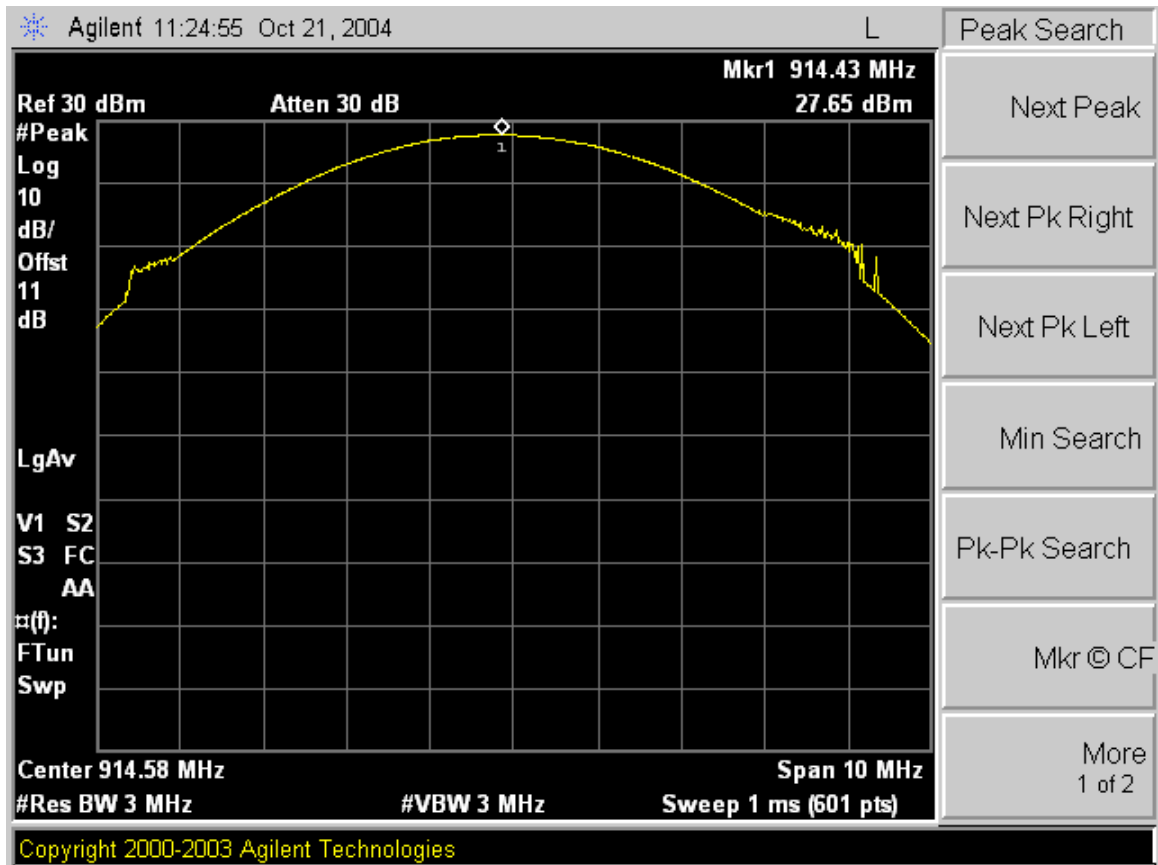
1. The EUT was configured on a test bench. The spectrum analyzer RBW and VBW were set to 3 MHz, to include the entire 99% bandwidth of approximately 2 MHz.
2. The spectrum analyzer was set for peak detection and the peak reading was recorded.
3. The process in (1) and (2) was repeated for MID channel and HIGH channel.

Test Results

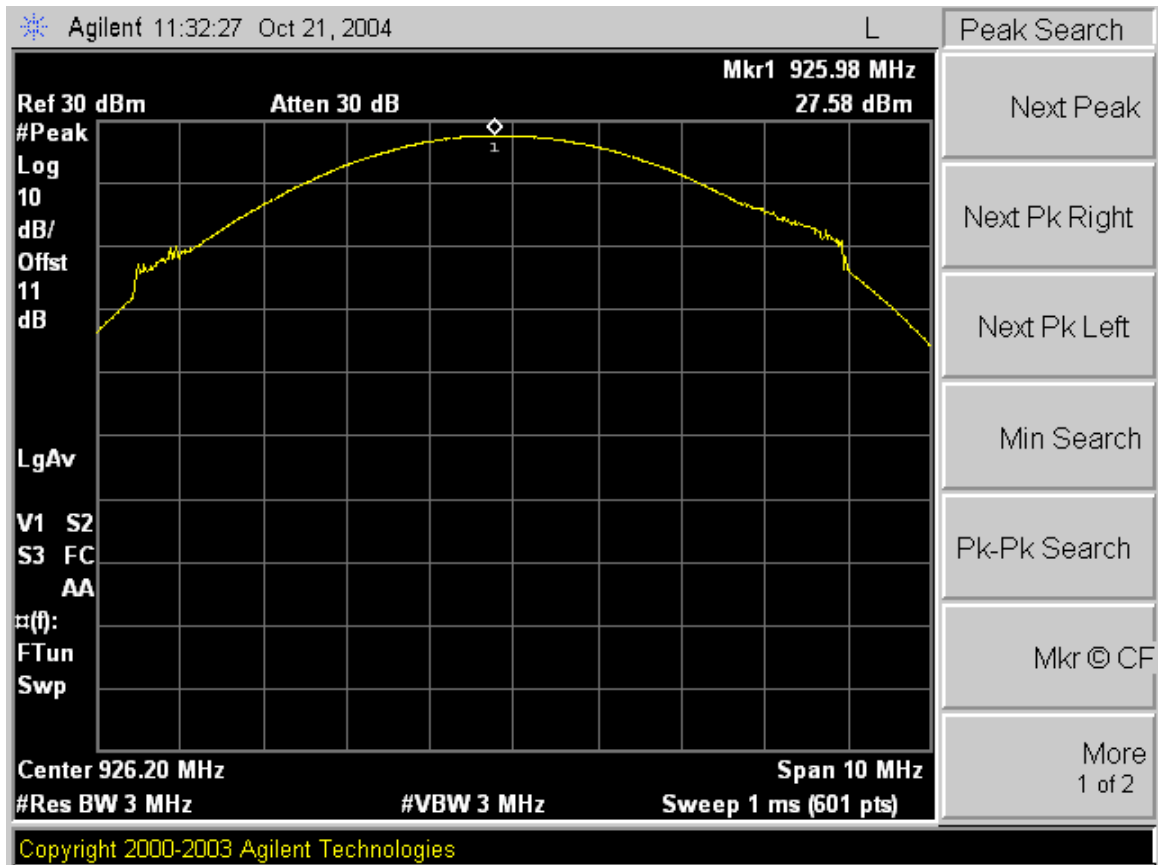
Power level readings converted to dBm are shown below. Refer also to spectrum analyzer graphs. Reference level offset corrects for external attenuation and cable loss.

