

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: ☐ **KCHBA0031**

II. DESCRIPTION OF EQUIPMENT UNDER TEST (EUT)

The Sensus FCC ID: **KCHBA0031** is a digital transmission system (DTS) operating under the requirements in FCC Part 15. The BA0031 operates in the U.S. ISM band between 902 and 928 MHz.

Transmitter Specification

TX Power	27.55 dBm max.
Frequency of operation	904.6 – 925.4 MHz
Data Rate	3.921 Kbps in 158 msec burst
6 dB bandwidth	1.15 MHz
Power source	AC mains

III. TEST DATES AND TEST LOCATION

Testing was performed 8 – 10 November 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

17 November 2004

15.203 Antenna connector requirement

The internal antenna is connected to the EUT via coaxial cable with a non-standard antenna connector (MMX connector). The external antenna is connected via a standard N connector.

This product is professionally installed. During the installation planning and the installation itself, always done by qualified engineers and technicians, the type of external antennas are carefully selected so that the gain of the antenna is within the FCC regulations, meaning less than 6dBi.

15.204 Antenna description

The transceiver uses either an internal antenna or an external antenna:

Antenna description	Gain
Internal patch antenna OR	4 dBi
External monopole antenna	3 dBd (5.2 dBi)

TEST PROCEDURES

All tests were performed in accordance with the applicable procedures called out in the following documents, unless otherwise noted:

- 1) **ANSI C63.4 – 2003**, 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
- 2) **FCC Public Notice 97-114**, Guidance on Measurements for Direct Sequence Spread Spectrum Systems

TEST RESULTS

Radiated Emissions, Transmitter Section

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.

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		

Compliance Certification Services, Morgan Hill Open Field Site

Test Engr: Thanh Nguyen
 Project #:04U3809-1
 Company:Sensus Metering Systems
 EUT Descip.:900MHz DSSS Transceiver
 EUT M/N:BA00311,BA0031-E, BA0031-R
 Target: FCC 15.247
 Mode Oper: Transmitting with Omni Antenna

Test Equipment:

EMCO Horn 1-18GHz T119; S/N: 29301 @3m Hi Frequency Cables	Pre-amplifier 1-26GHz T34 HP 8449B	Pre-amplifier 26-40GHz	Horn > 18GHz
2 foot cable 2_Thanh	3 foot cable	4 foot cable	12 foot cable 12_Thanh
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)
Tx Low channel															
1.809	3.0	48.4	38.3	31.0	1.8	-37.1	0.0	0.3	44.5	34.4	74	54	-29.5	-19.6	V
2.714	3.0	46.4	37.6	32.1	2.3	-35.9	0.0	0.6	45.4	36.7	74	54	-28.6	-17.3	V
3.618	3.0	42.6	30.8	33.0	2.7	-34.8	0.0	0.6	44.1	32.3	74	54	-29.9	-21.7	V
1.809	3.0	46.3	37.4	31.0	1.8	-37.1	0.0	0.3	42.5	33.5	74	54	-31.5	-20.5	H
Tx Mid Channel															
1.830	3.0	49.4	40.1	31.1	1.9	-37.0	0.0	0.3	45.6	36.4	74	54	-28.4	-17.6	V
2.745	3.0	42.6	34.4	32.2	2.3	-35.9	0.0	0.6	41.8	33.6	74	54	-32.2	-20.4	V
3.660	3.0	41.8	31.3	33.0	2.8	-34.7	0.0	0.6	43.4	32.9	74	54	-30.6	-21.1	V
1.830	3.0	47.4	37.0	31.1	1.9	-37.0	0.0	0.3	43.7	33.3	74	54	-30.3	-20.7	H
Tx High Channel															
1.851	3.0	48.5	37.4	31.2	1.9	-37.0	0.0	0.3	44.9	33.8	74	54	-29.1	-20.2	V
2.776	3.0	47.9	38.2	32.3	2.4	-35.9	0.0	0.6	47.2	37.5	74	54	-26.8	-16.5	V
3.702	3.0	42.7	31.4	33.0	2.8	-34.6	0.0	0.6	44.4	33.1	74	54	-29.6	-20.9	V
1.851	3.0	45.5	34.7	31.2	1.9	-37.0	0.0	0.3	41.9	31.1	74	54	-32.1	-22.9	H
No more spurious emissions above 3rd harmonic															

f Measurement Frequency
 Dist Distance to Antenna
 Read Analyzer Reading
 AF Antenna Factor
 CL Cable Loss

Amp Preamp Gain
 D Corr Distance Correct to 3 meters
 Avg Average Field Strength @ 3 m
 Peak Calculated Peak Field Strength
 HPF High Pass Filter

Avg Lim Average Field Strength Limit
 Pk Lim Peak Field Strength Limit
 Avg Mar Margin vs. Average Limit
 Pk Mar Margin vs. Peak Limit

Radiated Emissions, Transmitter Section
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

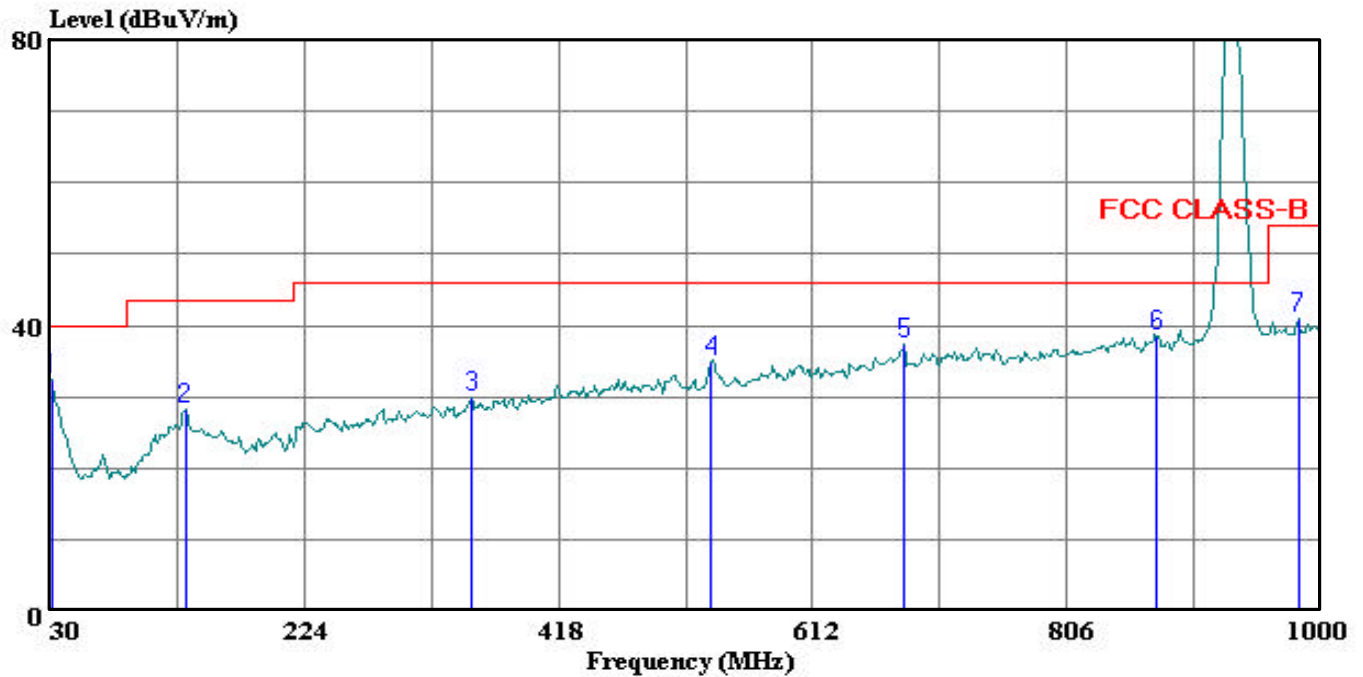
$$\text{Carrier field strength} = (95.24 + 22.44 + 2.2) = 119.88 \text{ dBuV/m}$$

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#: 11 File#: Sensus.EMI

Date: 11-08-2004 Time: 15:10:22



(Auxil ATC)

Trace: 6

Ref Trace:

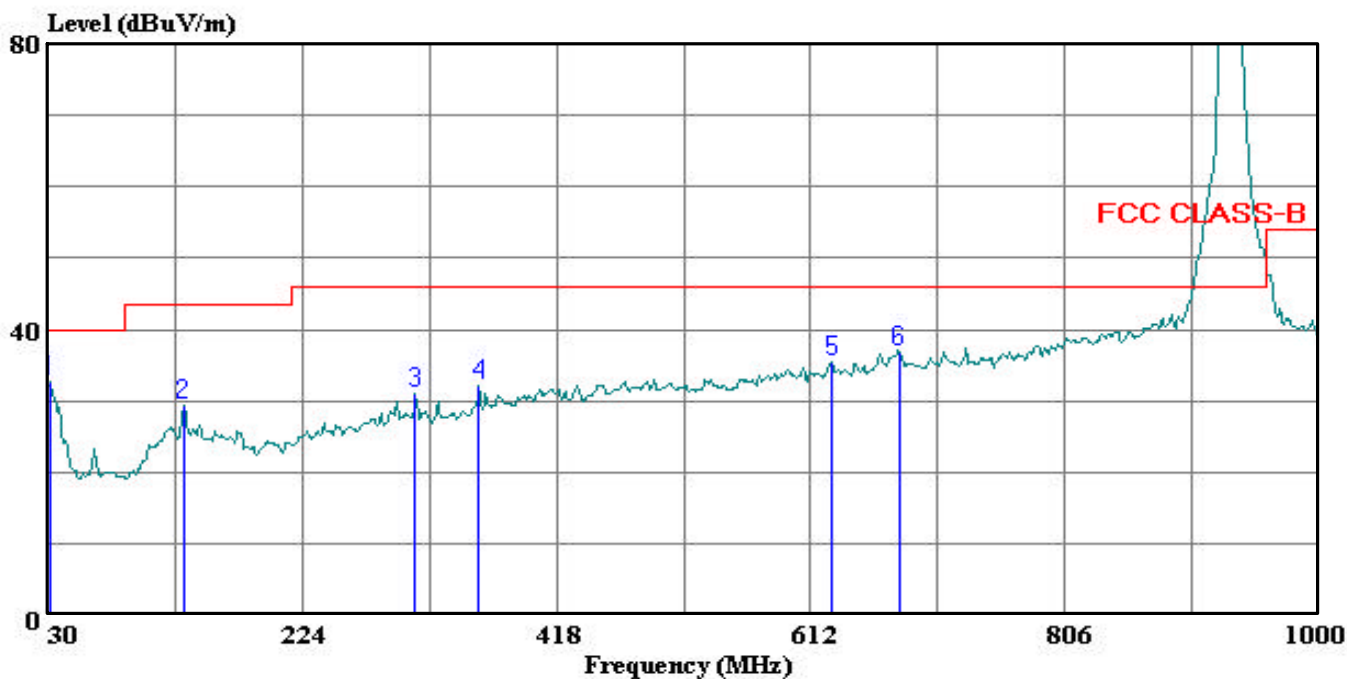
Condition: FCC CLASS-B HORIZONTAL
Test Operator: : Thanh Nguyen
Project #: : 04u3089-1
Company: : SENSUS Metering Systems
EUT: : 900MHz DSSS Transceiver
Model No: : BA0031-I, BA0031-E, BA0031-R
Configuration: : EUT, Antenna
Target of Test: : FCC CLASS B
Mode of Operation: Tx Worst Case, High Channel 57

Page: 1

	Freq	Remark	Read Level	Factor	Level	Limit Line	Over Limit
	MHz		dBuV	dB	dBuV/m	dBuV/m	dB
1	30.970	Peak	8.97	23.32	32.29	40.00	-7.72
2	133.790	Peak	12.40	15.85	28.25	43.50	-15.25
3	352.040	Peak	12.70	17.28	29.98	46.00	-16.02
4	534.400	Peak	13.65	21.37	35.02	46.00	-10.98
5	681.840	Peak	13.49	23.76	37.25	46.00	-8.75
6	874.870	Peak	12.39	26.08	38.47	46.00	-7.53
7	982.540	Peak	13.23	27.62	40.85	54.00	-13.15

Data#: 12 File#: Sensus.EMI

Date: 11-08-2004 Time: 15:12:28



(Auxiliary ATC)

Trace: 5

Ref Trace:

