

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: Invensys Metering Systems

FCC ID: **KCHMXU530E**

II. DESCRIPTION OF EQUIPMENT UNDER TEST (EUT)

The Invensys FCC ID: **KCHMXU530E** is a digital transmission system (DTS) operating under the requirements in FCC Part 15. The product is an electric utility meter that transmits meter readings to a receiver unit owned by the utility. The product has a receiver tuned to the utility licensed transmitter operating in the 952-956 MHz band. The licensed transmitter sends the transmit command to the MXU 530E

The MXU530E operates in the U.S. ISM band between 902 and 928 MHz.

Transmitter Specification

TX Power	21.6 DBMS measured
Frequency of operation	903.8-926.2 MHz
Data Rate	15.625 kbps in 72ms burst
6 dB bandwidth	1.18 MHz
Power source	240 VAC 60 Hz

III. TEST DATES AND TEST LOCATION

Testing was performed 14 - 15 January 2003. All tests were performed at:

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

T.N. Cokenias
EMC Consultant/Agent for Invensys

16 February 2003

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:

HP 8592EM Spectrum Analyzer
 Miteq NSP2600-44 Microwave pre-amplifier, 1-26.5 GHz
 EMCO 3115 Double Ridged Horn antenna, 1 - 18 GHz

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 open air test site. Several utility 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 in separate attachments. Restricted band emissions meet 54 dBuV/m. Other undesired emissions from the transmitter meet the -20 dBc requirement in 15.247(c).

Radiated Emissions

Test Requirement: 15.109

Measurement Equipment Used:

HP 8593EM Spectrum Analyzer, 30-1000 MHz

HP 8447D Pre-amplifier, .1 - 1300 MHz

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. No radiated emissions were detected coming from the 952-956 MHz receiver portion of the EUT.

A plot of antenna port conducted receiver emissions is attached .

Refer to data spreadsheet below for emissions from the 902-928 MHz transceiver.

[illegible]

Test Engr: Chin Pang
Project #:
Company: Invensys
EUT Descrip.: Electric meter Radio Transceiver 902-928MHz DTS
EUT M/N: MXU4E
Test Target: FCC 15.247
Mode Oper: TX

Cable (feet)	EMCO Horn 1-18GHz	Pre-amplifier 1-26GHz	Spectrum Analyzer	Horn > 18GHz
15	T72; S/N: 6739	Miteq NSP2600-44	8593EM Analyzer	