Channel	Frequency, MHz	Output Power, dBm
LOW	903.8	27.1
MID	915	27.65
HIGH	926.2	27.58

Low Channel Peak Output Power

Mid Channel Peak Output Power

High Channel Peak Output Power



Spurious Emissions, Conducted
Test Requirement: 15.247(c)

Measurement Equipment Used:

Measurement Equipment Used:

Agilent 4440A Spectrum Analyzer, 9 kHz-26.5 GHz
 10 dB attenuator
 1 ft coax cable, 1 dB loss max.

Test Procedure

1. The EUT was configured on a test bench. The cable was connected between the EUT antenna port and the spectrum analyzer input port.

Spectrum analyzer RES BW was set to 100 kHz. While the transmitter broadcast a steady stream of digital data, the analyzer MAX HOLD function was used to capture the envelope of the transmission.

Readings were taken out to 10fo.

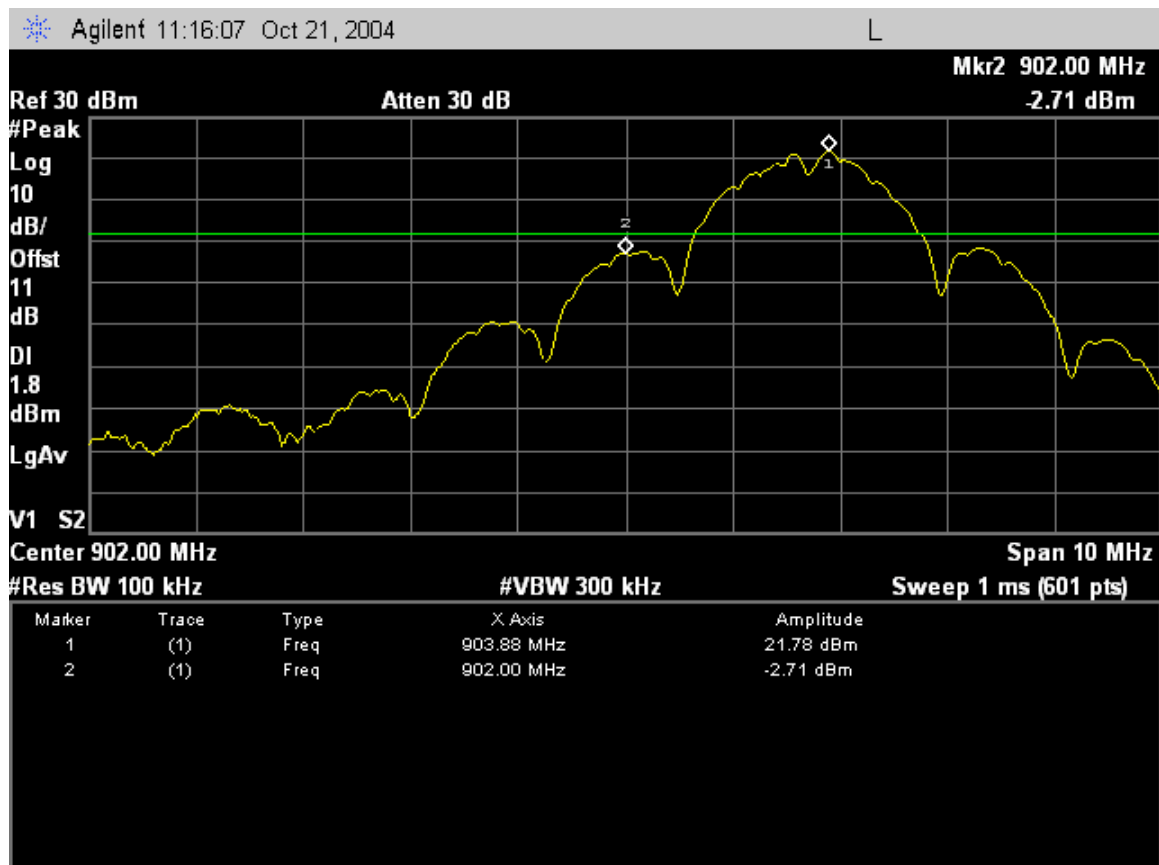
2. The process in (1) was repeated for MID channel and HIGH channel.

Test Results

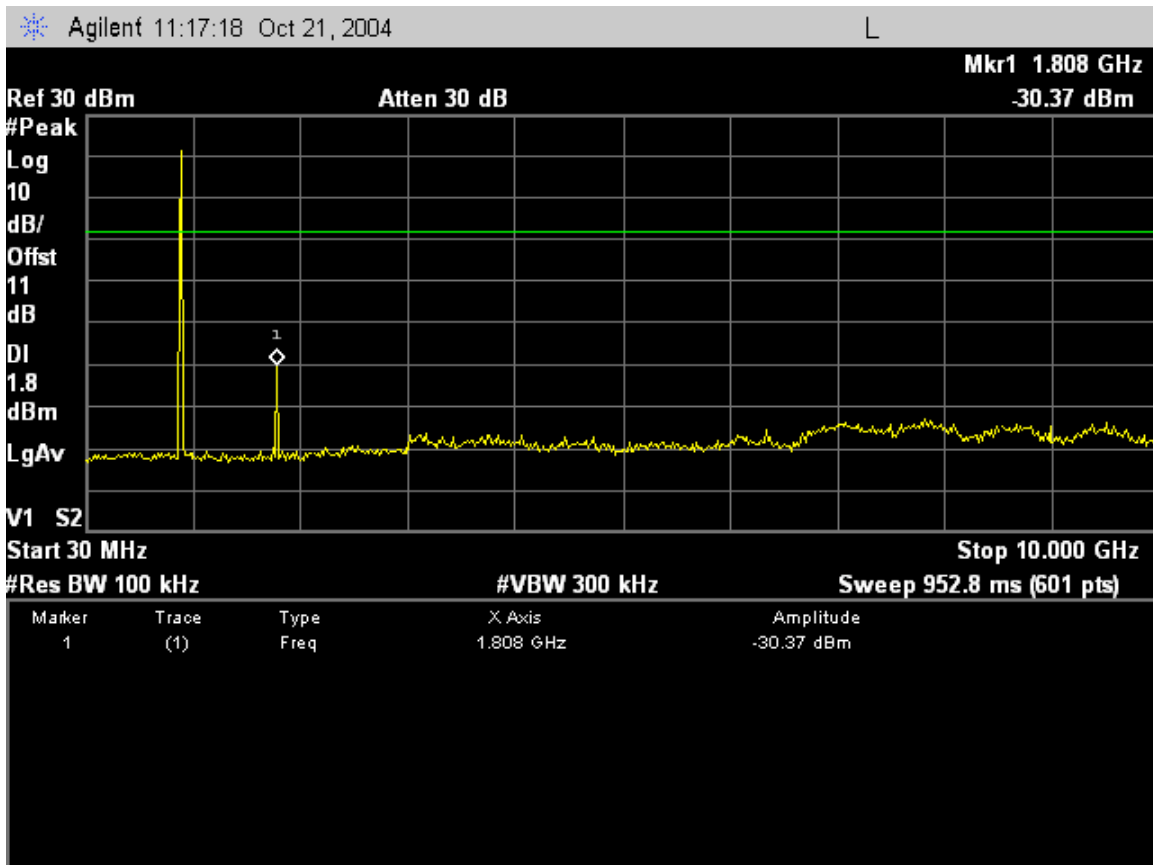
Refer to attached data sheets. Data shows out of band emissions are suppressed well below the -20 dBc minimum required by the Rules.