Condition: FCC CLASS-B VERTICAL

Test Operator: Thanh Nguyen

Project #: 04u3089-1

Company: SENSUS Metering Systems

EUT: 900MHz DSSS Transceiver

Model No: BA0031-I, BA0031-E, BA0031-R

Configuration: EUT, Antenna

Target of Test: FCC CLASS B

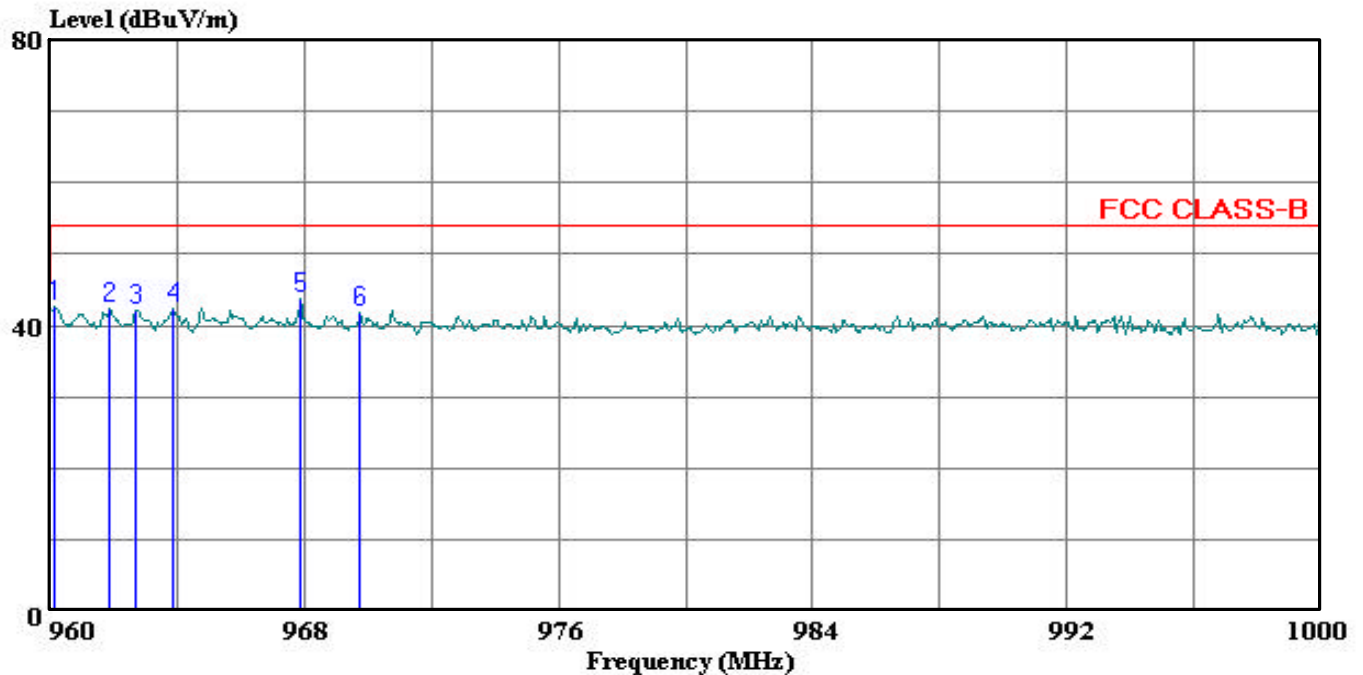
Mode of Operation: Tx Worst Case, High Channel 57

Page: 1

	Freq	Remark	Read Level	Factor	Level	Limit Line	Over Limit
	MHz		dBuV	dB	dBuV/m	dBuV/m	dB
1	30.970	Peak	9.26	23.32	32.58	40.00	-7.42
2	133.790	Peak	13.57	15.85	29.42	43.50	-14.08
3	310.330	Peak	14.50	16.48	30.98	46.00	-15.02
4	358.830	Peak	14.74	17.49	32.23	46.00	-13.78
5	628.490	Peak	12.69	22.70	35.39	46.00	-10.61
6	679.900	Peak	13.02	23.74	36.76	46.00	-9.24

Data#: 10 File#: Sensus.EMI

Date: 11-08-2004 Time: 15:08:19



(Auxiliary ATC)

Trace: 9

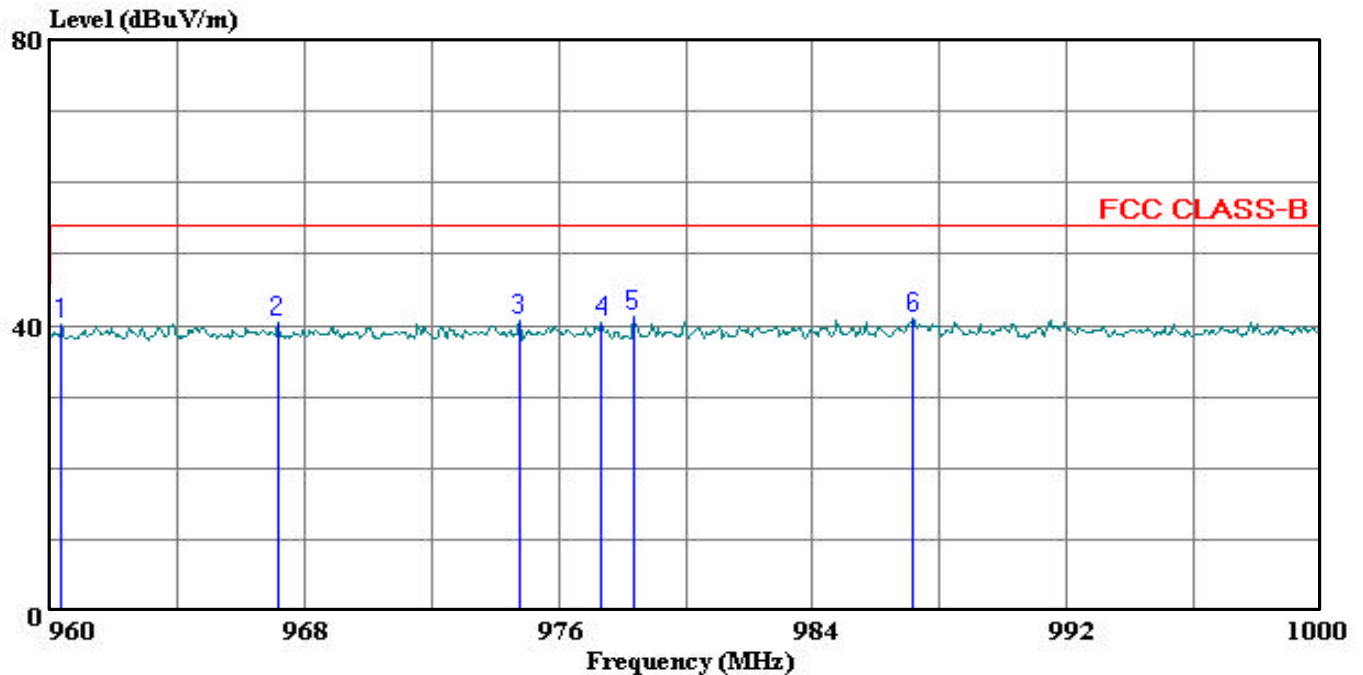
Ref Trace:

Condition: FCC CLASS-B VERTICAL
Test Operator: : Thanh Nguyen
Project #: : 04u3089-1
Company: : SENSUS Metering Systems
EUT: : 900MHz DSSS Transceiver
Model No: : BA0031-I, BA0031-E, BA0031-R
Configuration: : EUT, Antenna
Target of Test: : FCC CLASS B
Mode of Operation: Tx Worst Case, High Channel 57
: 960-1000MHz

Page: 1

	Freq	Remark	Read Level	Factor	Level	Limit Line	Over Limit
	MHz		dBuV	dB	dBuV/m	dBuV/m	dB
1	960.160	Peak	15.17	27.34	42.51	54.00	-11.49
2	961.880	Peak	15.00	27.40	42.40	54.00	-11.60
3	962.720	Peak	14.60	27.41	42.01	54.00	-11.99
4	963.880	Peak	15.00	27.42	42.42	54.00	-11.58
5	967.880	Peak	16.35	27.40	43.75	54.00	-10.25
6	969.760	Peak	14.36	27.40	41.76	54.00	-12.24

Data#: 8 File#: Sensus.EMI Date: 11-08-2004 Time: 15:03:58



(Auxiliary ATC)

Trace: 7

Ref Trace:

Condition: FCC CLASS-B VERTICAL
Test Operator: : Thanh Nguyen
Project #: : 04u3089-1
Company: : SENSUS Metering Systems
EUT: : 900MHz DSSS Transceiver
Model No: : BA0031-I, BA0031-E, BA0031-R
Configuration: : EUT, Antenna
Target of Test: : FCC CLASS B
Mode of Operation: Tx Worst Case, High Channel 57
: 960-1000MHz

Page: 1

	Freq	Remark	Read Level	Factor	Level	Limit Line	Over Limit
	MHz		dBuV	dB	dBuV/m	dBuV/m	dB
1	960.360	Peak	12.66	27.35	40.01	54.00	-13.99
2	967.160	Peak	12.95	27.41	40.36	54.00	-13.64
3	974.760	Peak	13.33	27.47	40.80	54.00	-13.20
4	977.360	Peak	12.93	27.52	40.45	54.00	-13.55
5	978.360	Peak	13.61	27.53	41.14	54.00	-12.86
6	987.160	Peak	13.37	27.72	41.09	54.00	-12.91

Radiated Emissions, Receiver Section and Digital Circuitry
Test Requirement: 15.109

Measurement Equipment Used:

HP 8542E Receiver, 9 kHz - 2.9 GHz
Schaffner/Chase CBL6112B Bilog Antenna, 30 - 2000 MHz

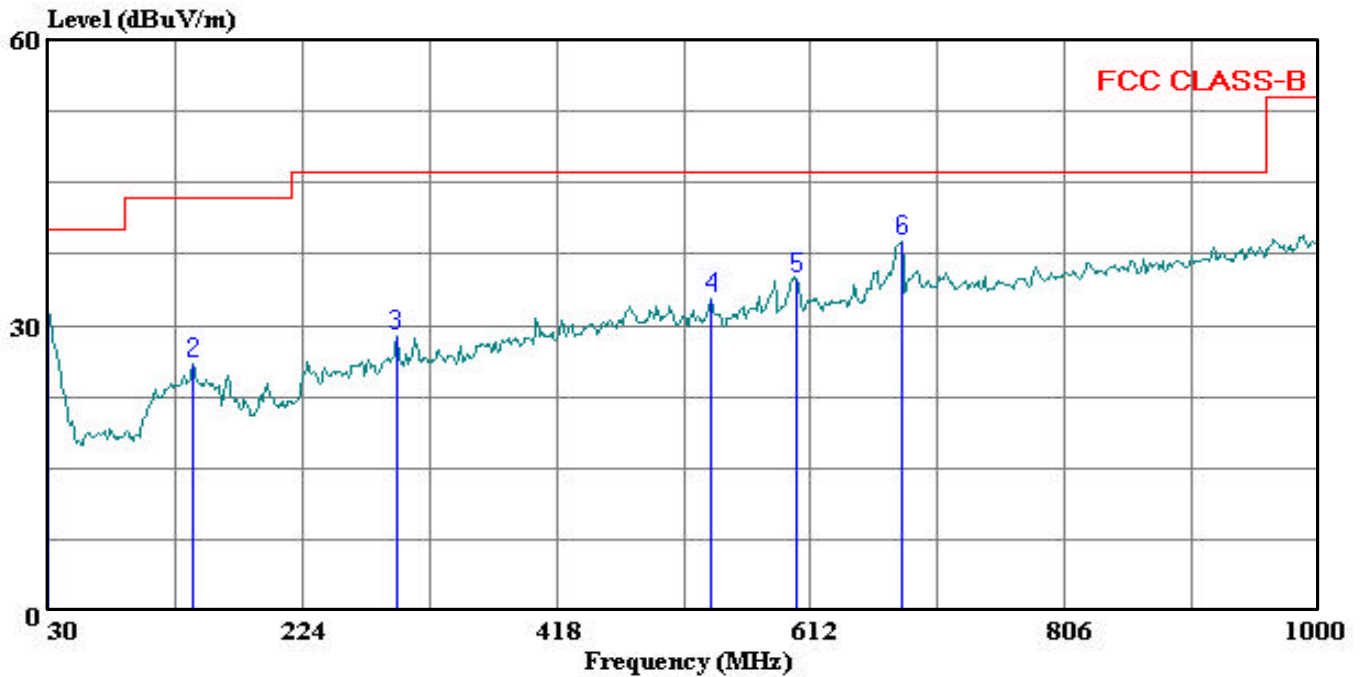
Radiated emissions generated by the digital portion of the EUT were measured.

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 emissions in the 30-1000 MHz band meet 15.109 class B limits. No emissions detected within 20 dB in the 1 – 5 GHz band.

Data#: 16 File#: Sensus.EMI

Date: 11-08-2004 Time: 15:31:35



(Auxiliary ATC)

Trace: 15

Ref Trace:

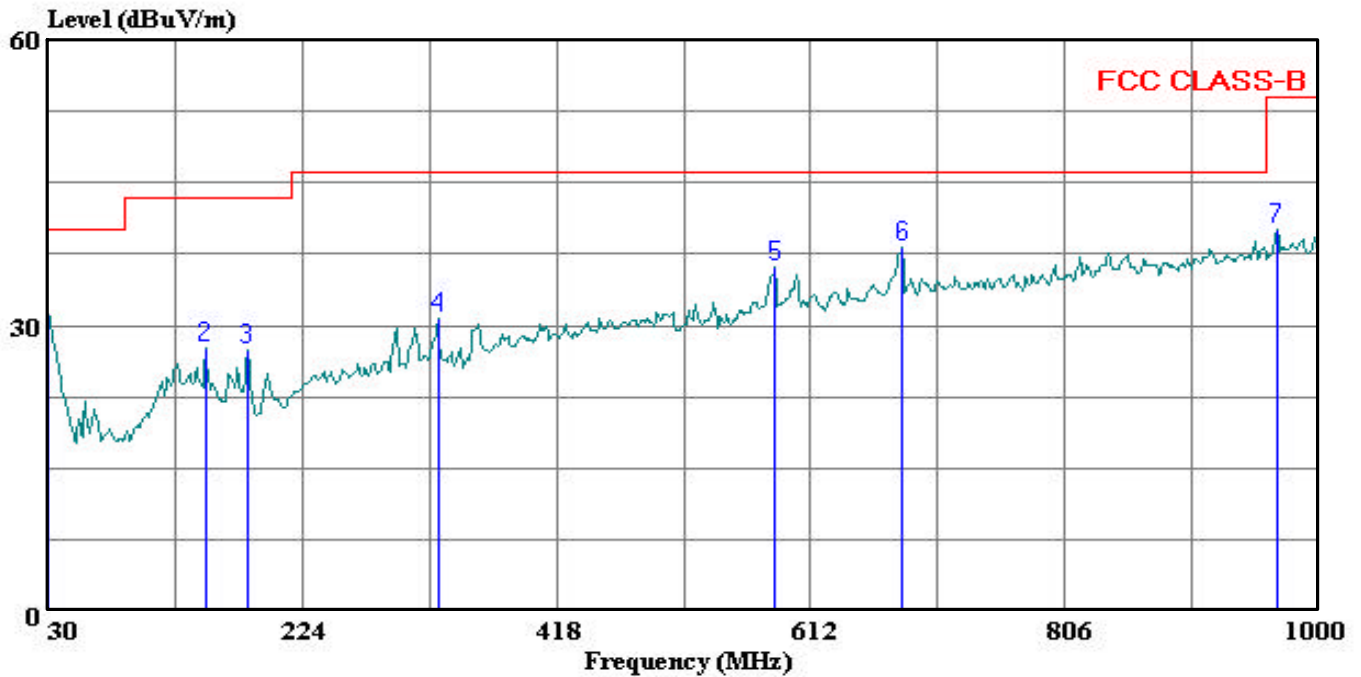
Condition: FCC CLASS-B HORIZONTAL
Test Operator: : Thanh Nguyen
Project #: : 04u3089-1
Company: : SENSUS Metering Systems
EUT: : 900MHz DSSS Transceiver
Model No: : BA0031-I, BA0031-E, BA0031-R
Configuration: : EUT, Antenna
Target of Test: : FCC CLASS B
Mode of Operation: Receive Mode