1 MHz Resolution Bandwidth
1 MHz Video Bandwidth

1 MHz Resolution Bandwidth
10Hz Video Bandwidth

[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		

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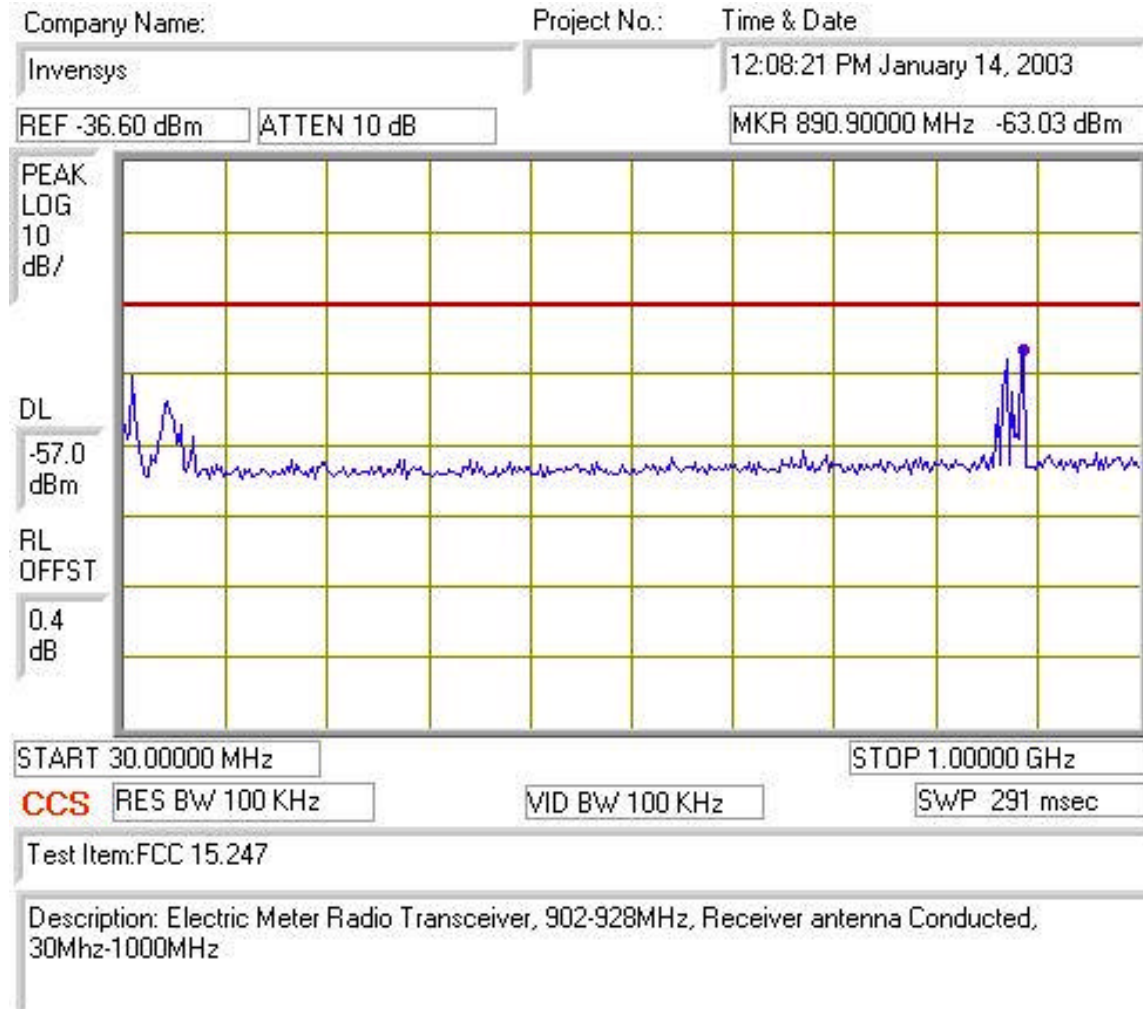
1 MHz Resolution Bandwidth
1MHz Video Bandwidth

1 MHz Resolution Bandwidth
10Hz Video Bandwidth

[illegible]

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CL	Cable Loss	HPF	High Pass Filter		

[illegible]

