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
Class 2 Permissive Change

Applicant: Sensus Metering Systems

FCC ID: **KCH520R**

II. DESCRIPTION OF EQUIPMENT UNDER TEST (EUT)

The Sensus FCC ID: **KCH520R** is a digital transmission system (DTS) operating under the requirements in FCC Part 15. 247. The Model 510R/520R incorporates a part 15.247 Direct Sequence Spread Spectrum Transmitter operating in the 902 to 928 MHz ISM band, and a Part 15 AM Receiver operating in the 952 or 956 MHz MAS bands. The MXU uses spread spectrum techniques for remote water meter reading.

A new pit assembly antenna was tested for TX radiated emissions.

Transmitter Specification

TX Power	24.15 dBm max.
Frequency of operation	904.6-925.4 MHz
Data Rate	15.625 Kbps in <80ms burst
6 dB bandwidth	1.15 MHz
Power source	3.6 V lithium thionyl chloride battery
Radio firmware	MXU4 GP-TC v0.0.4
Test software name	MXU4T

III. TEST DATES AND TEST LOCATION

Testing was performed 28 March 2006. Testing was performed at:

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

T.N. Cokenias 27 April 2006
EMC Consultant/Agent for Sensus Metering Systems

15.203 Antenna connector requirement

The pit assembly antenna does not connect directly to the EUT, RF energy is coupled capacitively to the pit antenna from the printed circuit board antenna on the module.

15.204 Antenna description

Antenna description	Gain
pit assembly antenna	< 1.0 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 EQUIPMENT

TEST EQUIPMENT LIST				
Name of Equipment	**Manufacturer**	**Model No.**	**Serial No.**	**Due Date**
Antenna, Horn 1 ~ 18 GHz	ETS	3117	29301	4/22/06
Preamplifier, 1 ~ 26.5 GHz	Agilent / HP	8449B	3008A00369	8/17/06
Spectrum Analyzer 3 Hz ~ 44 GHz	Agilent / HP	E4446A	US42510266	10/19/06
1.5 GHz HPF	MicroTronics		002	

TEST RESULTS

Radiated Emissions
Test Requirement: 15.205, 15.247

Out of Band Measurements
Test Requirement: 15.247

Measurement Equipment Used:

Agilent 4446A Spectrum Analyzer, 9 kHz-40 GHz
Sunol Sciences JB1 Biconolog antenna
EMCO 3115 Horn antenna, 1-18 GHZ
Miteq NSP2600-SP pre-amplifier, 1 – 26.5 GHz
IFI High pass filter, fp = 1500 MHz

Radiated Test Set-up, 1-26 GHz

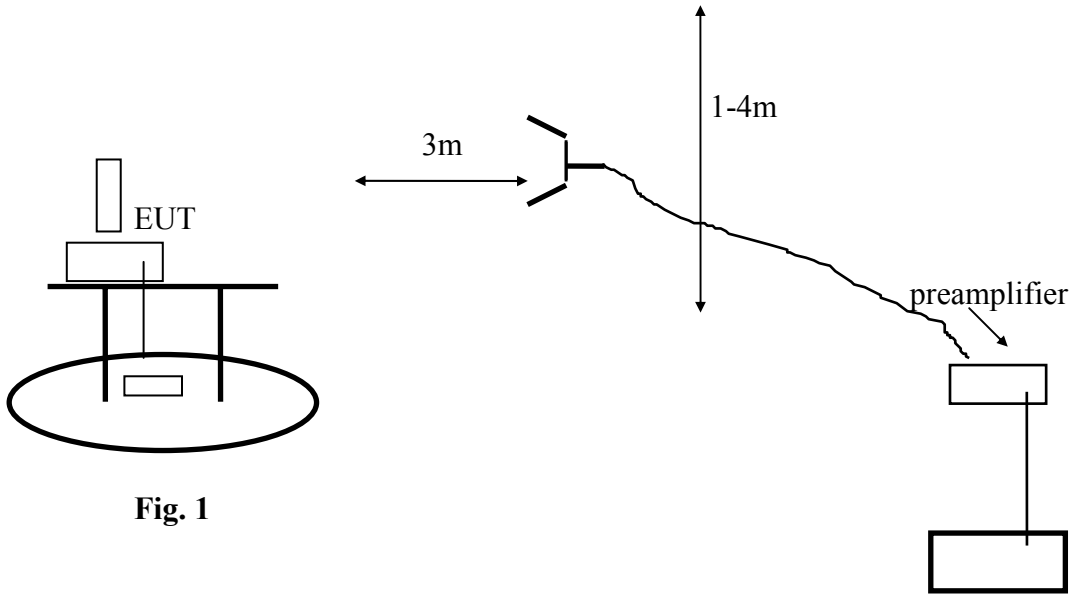

Fig. 1

Test Procedures

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.
The search antenna was placed 3m from the EUT. The EUT antenna was mounted in the XY plane, the first of three test positions.