Page: 1

	Freq	Remark	Read Level	Factor	Level	Limit Line	Over Limit
	MHz		dBuV	dB	dBuV/m	dBuV/m	dB
1	30.000	Peak	7.83	23.32	31.15	40.00	-8.85
2	140.580	Peak	10.34	15.60	25.94	43.50	-17.56
3	295.780	Peak	12.65	16.21	28.86	46.00	-17.15
4	536.340	Peak	11.41	21.36	32.77	46.00	-13.23
5	601.330	Peak	12.59	22.33	34.92	46.00	-11.08
6	681.840	Peak	15.03	23.76	38.79	46.00	-7.21

Data#: 14 File#: Sensus.EMI

Date: 11-08-2004 Time: 15:28:45



(Auxil ATC)

Trace: 13

Ref Trace:

Condition: FCC CLASS-B VERTICAL
Test Operator: : Thanh Nguyen
Project #: : 04u3089-1
Company: : SENSUS Metering Systems
EUT: : 900MHz DSSS Transceiver
Model No: : BA0031-I, BA0031-E, BA0031-R
Configuration: : EUT, Antenna
Target of Test: : FCC CLASS B
Mode of Operation: Receive Mode

Page: 1

	Freq	Remark	Read Level	Factor	Level	Limit Line	Over Limit
	MHz		dBuV	dB	dBuV/m	dBuV/m	dB
1	30.000	Peak	7.86	23.32	31.18	40.00	-8.82
2	150.280	Peak	12.94	14.65	27.59	43.50	-15.91
3	182.290	Peak	14.06	13.31	27.37	43.50	-16.13
4	327.790	Peak	13.89	16.77	30.66	46.00	-15.34
5	584.840	Peak	13.80	22.25	36.05	46.00	-9.96
6	681.840	Peak	14.54	23.76	38.30	46.00	-7.70
7	967.990	Peak	12.65	27.40	40.05	54.00	-13.95

Compliance Certification Services, Morgan Hill Open Field Site

Test Engr: Thanh Nguyen
 Project #:04U3809-1
 Company:Sensus Metering Systems
 EUT Descrip.:900MHz DSSS Transceiver
 EUT M/N:BA0031L,BA0031-E, BA0031-R
 Target: FCC 15.247
 Mode Oper: Receive mode

Test Equipment:

EMCO Horn 1-18GHz		Pre-amplifier 1-26GHz		Pre-amplifier 26-40GHz		Horn > 18GHz	
T119; S/N: 29301 @3m		T34 HP 8449B					
Hi Frequency Cables							
2 foot cable		3 foot cable		4 foot cable		12 foot cable	
2_Thanh						12_Thanh	
				HPF		Reject Filter	
				HPF_1.5GHz			

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	Fldr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
Rx worst case, Mid Channel															
1.102	3.0	48.9	35.2	27.7	1.4	-37.9	0.0	0.0	40.2	26.5	74	54	-33.8	-27.5	H
2.128	3.0	46.5	33.5	31.7	2.0	-36.7	0.0	0.5	44.1	31.0	74	54	-29.9	-23.0	H
3.319	3.0	44.0	32.0	32.9	2.6	-35.2	0.0	0.6	44.9	32.9	74	54	-29.1	-21.1	H
1.187	3.0	47.7	35.4	28.1	1.5	-37.8	0.0	0.1	39.6	27.2	74	54	-34.4	-26.8	V

No spurious emissions were detected for Receive Mode up to 5GHz.

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		

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

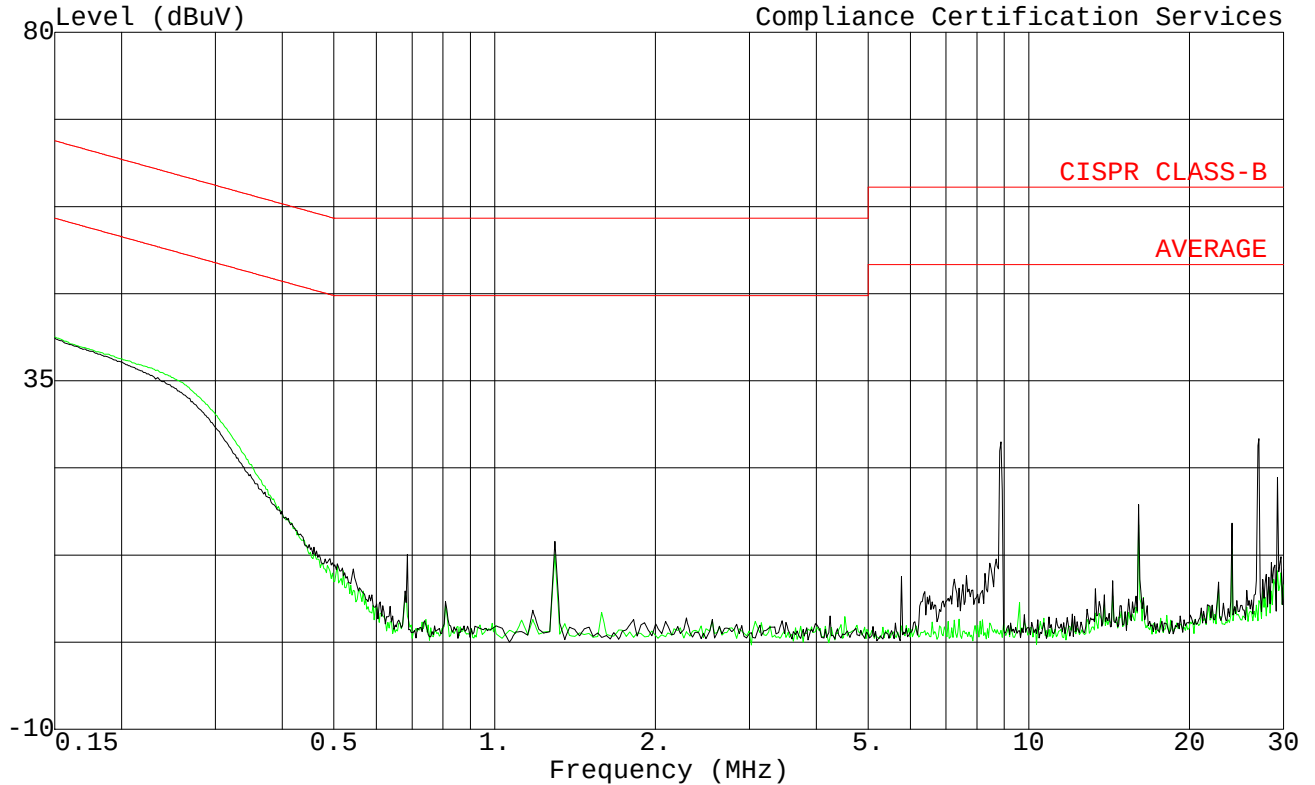
1. The EUT was placed on a wooden table 40 cm from a vertical ground plane and approximately 80 cm above the horizontal ground plane on the floor. The EUT was set to transmit in normally.
2. Line conducted data was recorded for both NEUTRAL and HOT lines.

Test Results

PASS. Refer to attached data sheets and plots.

Data#: 7 File#: 04U3089N.EMI

Date: 11-09-2004 Time: 17:12:13
Compliance Certification Services



Trace: 3

Ref Trace:

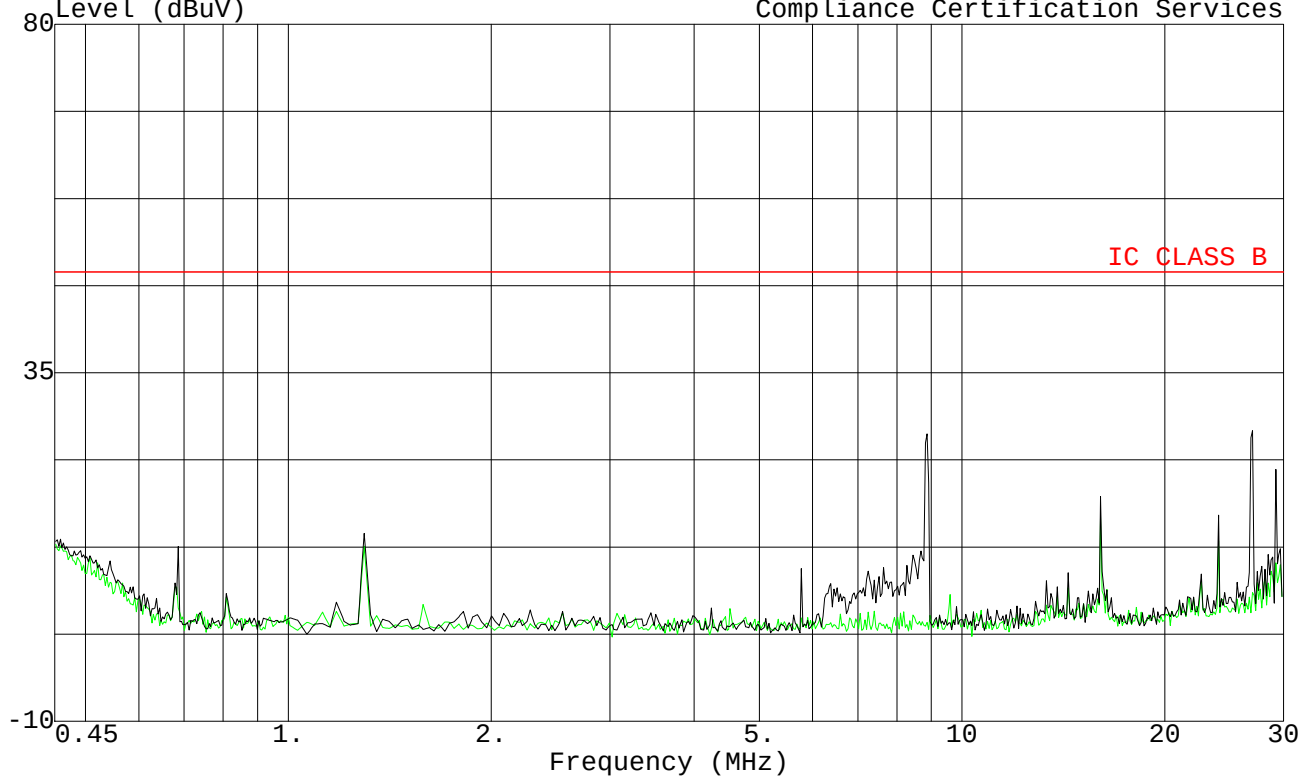
Project No. : 04T3089-1
Test Engr : Thanh Nguyen
Company : Sensus Metering System
EUT : 900MHz DSSS Transceiver
Model Nos. : BA0031-I, BA0031-E, BA0031-R
Test Config.: EUT and Remote LAPTOP
Type of Test: FCC CLASS B (CISPR22 Class B)
Mode of Op. : TX WORST CASE, Mid Channel/Patch
AC Mains : 115 V AC / 60 Hz
: Peak : L1(Green); L2(Black)

Data#: 9 File#: 04U3089N.EMI

Date: 11-09-2004 Time: 17:12:13

Level (dBuV)

Compliance Certification Services



Trace: 8

Ref Trace:

Project No. : 04T3089-1
Test Engr : Thanh Nguyen
Company : Sensus Metering System
EUT : 900MHz DSSS Transceiver
Model Nos. : BA0031-I, BA0031-E, BA0031-R
Test Config.: EUT and Remote LAPTOP
Type of Test: IC CLASS B
Mode of Op. : TX WORST CASE, Mid Channel/Patch
AC Mains : 115 V AC / 60 Hz
Peak : L1(Green); L2(Black)

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.