Channel	Frequency, MHz
LOW	903.8
MID	915
HIGH	926.2

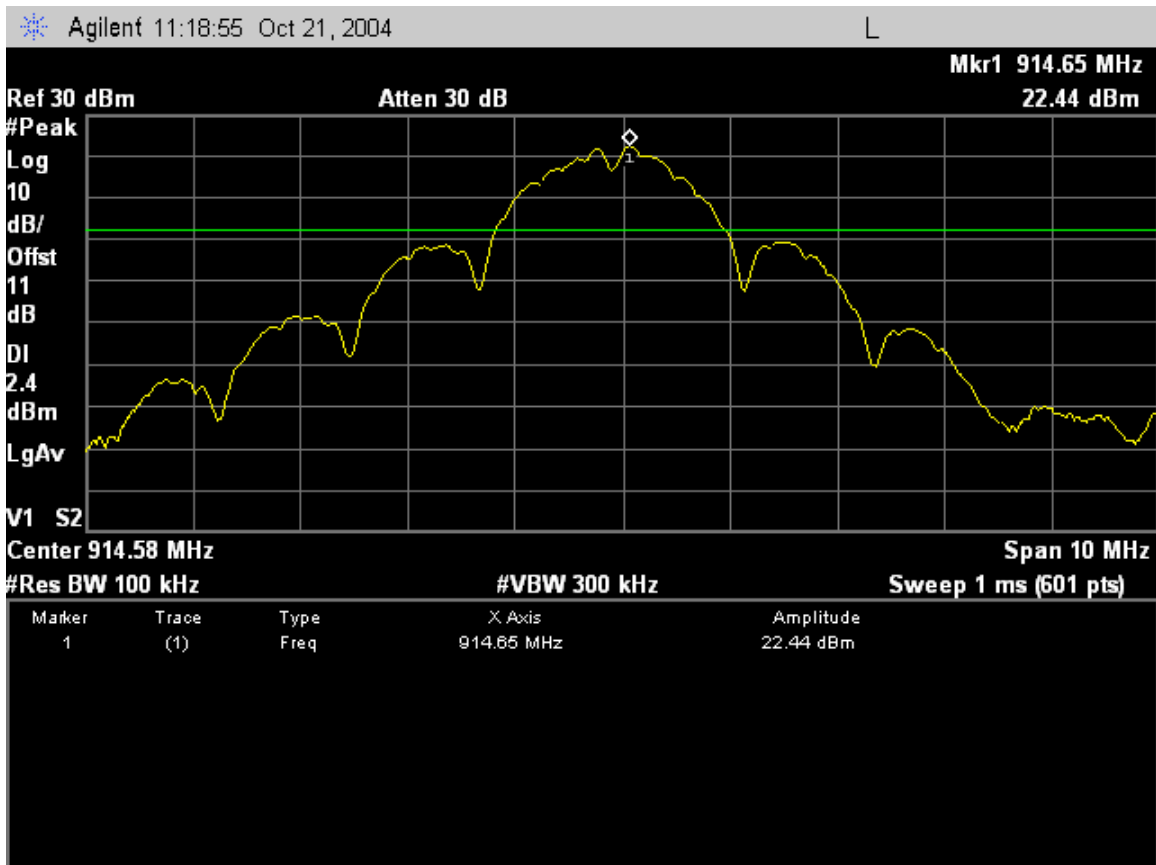
Out of Band Low Channel (1 of 2)



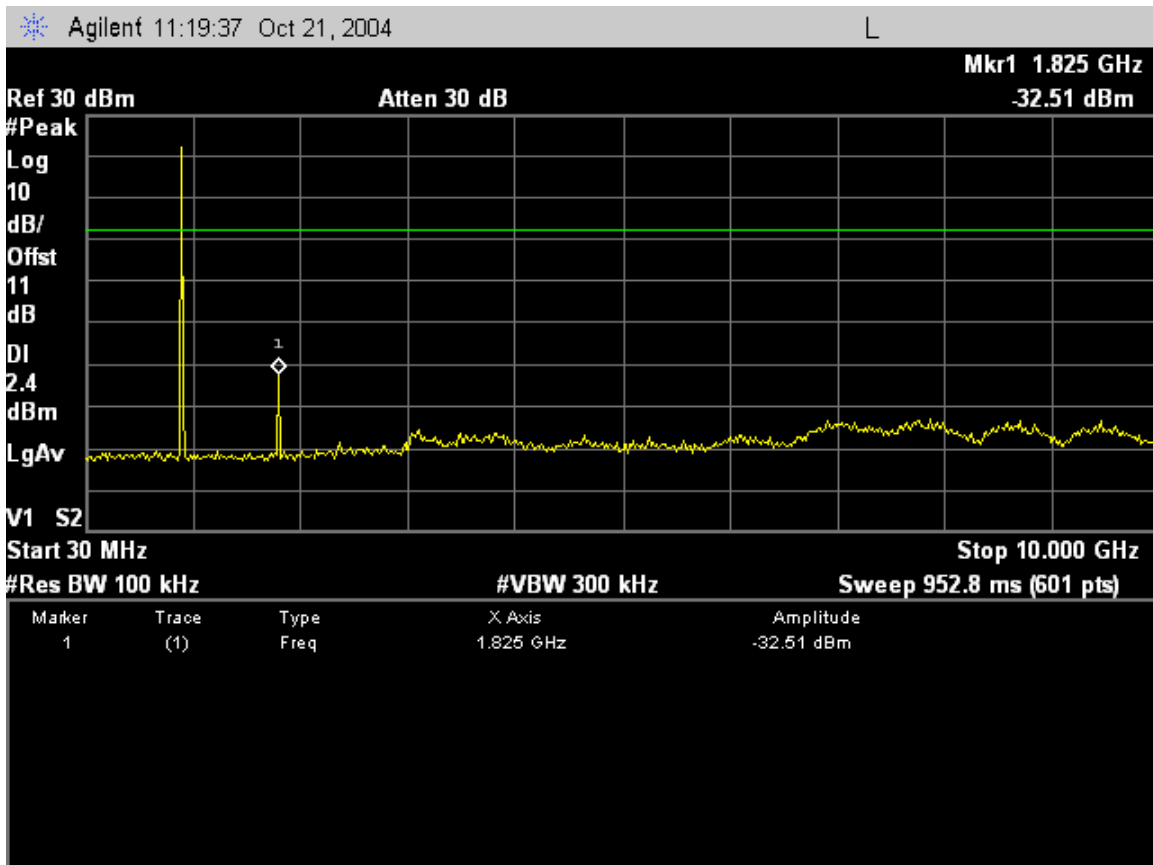
Out of Band Low Channel (2 of 2)