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.

5. Steps 2 through 5 were repeated for YZ and XZ orientation of the EUT.

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.

3/28//2006 **High Frequency Measurement**

Compliance Certification Services, Morgan Hill Open Field Site

Test Engineer: Frank Ibrahim
Project #: 06U10060
Company: Sensus
EUT Description: RF module for utility meter
EUT M/N: 520R with pit antenna
EUT S/N: CS01698
Test Target: FCC 15.247
Mode Of Operation: TX ON
Average Power Meter: Low = 27 dBm, Mid = 27 dBm, High = 27 dBm

Test Equipment:

Horn 1-18GHz: T119; S/N: 29301 @3m
Pre-amplifer 1-26GHz: T34 HP 8449B
Pre-amplifer 26-40GHz:
Horn > 18GHz:

Hi Frequency Cables
2 foot cable:
3 foot cable: Frank 177080001
12 foot cable: Frank 187209001

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	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
Low Channel (904.6 MHz)															
2.714	3.0	53.7	48.1	32.3	3.0	-36.1	0.0	0.6	53.5	47.9	74	54	-20.5	-6.1	V
3.618	3.0	51.3	47.2	33.2	3.4	-35.3	0.0	0.6	53.2	49.1	74	54	-20.8	-4.9	V
4.523	3.0	46.0	36.0	33.8	3.8	-34.9	0.0	0.6	49.4	39.4	74	54	-24.6	-14.6	V
5.428	3.0	45.0	35.5	34.3	4.2	-34.7	0.0	0.5	49.3	39.8	74	54	-24.7	-14.2	V
2.714	3.0	49.6	42.1	32.3	3.0	-36.1	0.0	0.6	49.4	42.0	74	54	-24.6	-12.0	H
3.618	3.0	48.7	43.6	33.2	3.4	-35.3	0.0	0.6	50.6	45.5	74	54	-23.4	-8.5	H
4.523	3.0	46.0	36.7	33.8	3.8	-34.9	0.0	0.6	49.3	40.0	74	54	-24.7	-14.0	H
5.428	3.0	45.7	38.7	34.3	4.2	-34.7	0.0	0.5	50.0	43.0	74	54	-24.0	-11.0	H
8.141	3.0	44.0	33.5	35.9	4.7	-34.0	0.0	0.7	51.3	40.8	74	54	-22.7	-13.2	H
Mid Channel (915 MHz)															
2.745	3.0	53.0	47.1	32.4	3.0	-36.1	0.0	0.6	52.9	47.0	74	54	-21.1	-7.0	V
3.660	3.0	49.6	44.7	33.2	3.5	-35.3	0.0	0.6	51.6	46.6	74	54	-22.4	-7.4	V
4.575	3.0	44.3	33.6	33.8	3.9	-34.9	0.0	0.6	47.7	37.0	74	54	-26.3	-17.0	V
2.745	3.0	50.8	44.0	32.4	3.0	-36.1	0.0	0.6	50.7	43.9	74	54	-23.3	-10.1	H
3.660	3.0	51.5	46.2	33.2	3.5	-35.3	0.0	0.6	53.4	48.1	74	54	-20.6	-5.9	H
4.575	3.0	45.2	35.2	33.8	3.9	-34.9	0.0	0.6	48.6	38.6	74	54	-25.4	-15.4	H
High Channel (925.4 MHz)															
2.779	3.0	52.1	46.4	32.5	3.1	-36.1	0.0	0.6	52.1	46.4	74	54	-21.9	-7.6	V
4.631	3.0	51.0	46.6	33.9	3.9	-34.9	0.0	0.6	54.5	50.1	74	54	-19.5	-3.9	V
2.779	3.0	50.1	41.8	32.5	3.1	-36.1	0.0	0.6	50.1	41.8	74	54	-23.9	-12.2	H
3.705	3.0	49.6	43.8	33.2	3.5	-35.2	0.0	0.6	51.7	45.8	74	54	-22.3	-8.2	H
4.631	3.0	47.7	39.1	33.9	3.9	-34.9	0.0	0.6	51.2	42.6	74	54	-22.8	-11.4	H
4.631	3.0	46.3	36.7	33.9	3.9	-34.9	0.0	0.6	49.8	40.2	74	54	-24.2	-13.8	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		

Revision History

Rev	Description	Revised by	Date
A	Original	T. Cokenias	4/11/06
A.1	Correct typo in data	T. Cokenias	4/27/06