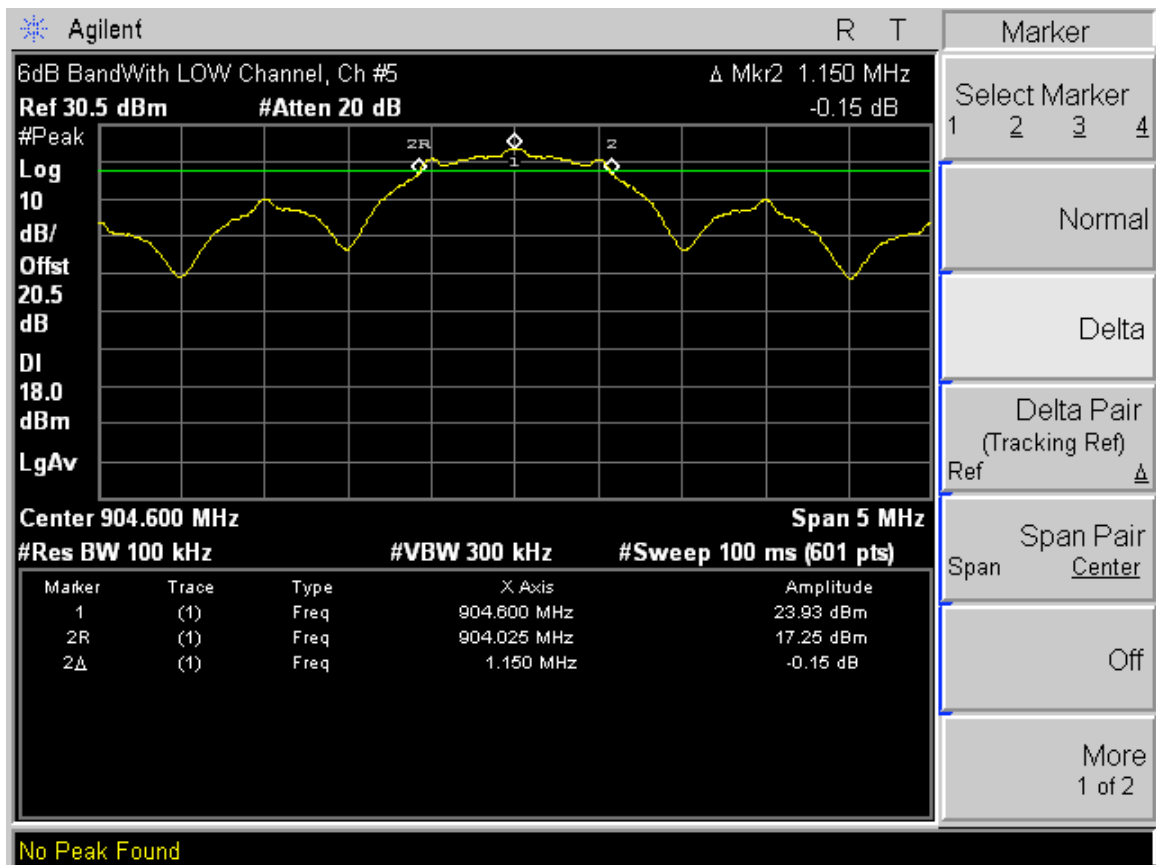
Test Procedures

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 904.6 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.

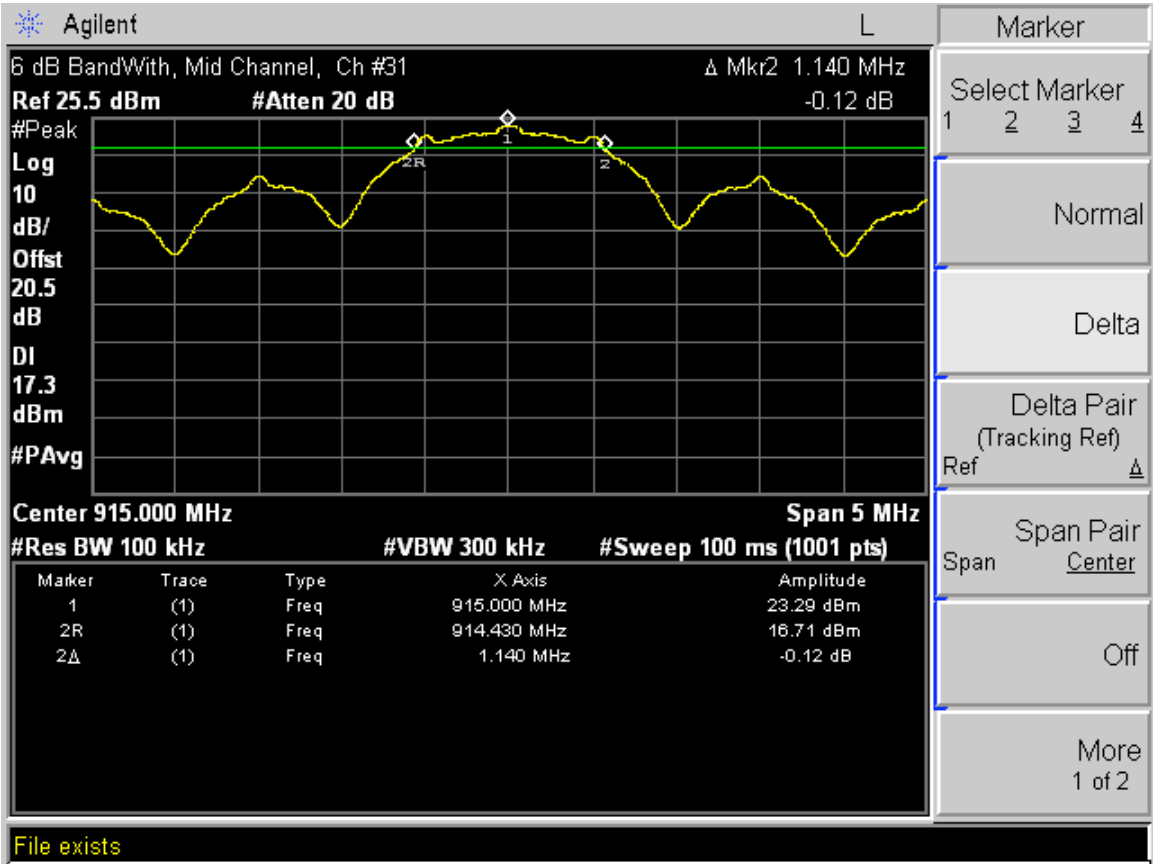
Test was repeated for MID and HIGH channels.

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

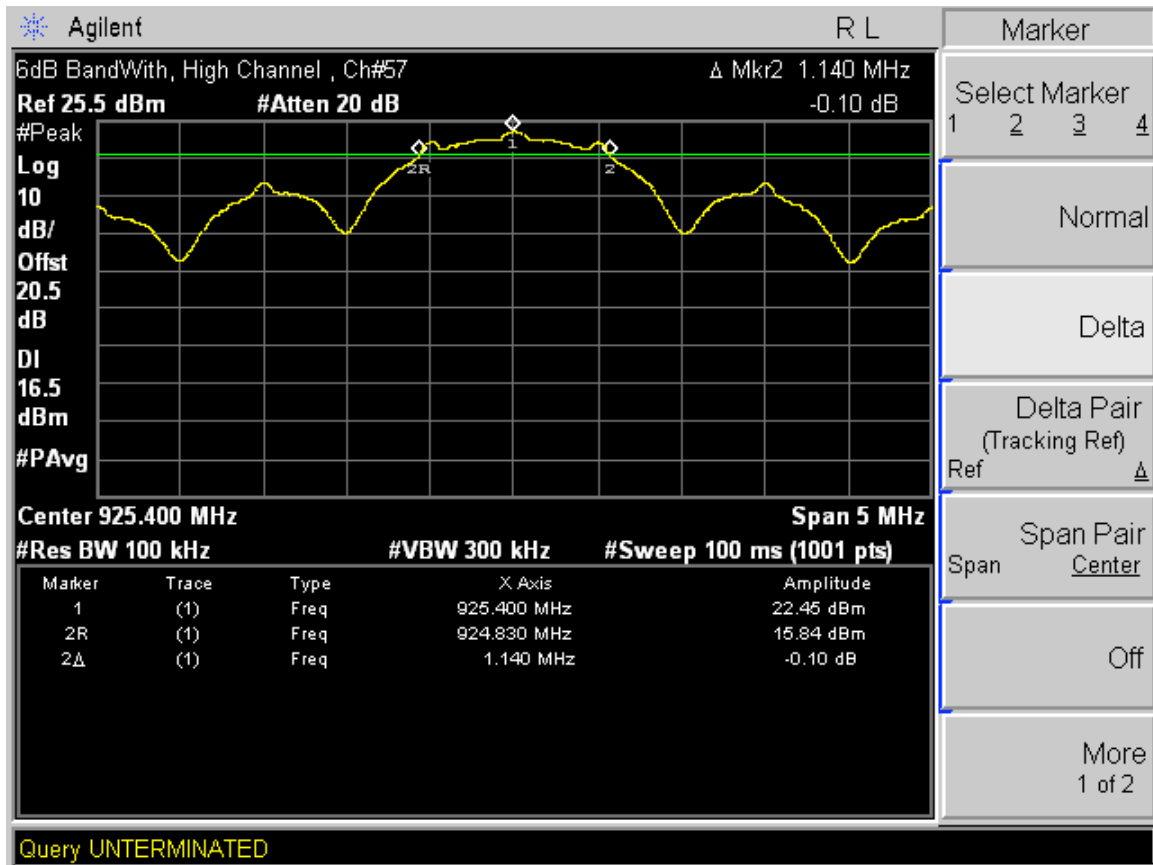
15.247 6dB Channel Bandwidth LOW channel



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

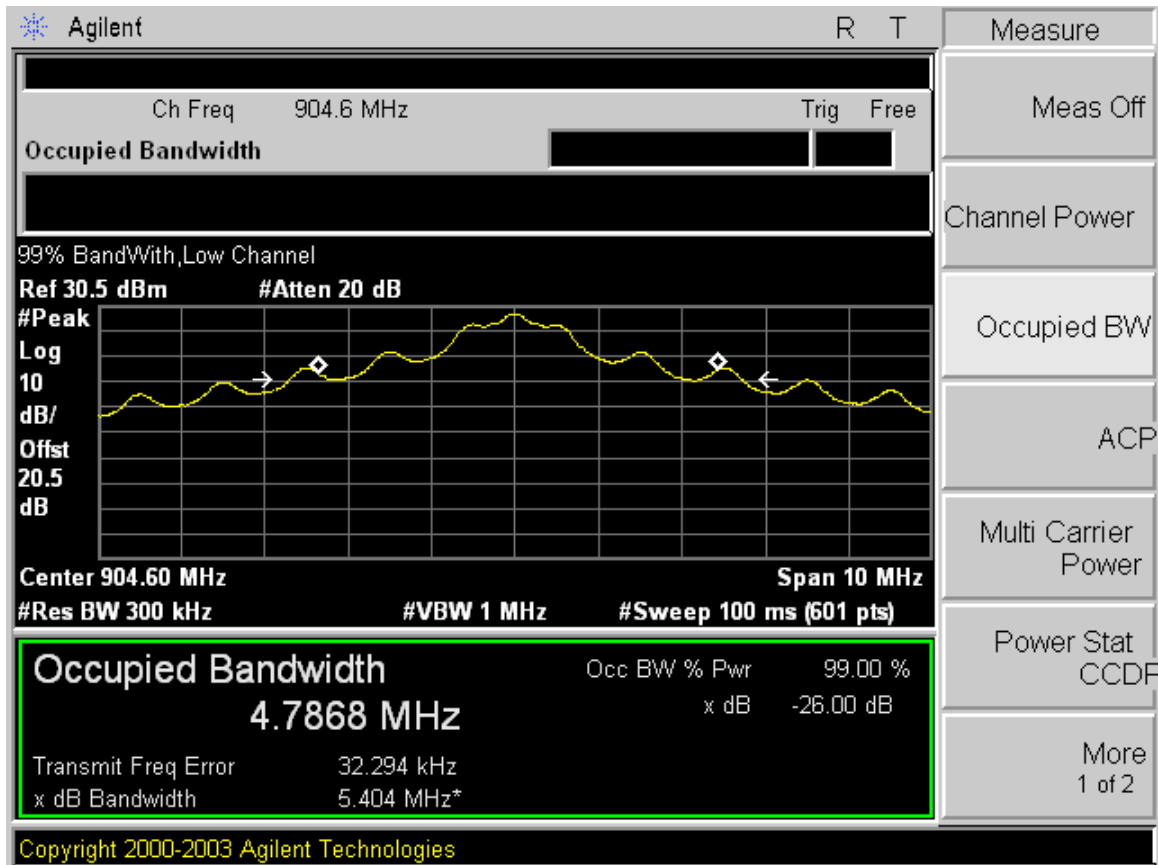
None: for reporting purposes only.

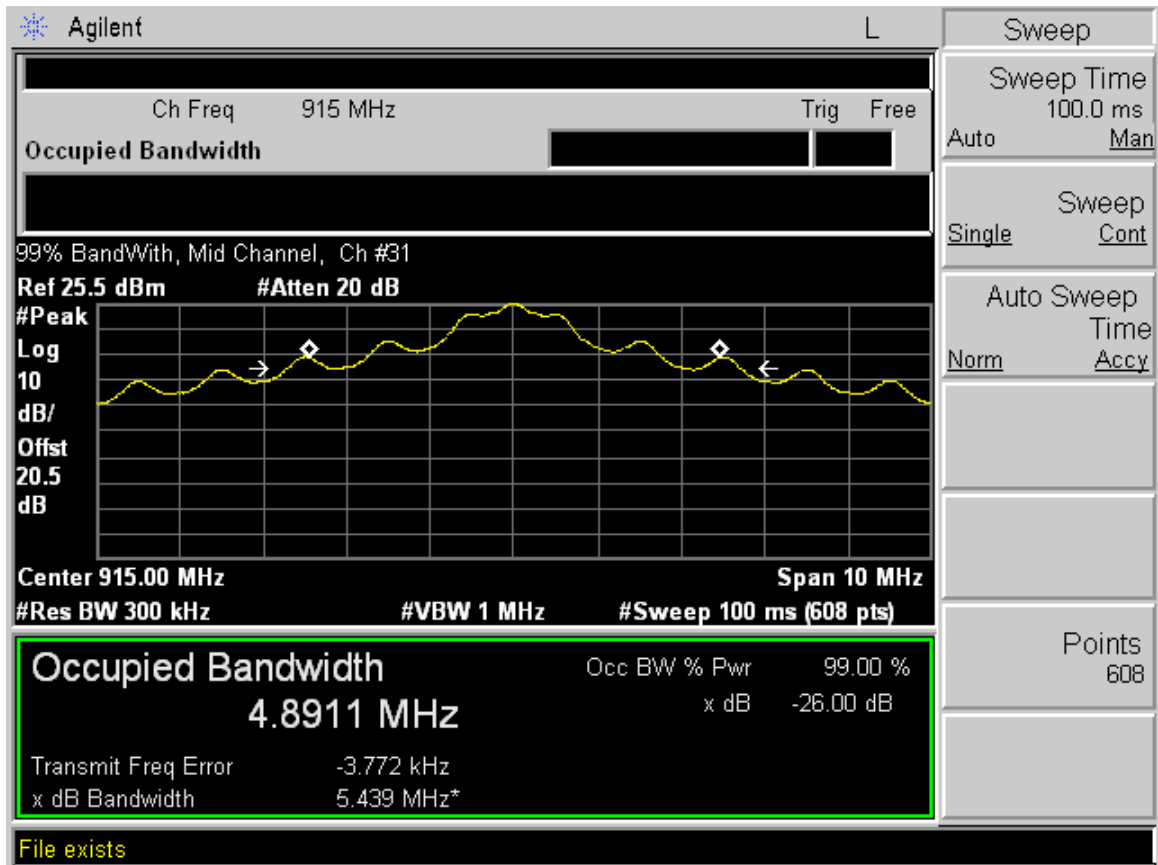
Test Procedure

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.