Receiver antenna conducted emissions

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

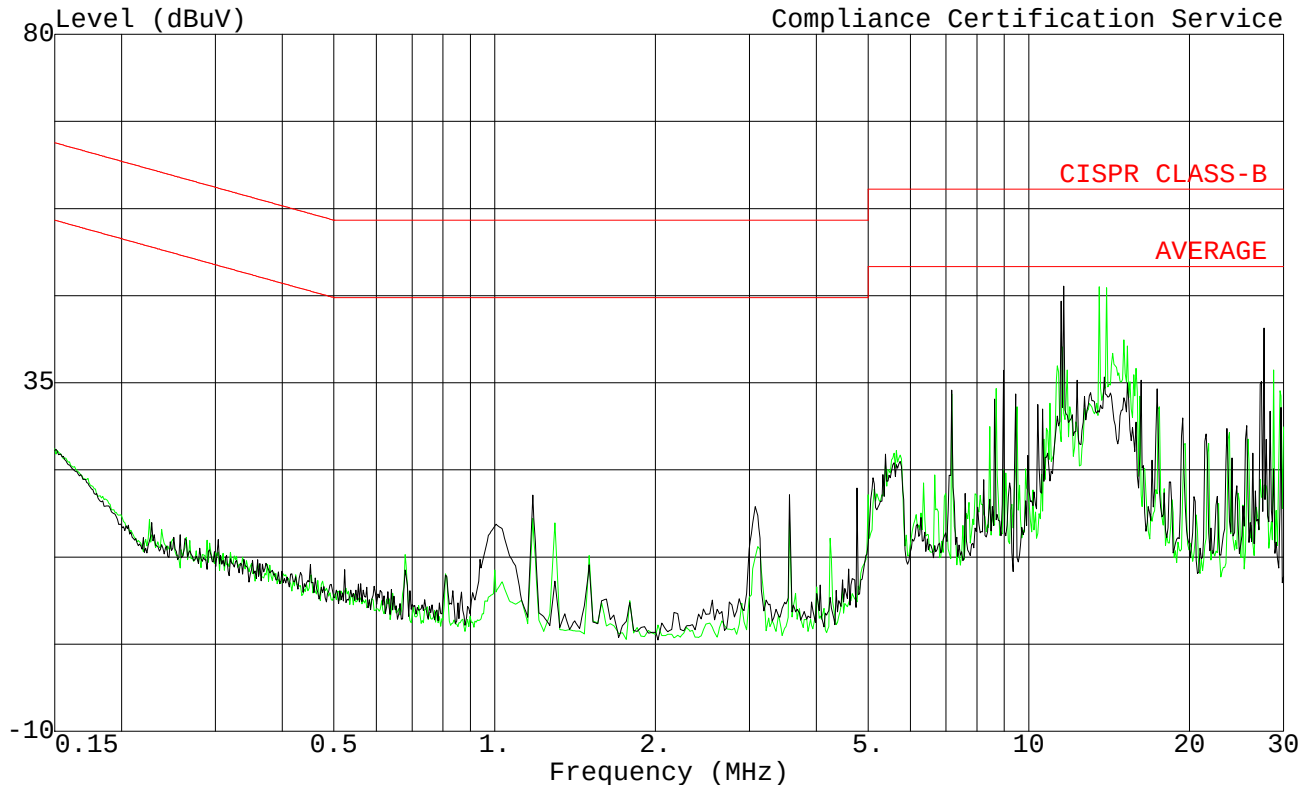
1. The EUT was placed on a wooden table 40 cm from a vertical ground plane and approximately 80 cm above the horizontal ground plane on the floor. The EUT was set to transmit in normally.
2. Line conducted data was recorded for both NEUTRAL and HOT lines.

Test Results

PASS. Refer to data sheets below.

Data#: 7 File#: INVENSYS.EMI

Date: 01-14-2003 Time: 10:10:41
Compliance Certification Service



Trace: 3
Project # :
Test Engineer : Chin Pang
Company : Invensys
EUT : 902-928MHz DTS, electric Meter Radio
Model Name : MXU4E
Test Config. : EUT Only
Test of Target: FCC, Class B
Mode of Op. : Tx
240VAC/60Hz
L1: Peak (Black), L2: Peak (Green)

Ref Trace:

6dB Bandwidth for DTS
Test Requirement: 15.247

Measurement Equipment Used:

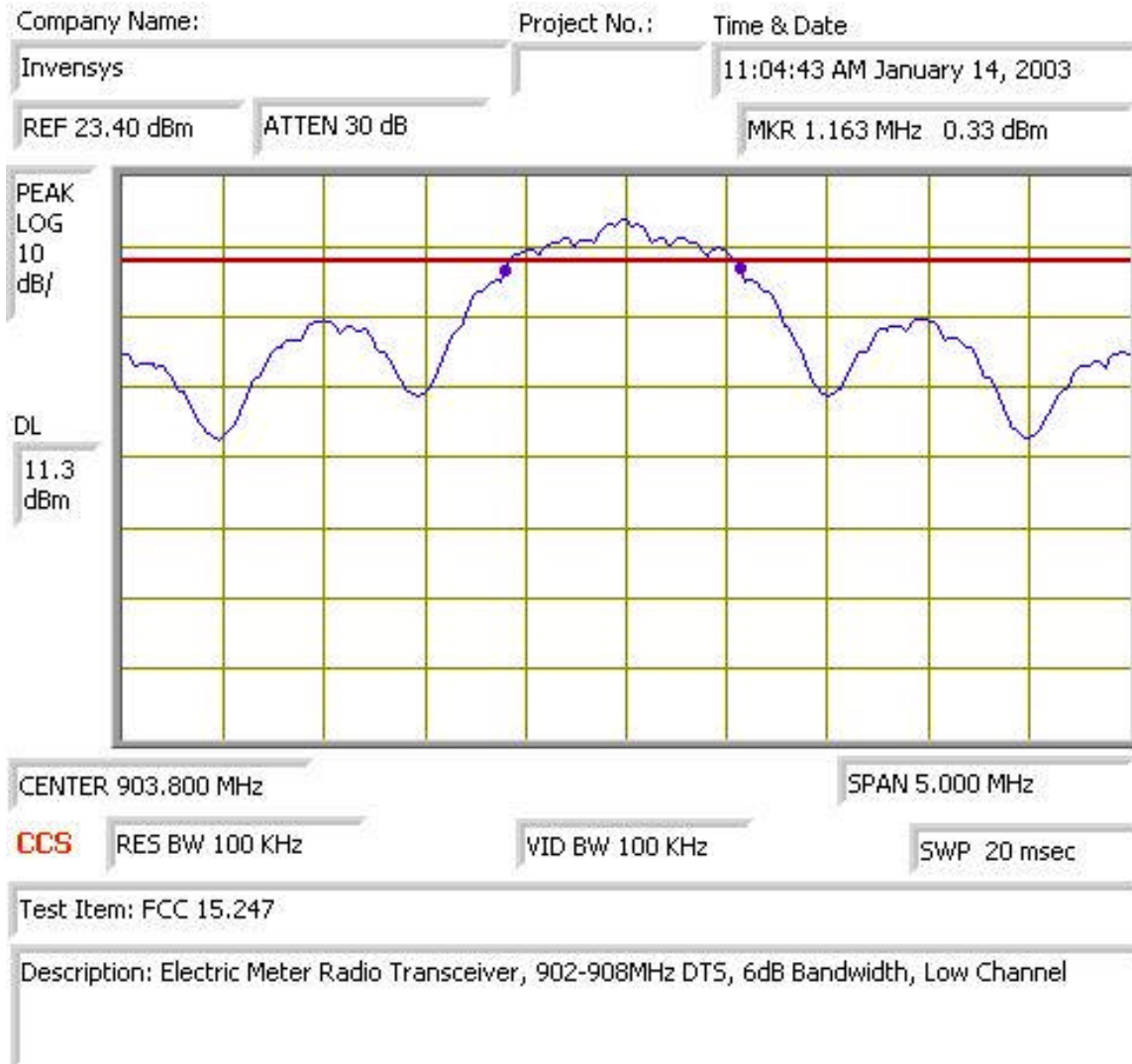
HP 8593EM Spectrum Analyzer
2ft test coaxial cable from antenna connector (test purposes only)