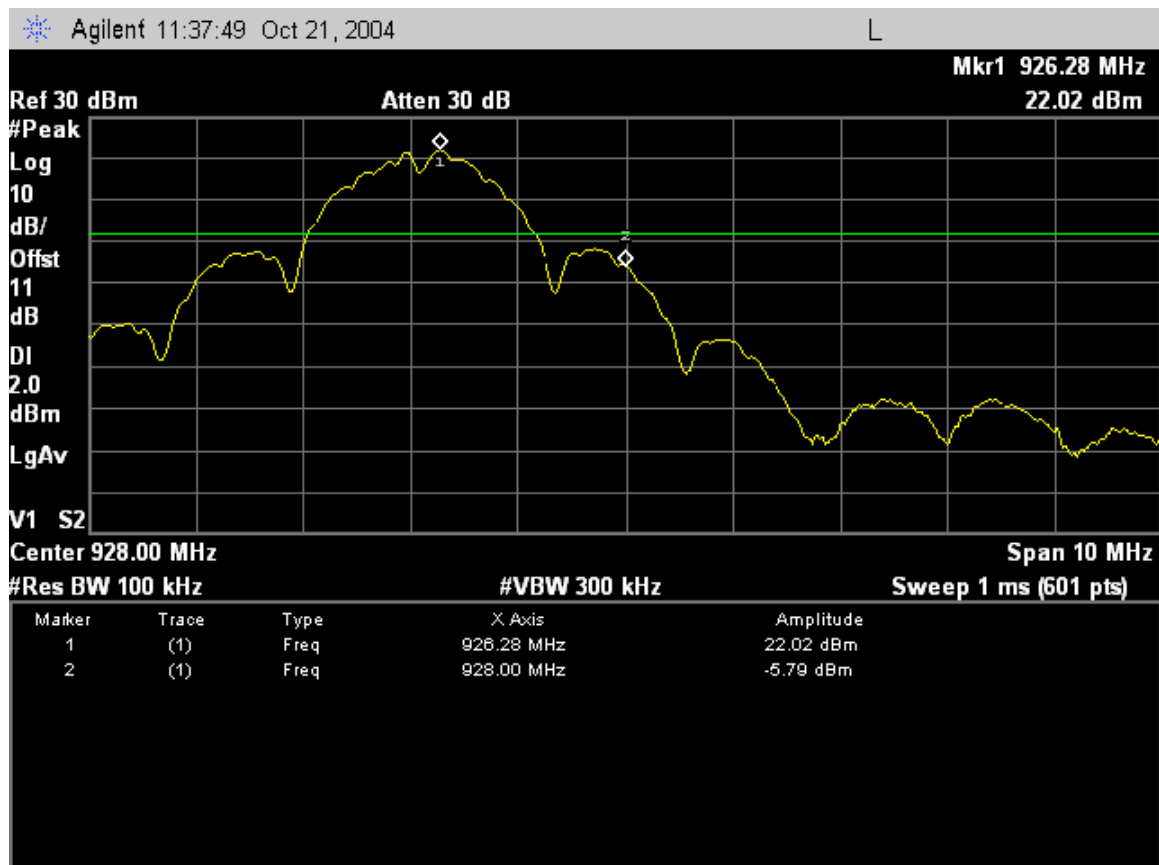
Out of Band Mid Channel (1 of 2)



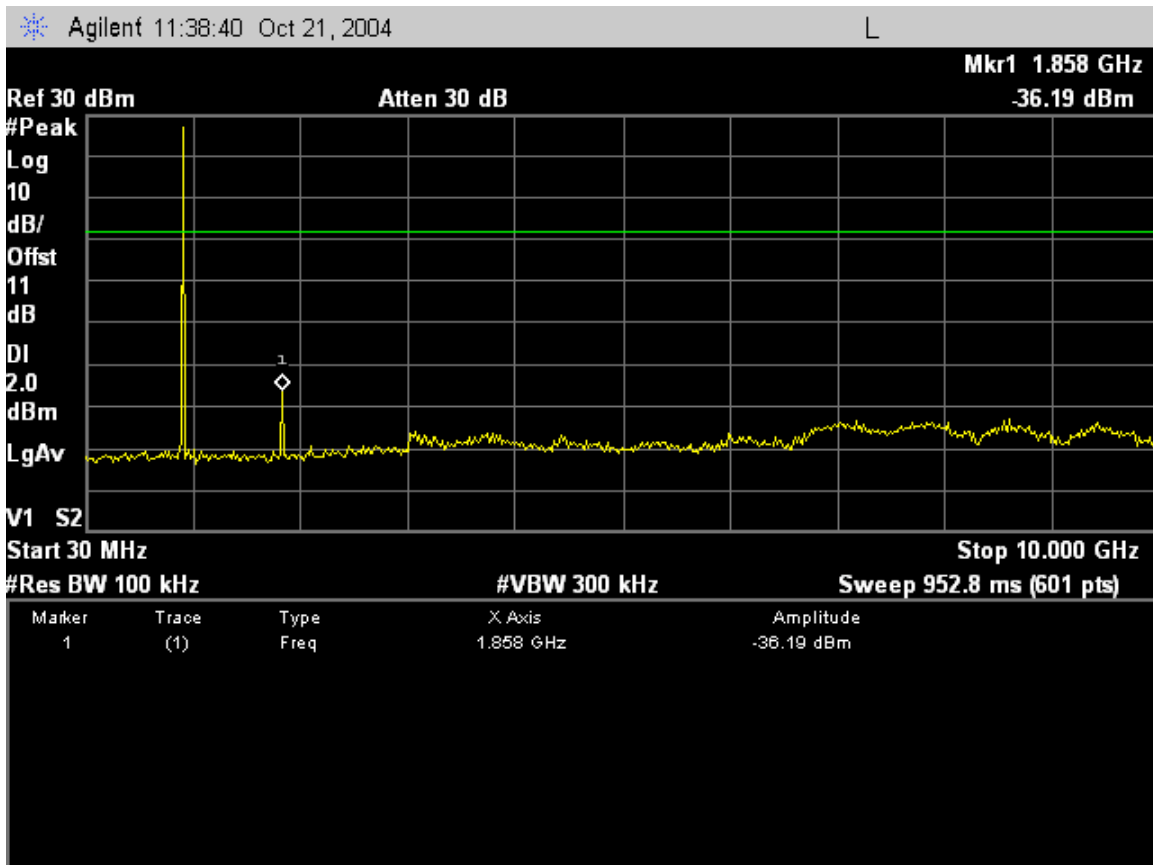
Out of Band Mid Channel (2 of 2)