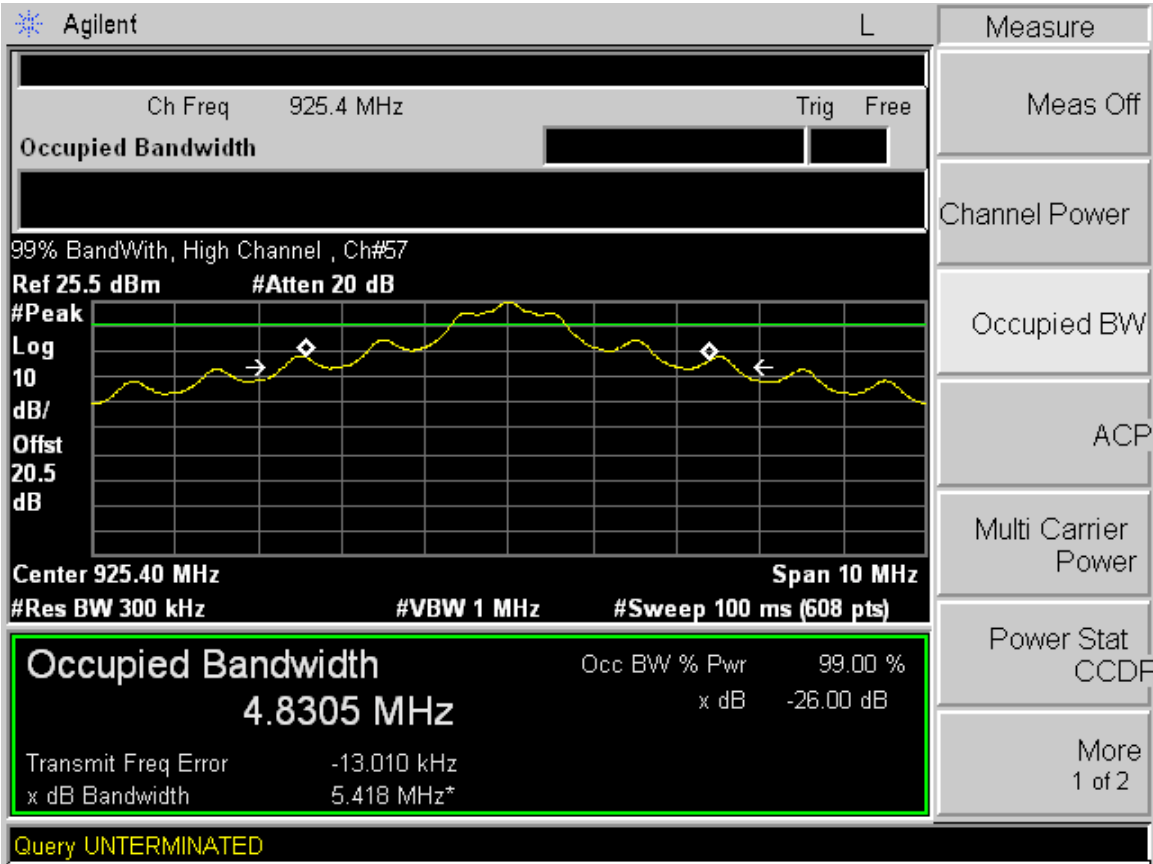
Test Results

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

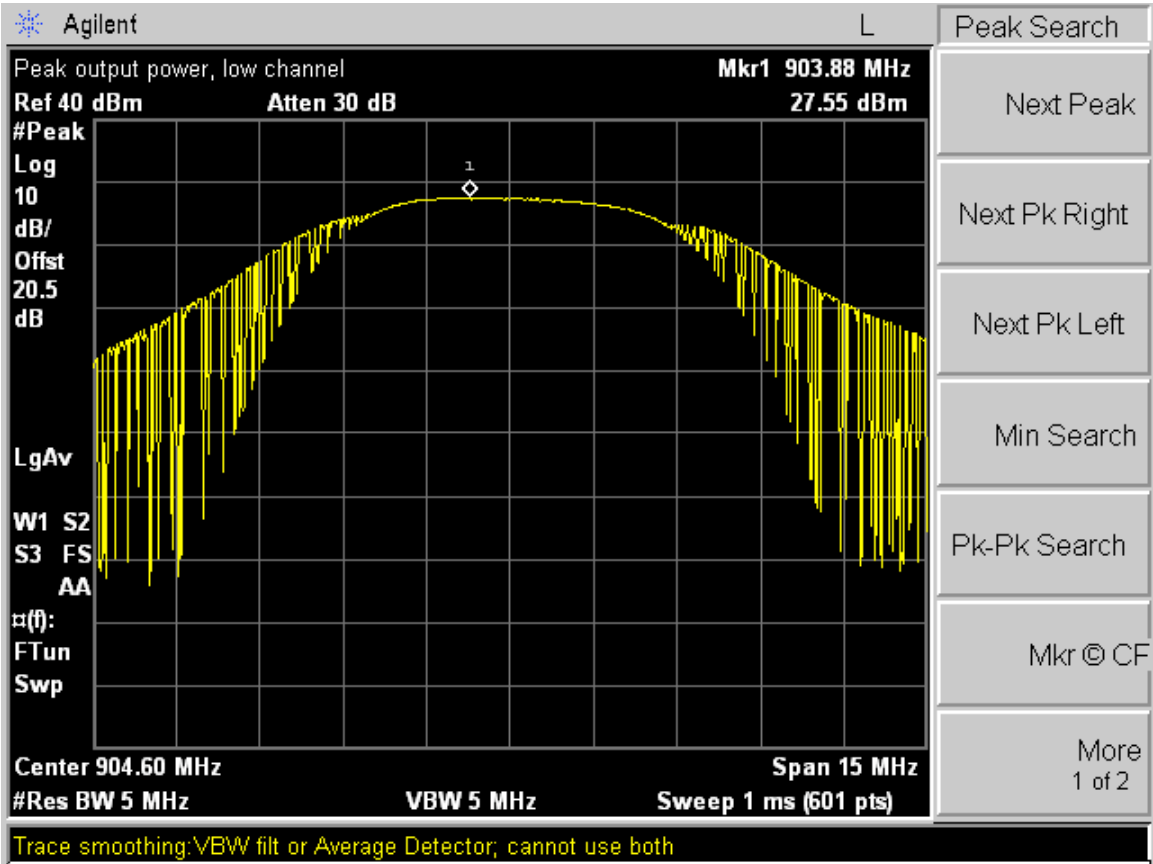
1. The EUT was configured on a test bench. The spectrum analyzer RBW and VBW were set to 3 MHz, to include the entire 99% bandwidth of approximately 2 MHz.
2. The spectrum analyzer was set for peak detection and the peak reading was recorded.
3. The process in (1) and (2) was repeated for MID channel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

Test Results

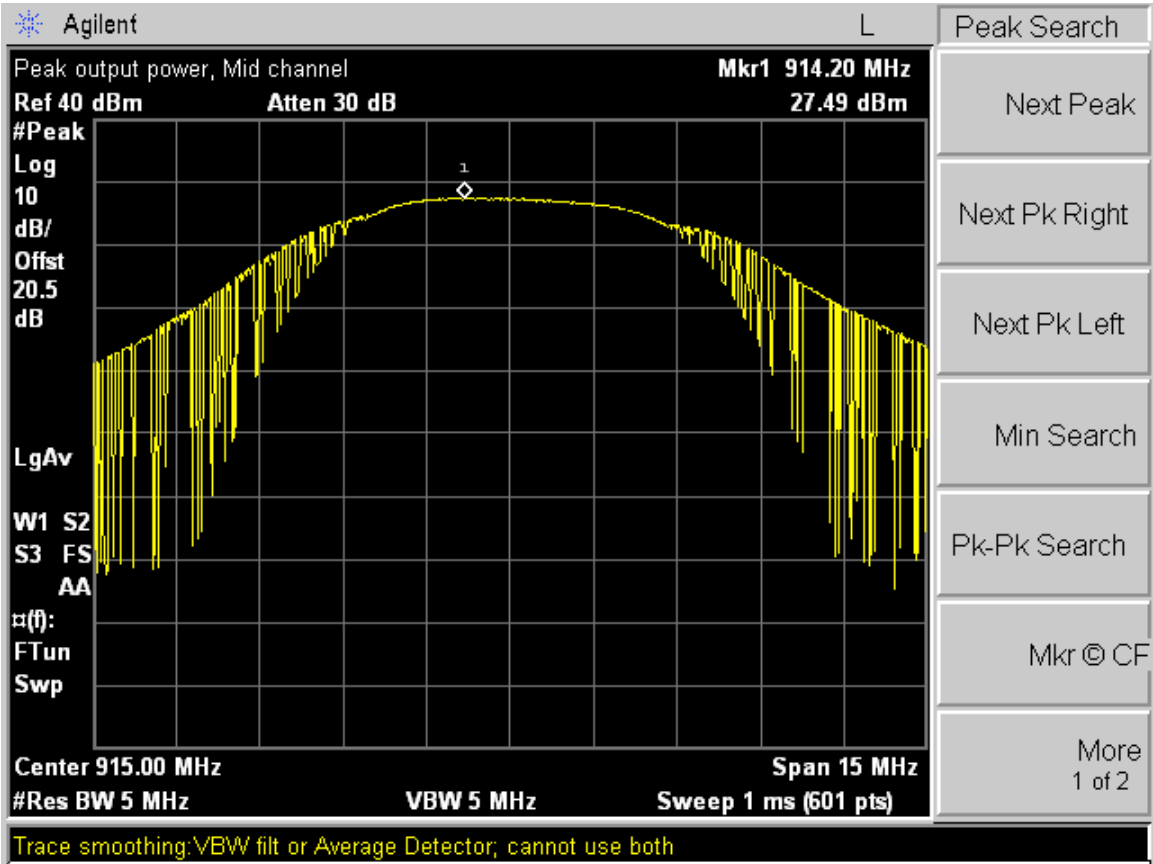
Power level readings converted to dBm are shown below. Refer also to spectrum analyzer graphs. Reference level offset corrects for external attenuation and cable loss.

Channel	Frequency, MHz	Output Power, dBm
LOW	904.6	27.55
MID	915	27.49
HIGH	925.6	27.17

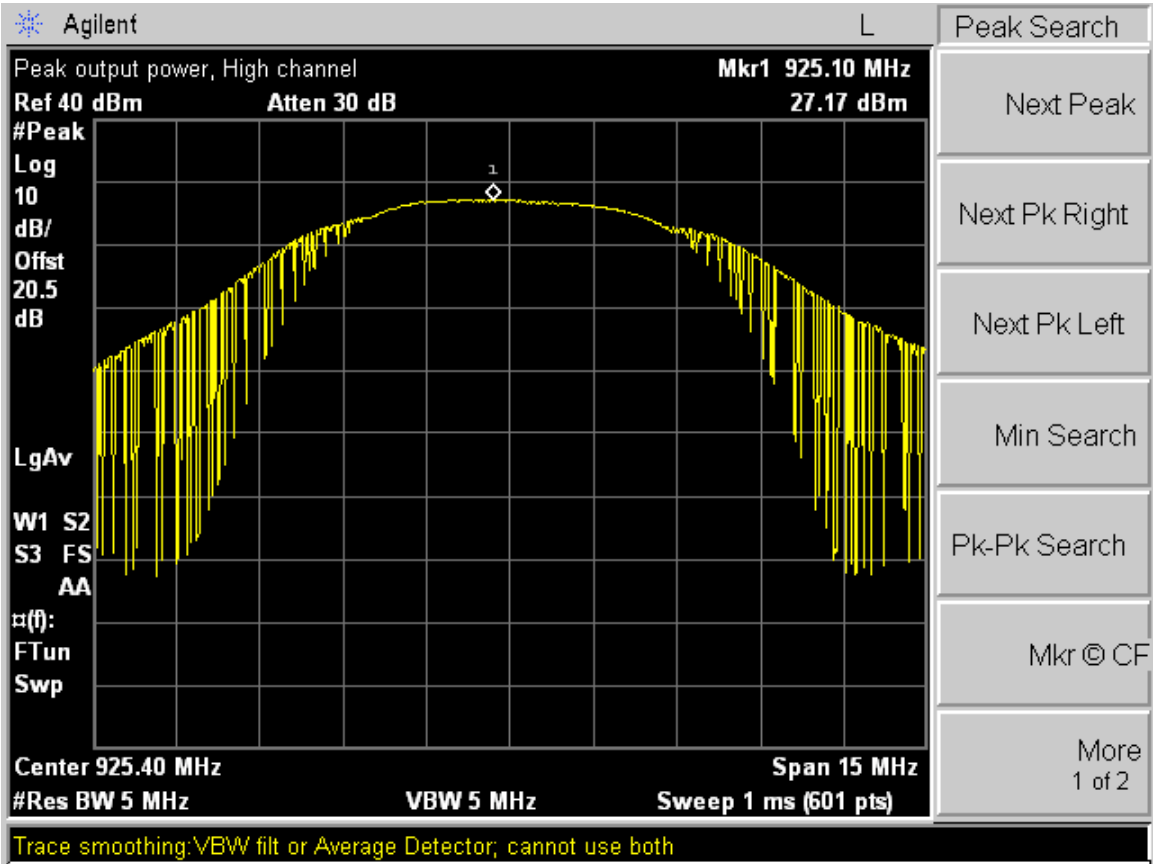
Low Channel Peak Output Power



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.

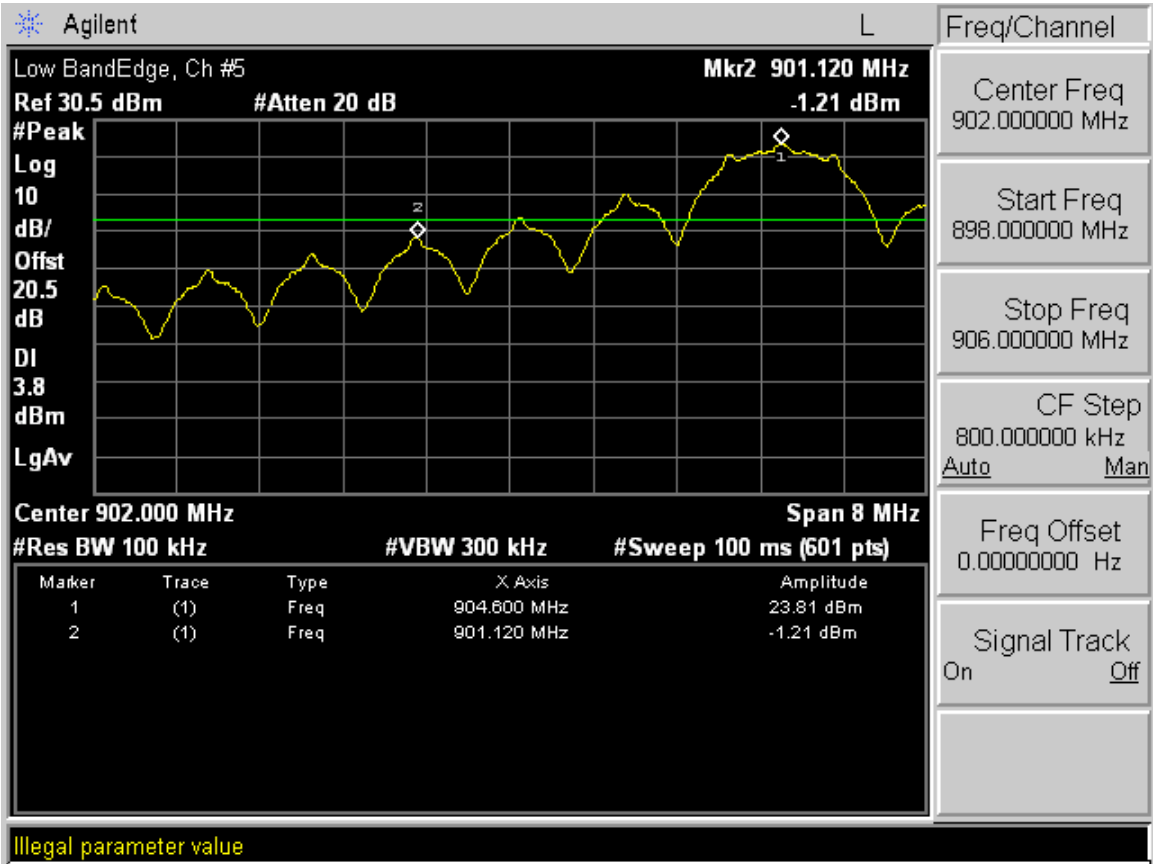
2. The process in (1) was repeated for MID channel and HIGH channel.

Test Results

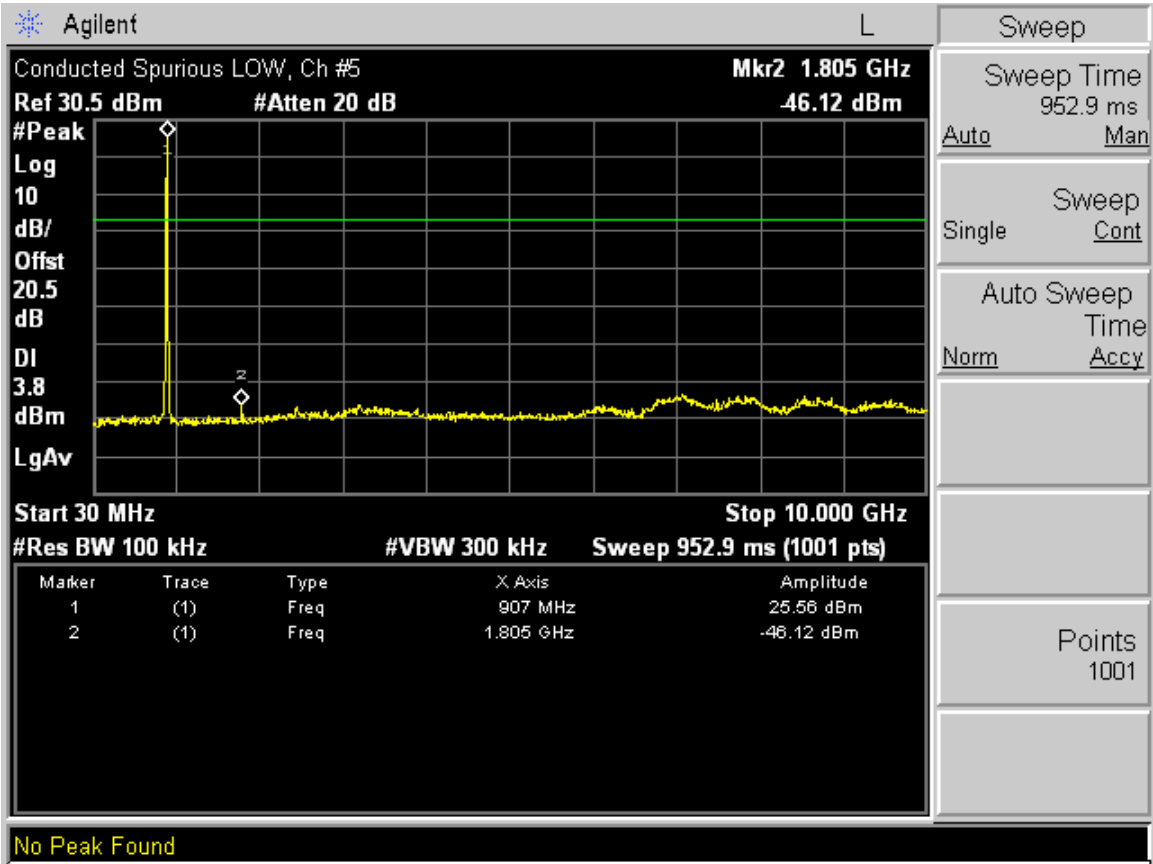
Refer to attached data sheets. Data shows out of band emissions are suppressed well below the -20 dBc minimum required by the Rules.

Channel	Frequency, MHz
LOW	904.6
MID	915
HIGH	925.6

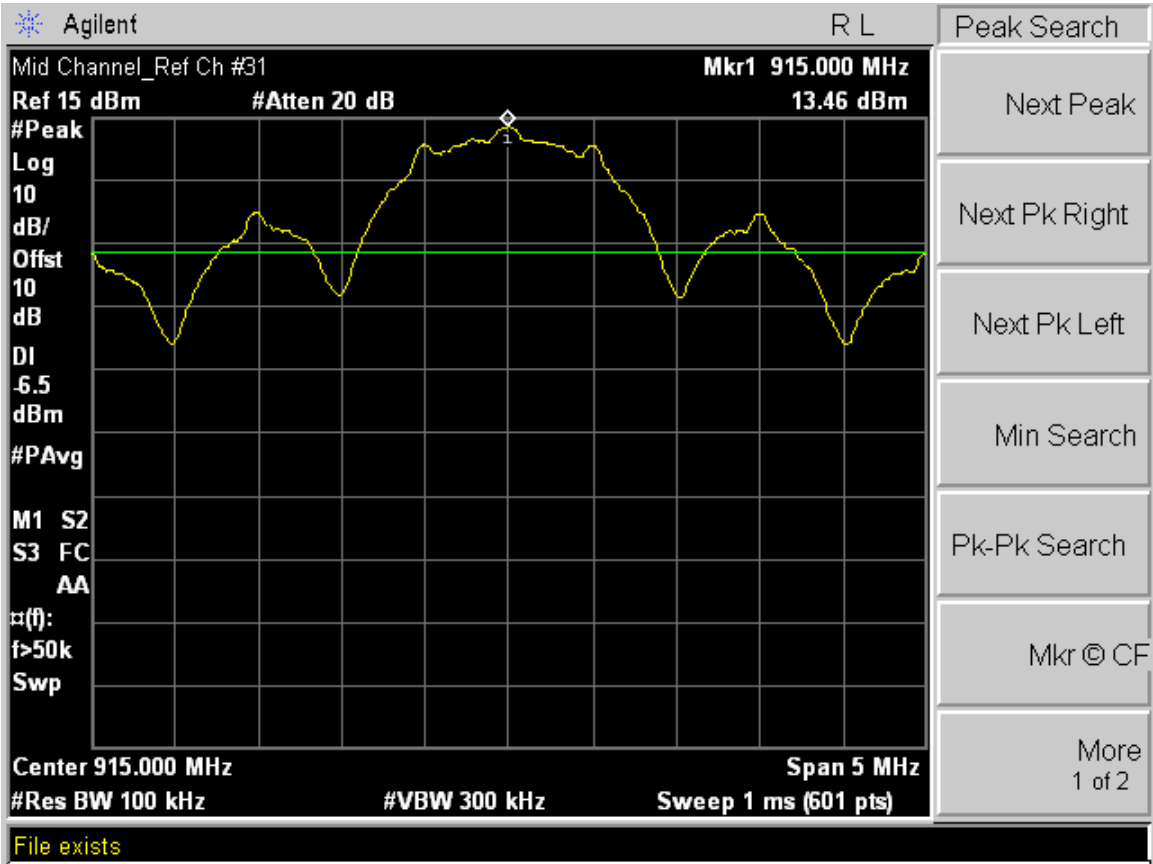
Out of Band Low Channel (1 of 2)



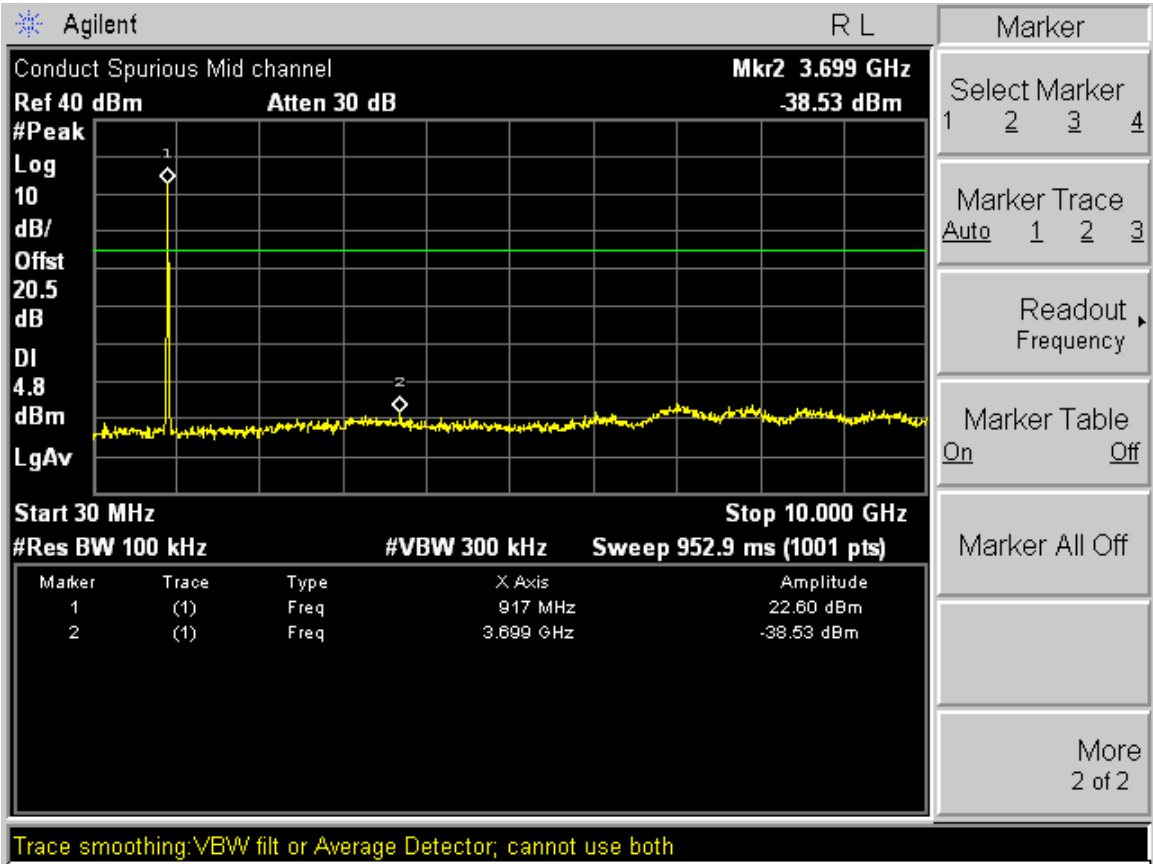
Out of Band Low Channel (2 of 2)