Out of Band High Channel (1 of 2)



Out of Band High Channel (2 of 2)



Power Spectral Density**Test Requirement: 15.247(d)****Measurement Equipment Used:****Measurement Equipment Used:**

Agilent 4440A Spectrum Analyzer, 9 kHz-26.5 GHz

10 dB attenuator

1 ft coax cable, 1 dB loss max.

Test Procedure

The EUT has spectrum line spacing less than 3 kHz , approximately 560 HZ. Per FCC Public Notice 97-114, the following alternative procedure was followed:

- For devices with spectrum line spacing equal to or less than 3 kHz, the resolution bandwidth must be reduced below 3 kHz until the individual lines in the spectrum are resolved. The measurement data must then be normalized to 3 kHz by summing the power of all the individual spectral lines within a 3 kHz band (in linear power units) to determine compliance.

The test was repeated for LOW, MID and HIGH channel.

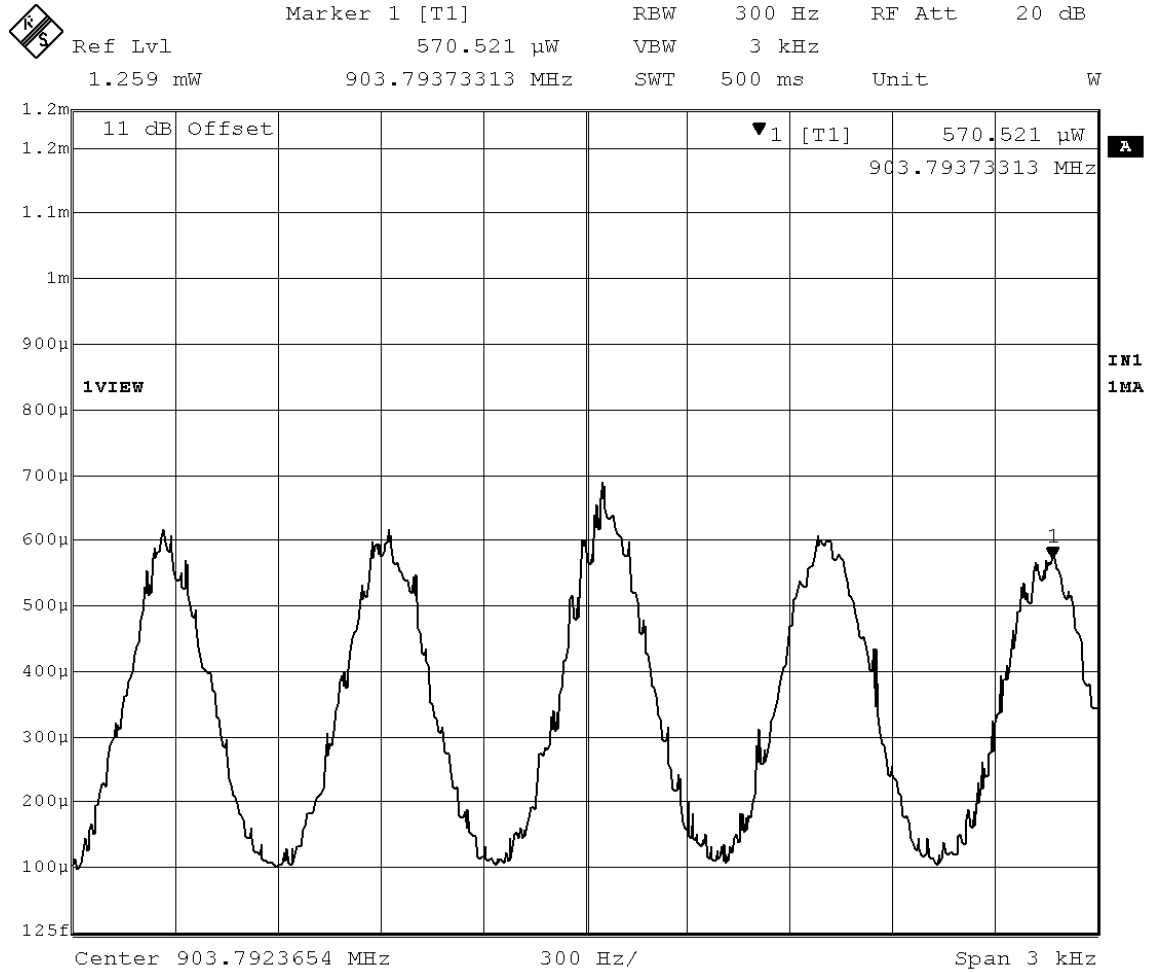
Test Results

Maximum PSD was 5.37 dBm. Refer to attached spectrum analyzer charts. Spectral line powers were added linearly, sum converted to dBm .

Data points	LOW , uW	MID, uW	HIGH, uW	
1	570.521	649.637	560.514	
2	605.904	680.634	595.129	
3	688.213	714.504	641.144	
4	614.403	705.536	577.503	
5	615.718	696.859	579.929	
TOTAL uW	3094.759	3447.17	2954.219	
10log(total/1000)	4.91 dBm	5.37 dBm	4.70 dBm	

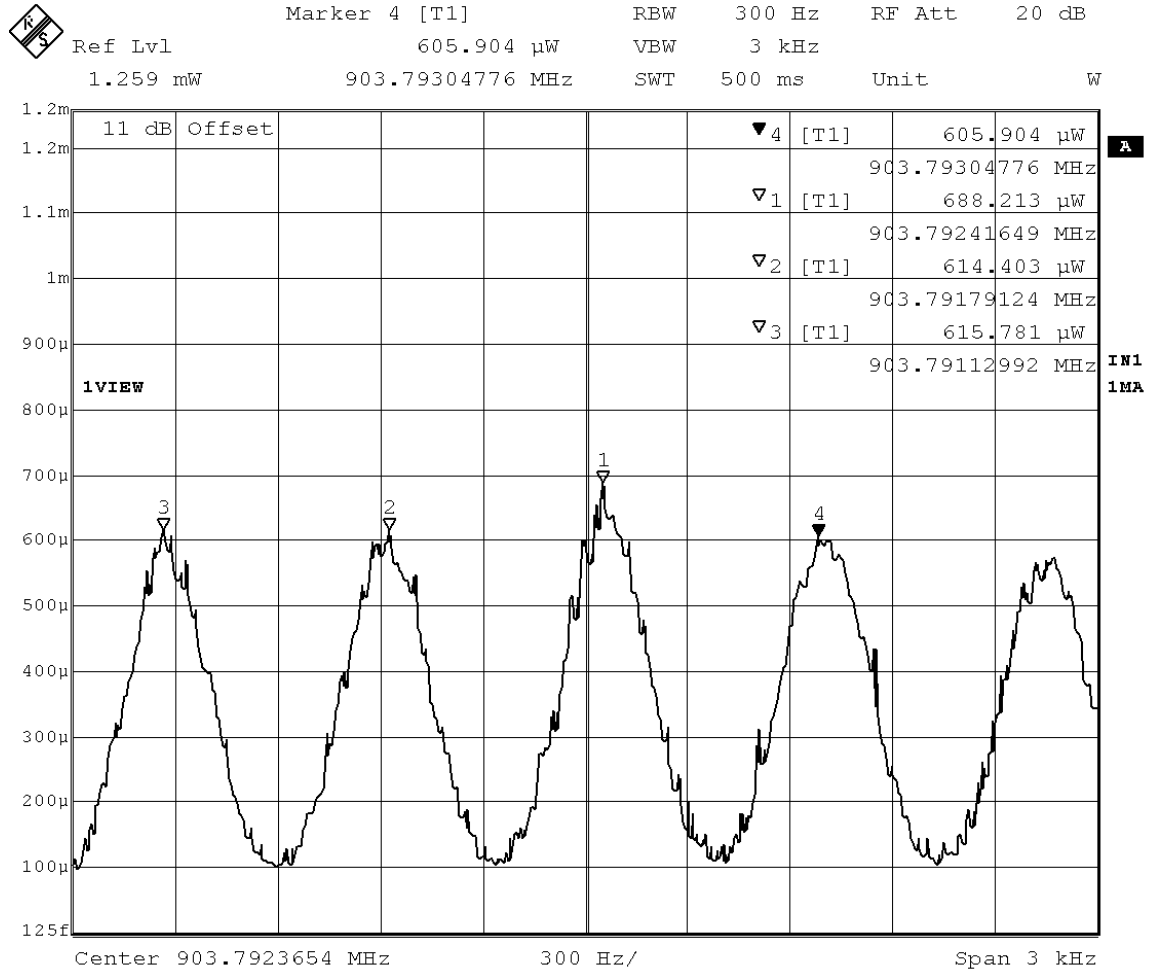
Limit: 8 dBm

Power Spectral Density, LOW Channel

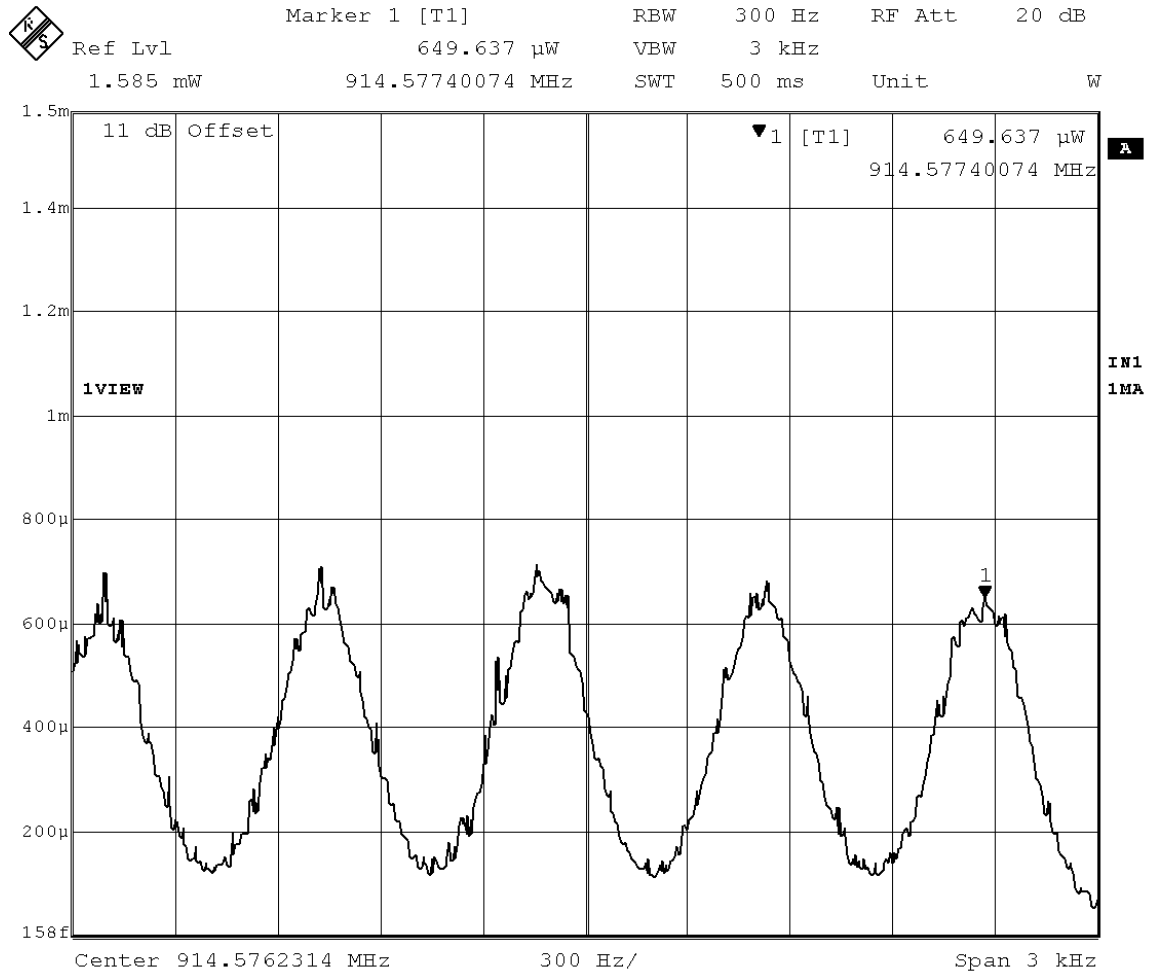


Date: 21.OCT.2004 12:10:47

Power Spectral Density, LOW Channel

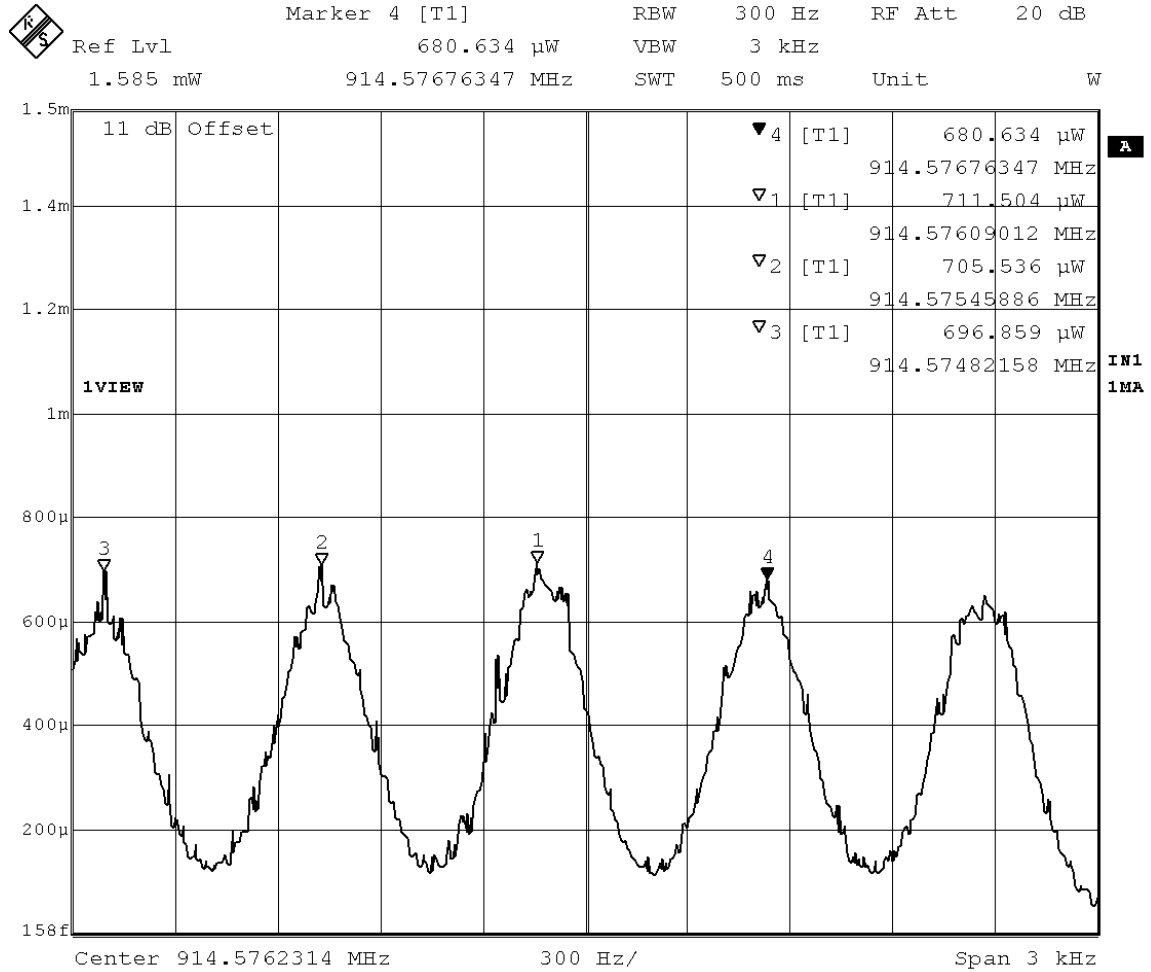


Power Spectral Density, MID Channel