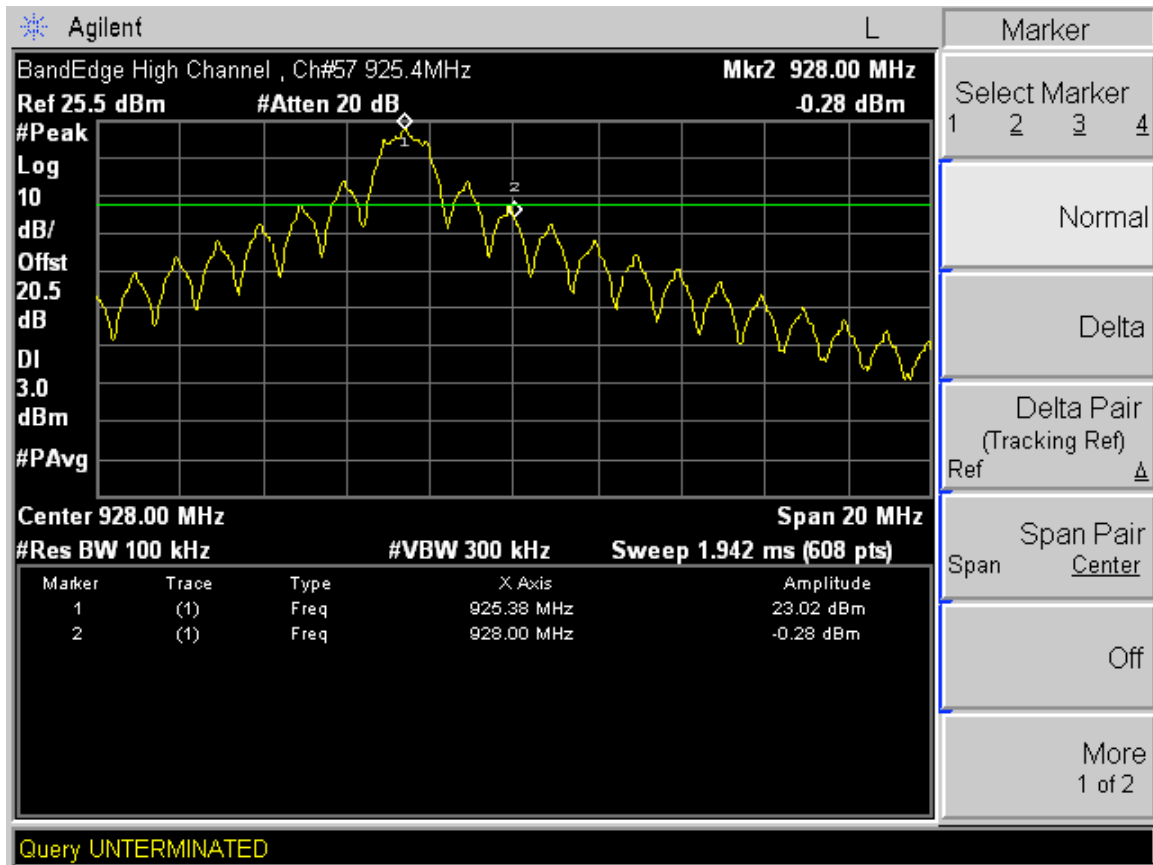
Out of Band Mid Channel (1 of 2)



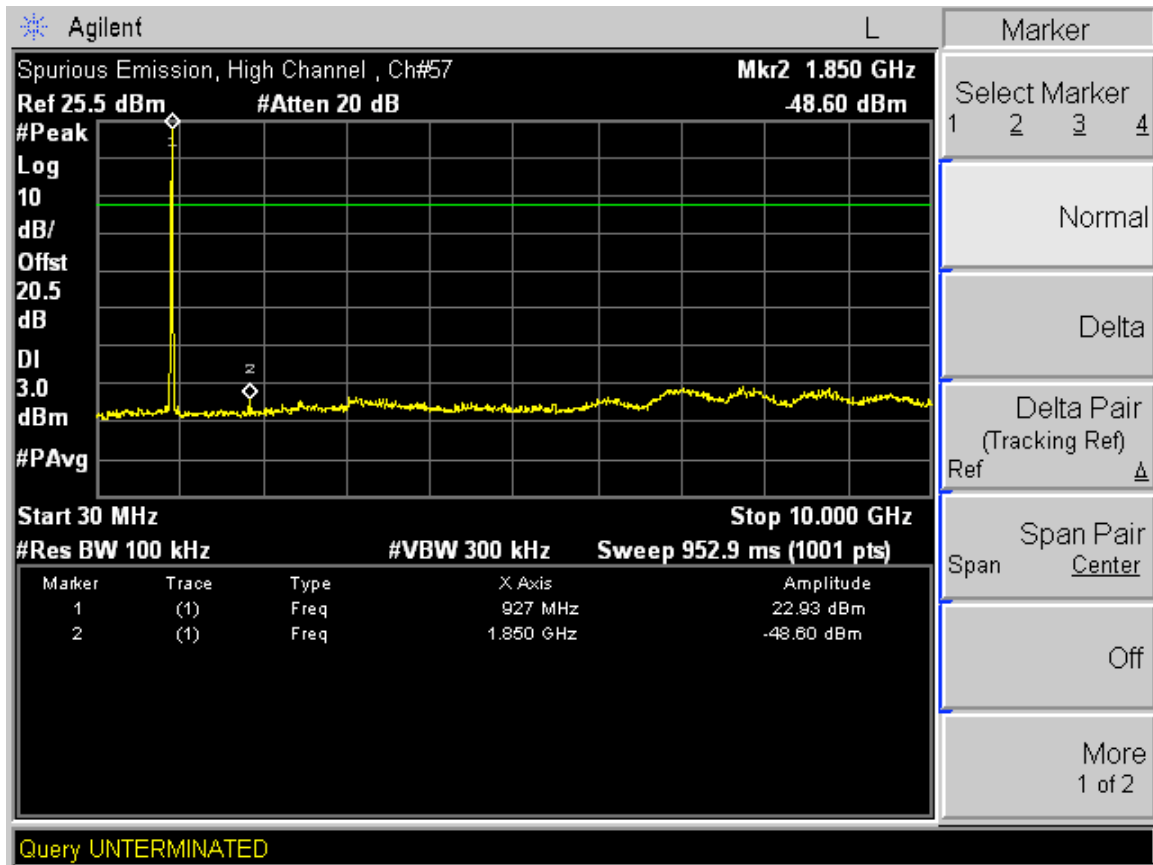
Out of Band Mid Channel (2 of 2)



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 was tuned to the LOW channel. The spectrum analyzer center frequency was set to the maximum emission level. The SPAN was reduced to 300 kHz while maintaining the maximum reading near the center screen. RBW was set to 3 kHz, VID = 10 kHz, and SWEEP set to 100 seconds. PEAK SEARCH function was used to determine the highest level PSD reading.

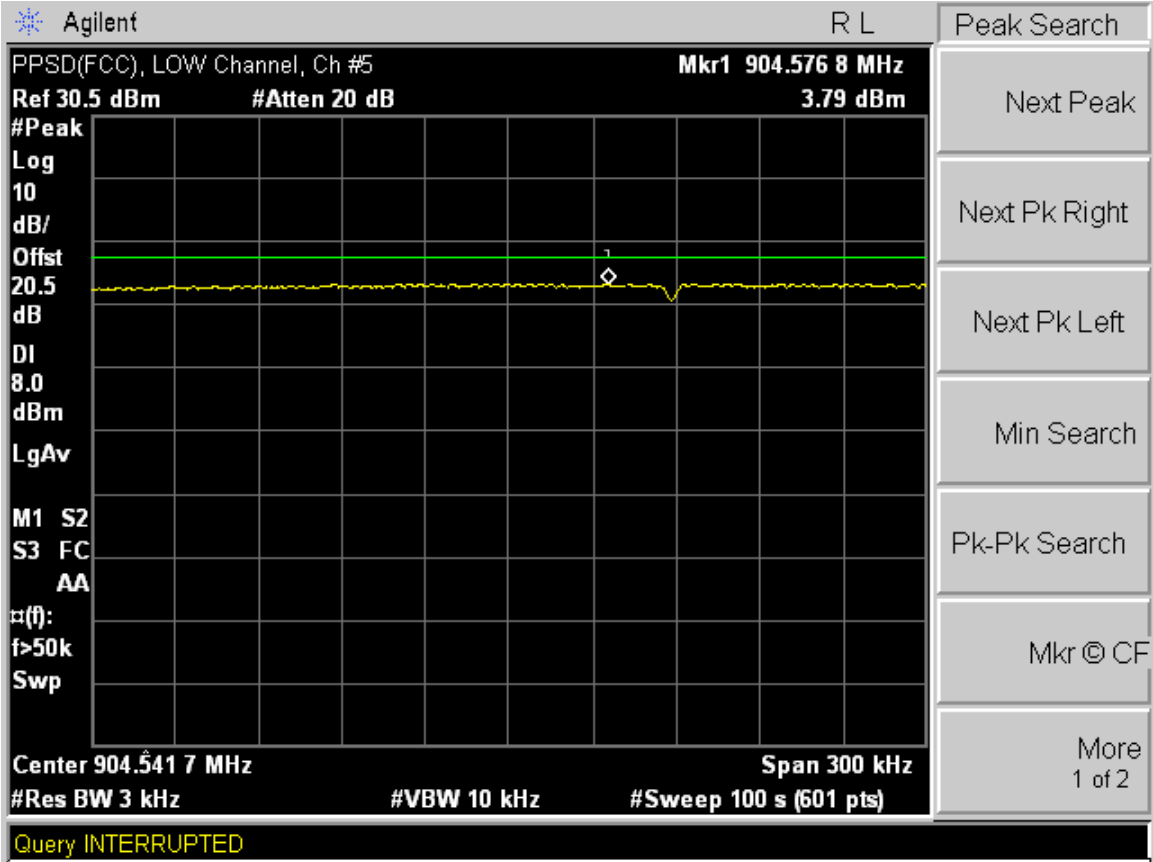
The test was repeated for MID and HIGH channel.

Test Results

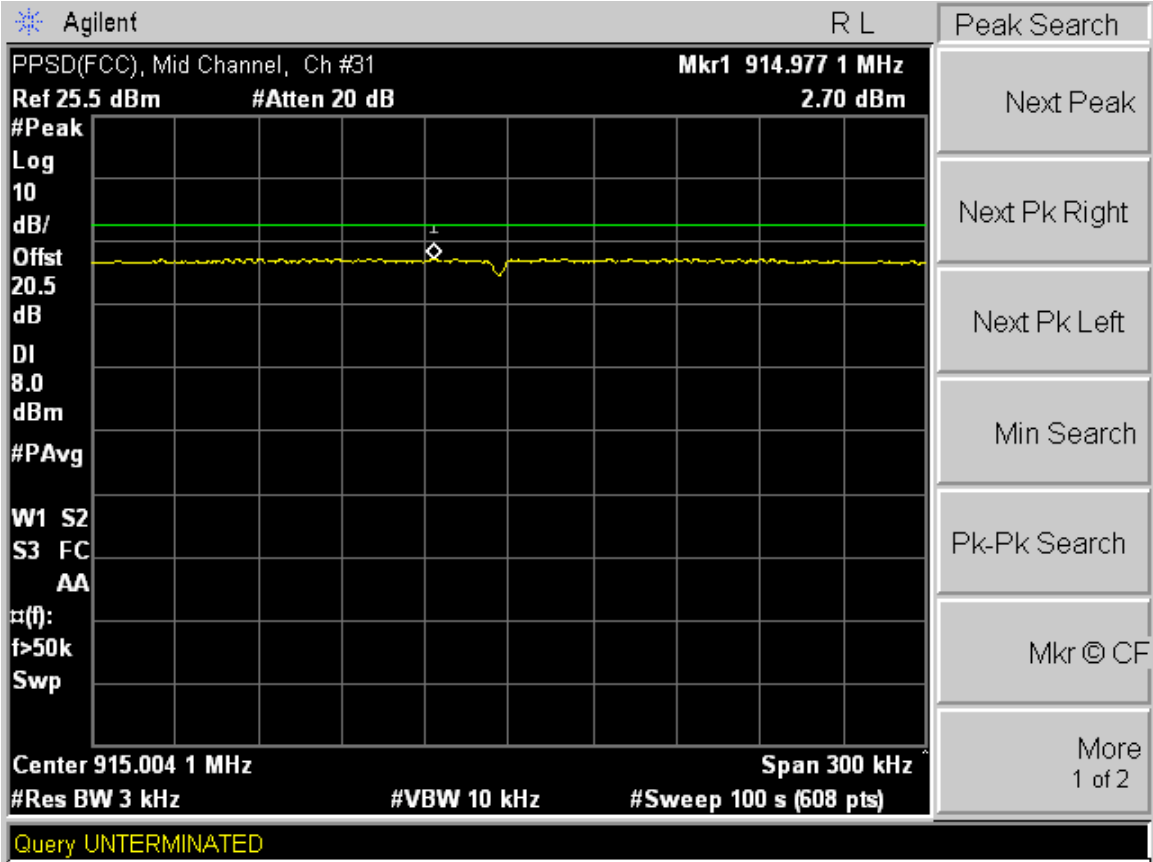
Maximum PSD was 3.79 dBm. Refer to attached spectrum analyzer charts.