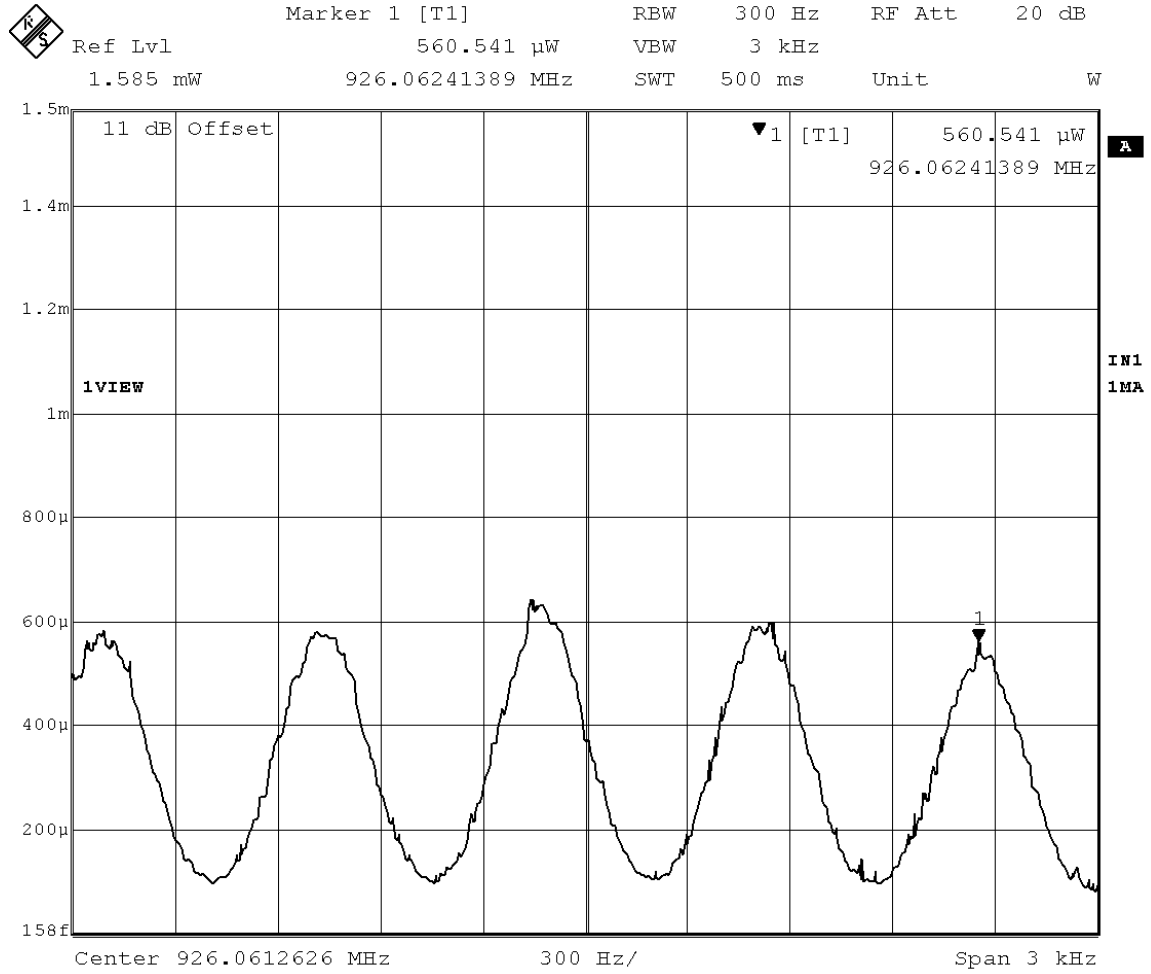
Date: 21.OCT.2004 12:17:44

Power Spectral Density, MID Channel



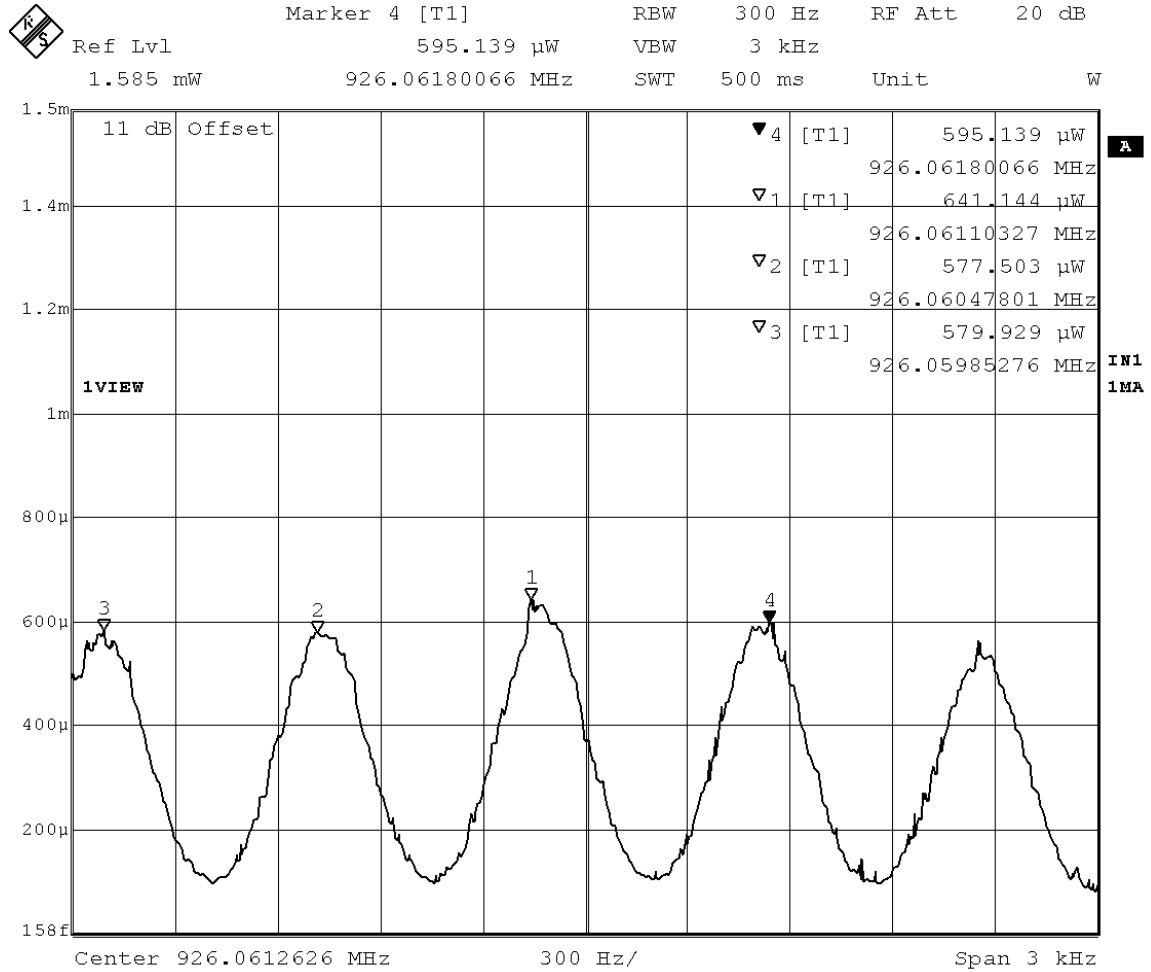
Date: 21.OCT.2004 12:17:11

Power Spectral Density, HIGH Channel



Date: 21.OCT.2004 12:22:46

Power Spectral Density, HIGH Channel



Date: 21.OCT.2004 12:21:48

RF Exposure (MPE) Calculations

905 - 924.6 MHz DTS Radio

Applicant: Sensus Metering Systems

FCC ID: KCH520C

RF Hazard Distance Calculation

mW/cm² from Table1: 1.00

Max RF Power	TX Antenna	MPE	MPE, inches
P, dBm	G, dBi	Safe Distance, cm	
27.7	2.2	8.8	3.5

Basis of Calculations:

$$E^2/3770 = S, \text{ mW/cm}^2$$

$$E, \text{ V/m} = (P_{\text{watts}} * G_{\text{gain}} * 30)^{.5} / d, \text{ meters}$$

$$d = ((P_{\text{watts}} * G_{\text{gain}} * 30) / (3770 * S))^{.5} \quad P_{\text{watts}} * G_{\text{gain}} = 10^{(P_{\text{dBm}} - 30 + G_{\text{dBi}}) / 10}$$

NOTE: For mobile or fixed location transmitters, minimum separation distance is 20cm, even if calculations indicate MPE distance is less