Limit: 8 dBm

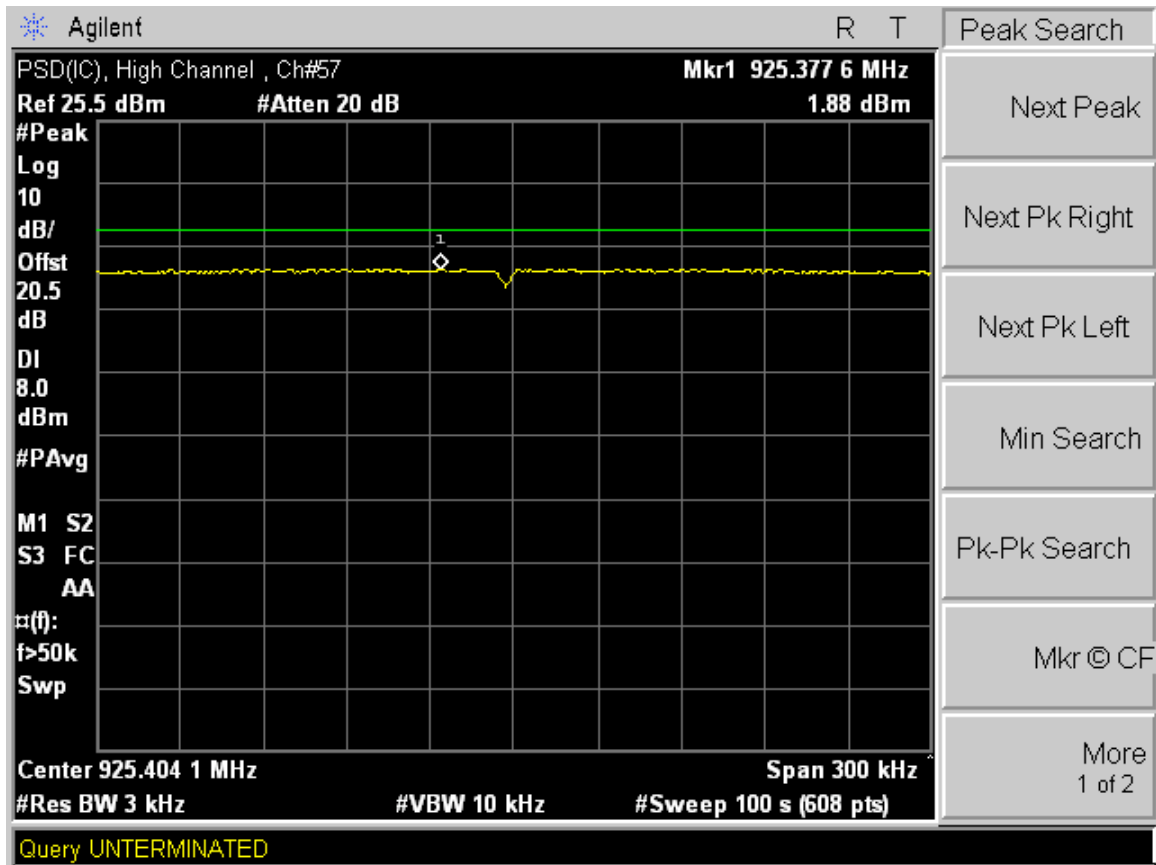
Power Spectral Density, LOW Channel



Power Spectral Density, MID Channel



Power Spectral Density, HIGH Channel



**Industry Canada Power Spectral Density
Test Requirement: RSS-210**

Measurement Equipment Used:

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

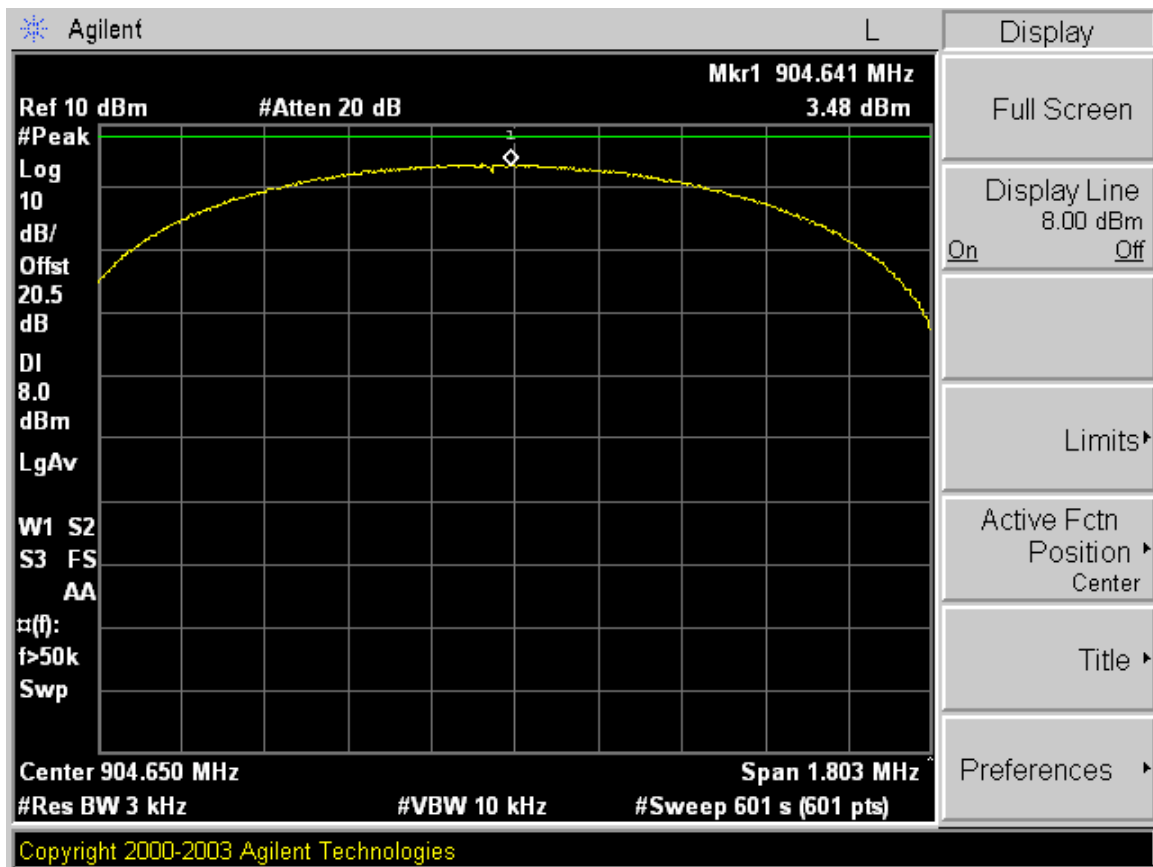
Test Procedures

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 904.6 MHz (LOW channel). While the transmitter broadcast a steady stream of digital data.

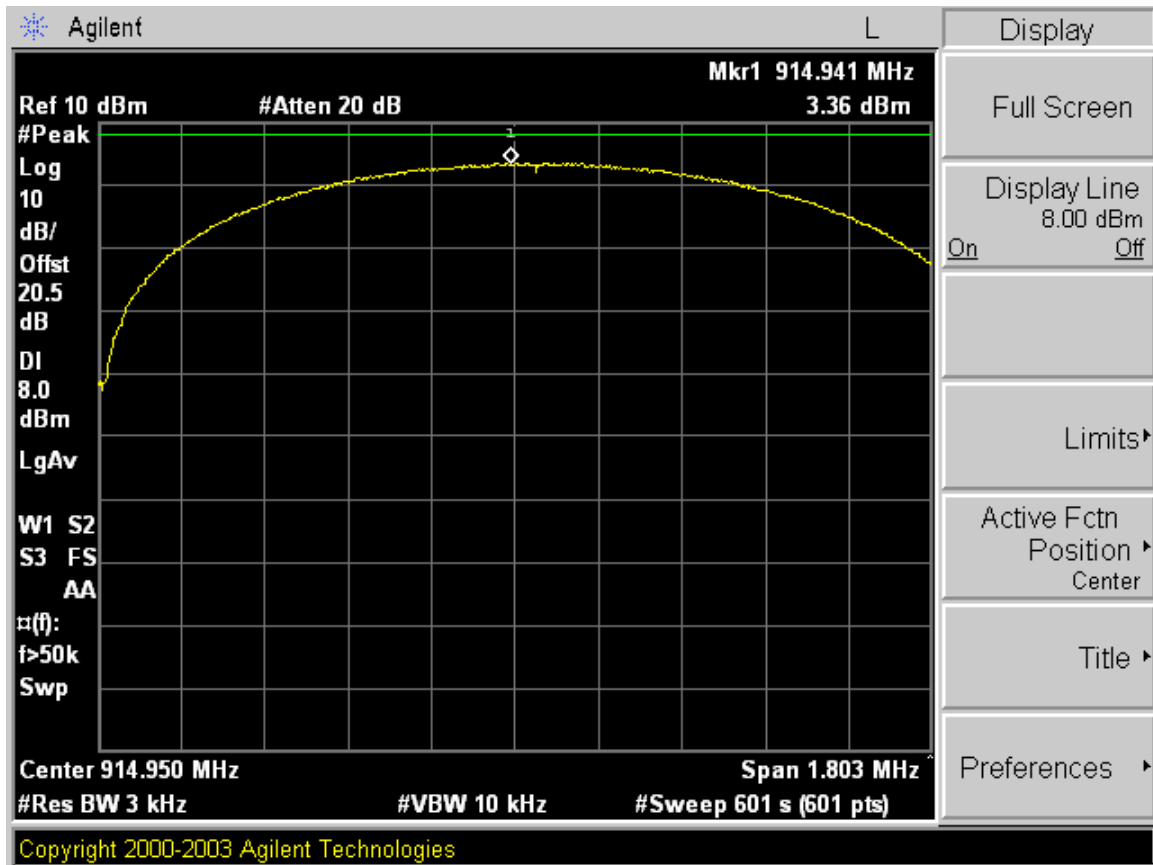
Test was repeated for MID and HIGH channels.

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

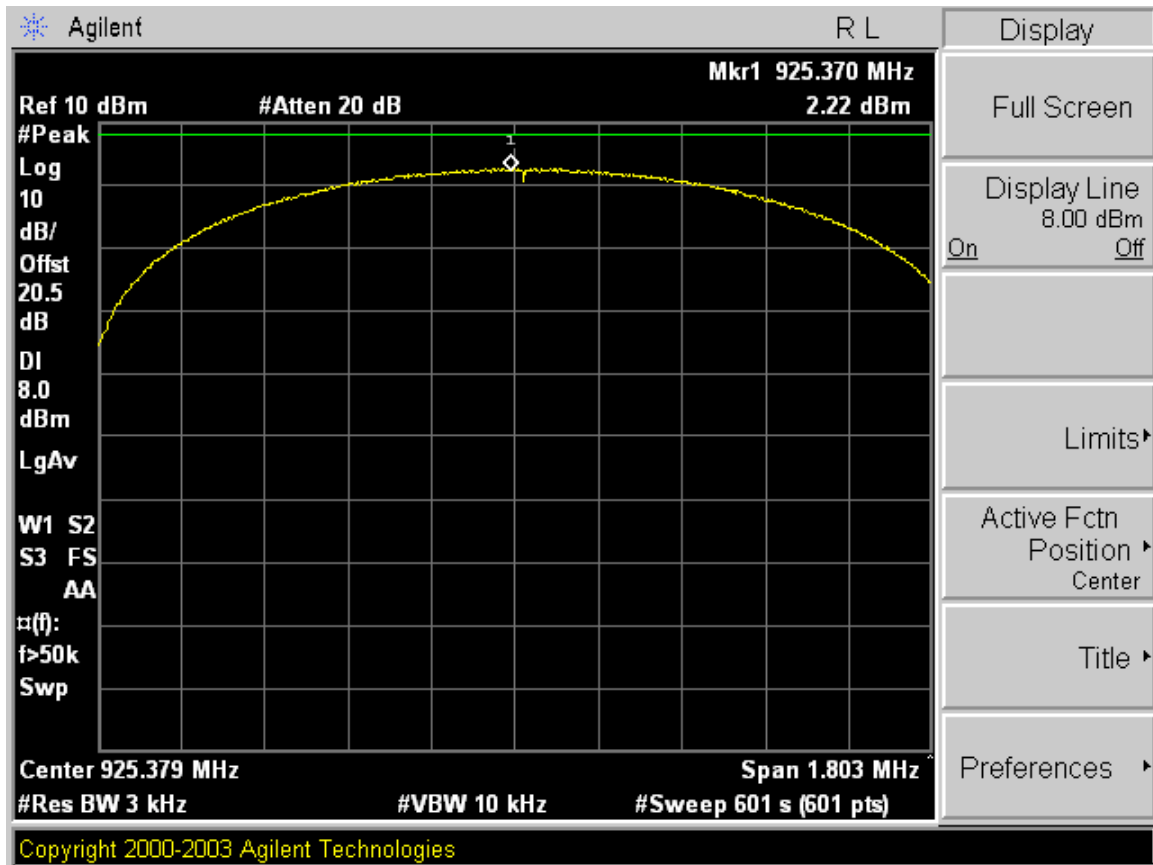
Industry Canada RSS-210



Industry Canada RSS-210



Industry Canada RSS-210



RF Exposure (MPE) Calculations

904.5 - 925.4 MHz DTS Radio

Applicant: Sensus Metering Systems

FCC ID: **KCH5BA0031**

mW/cm2 from Table1: **0.60**

Max RF Power P, dBm	TX Antenna G, dBi	MPE Safe Distance, cm	MPE, inches
27.6	5.2	15.8	6.2

Basis of Calculations:

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

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

$$d = ((P_{\text{watts}} * G * 30) / 3770 * S)^{.5}$$

$$P_{\text{watts}} * G_{\text{gain}} = 10^{(P_{\text{dBm}} - 30 + G_{\text{dBi}}) / 10}$$

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