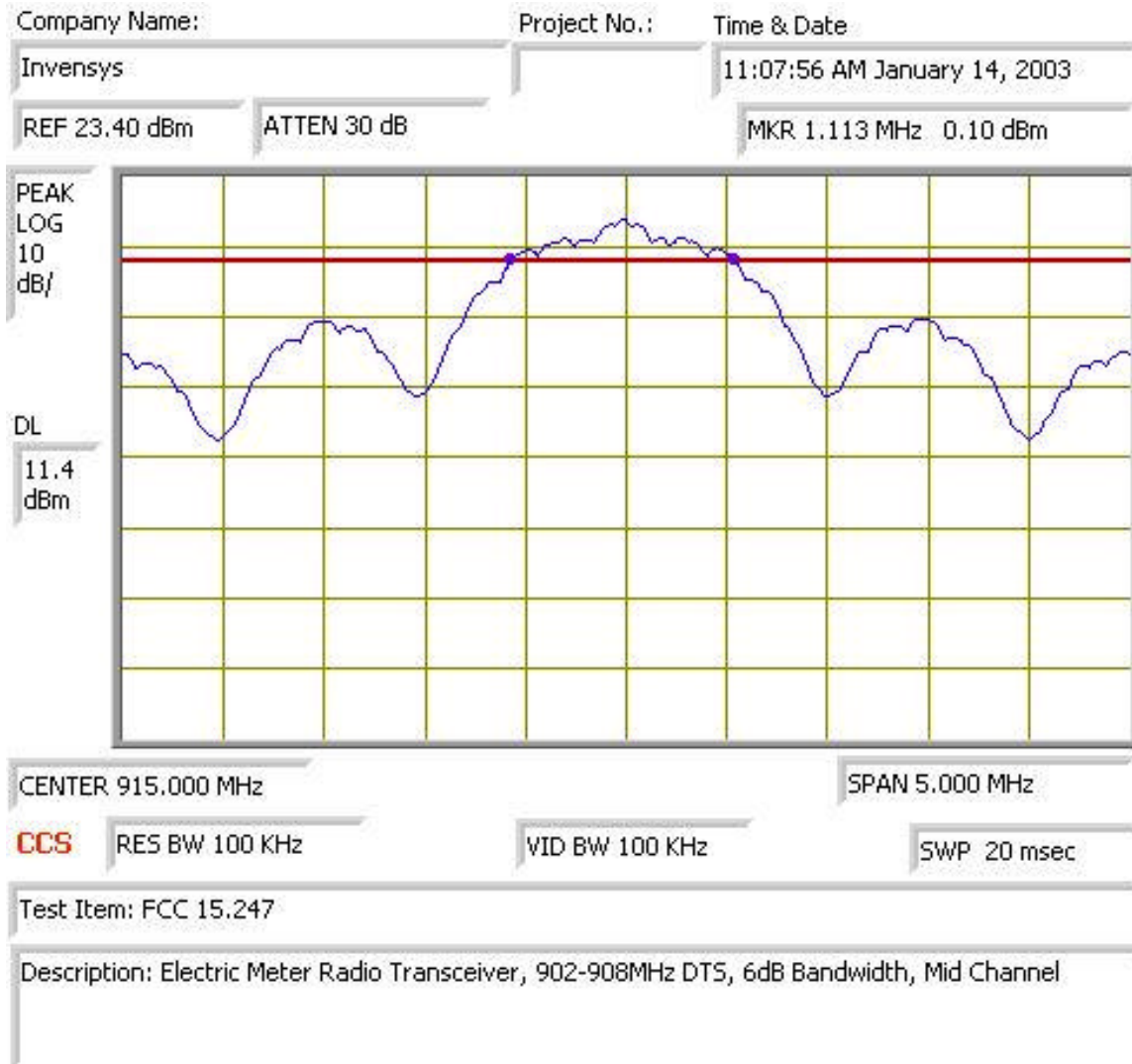
Test Procedures

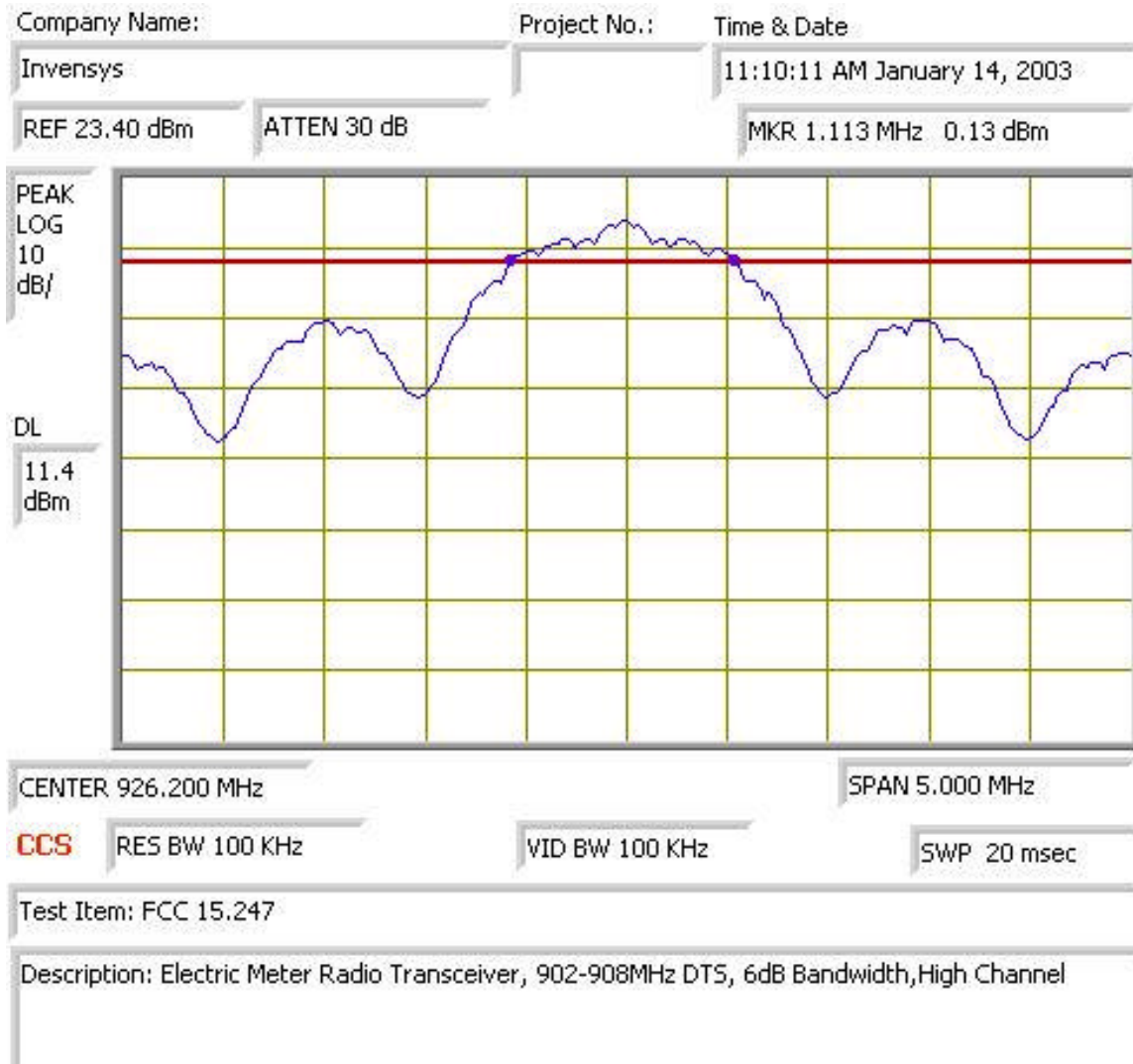
A modified EUT with a coaxial cable attached to the radio antenna port was configured on a test bench. The cable's SMA connector was connected to the spectrum analyzer. The EUT transmission was continuous at 903.8 MHz (LOW channel). While the transmitter broadcast a steady stream of digital data, the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

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

Agilent E4416A power meter
Agilent E9327A RF sensor
20 dB attenuator

Test Procedures

1. The EUT was configured on a test bench. The power meter was zeroed and calibrated. The control software was activated and power was set to produce highest output level.
2. The 20 dB attenuator was connected to the antenna port of the EUT. The power meter head was connected to the other end of the attenuator. Peak power was read directly off the meter, accounting for the 20 dB attenuator.
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	21.5
MID	915	21.5
HIGH	926.2	21.6

**Spurious Emissions, Conducted
Test Requirement: 15.247(c)****Measurement Equipment Used:**

HP 8593EM Spectrum Analyzer
20 dB attenuator
3 ft length low loss A coaxial RF cable

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.

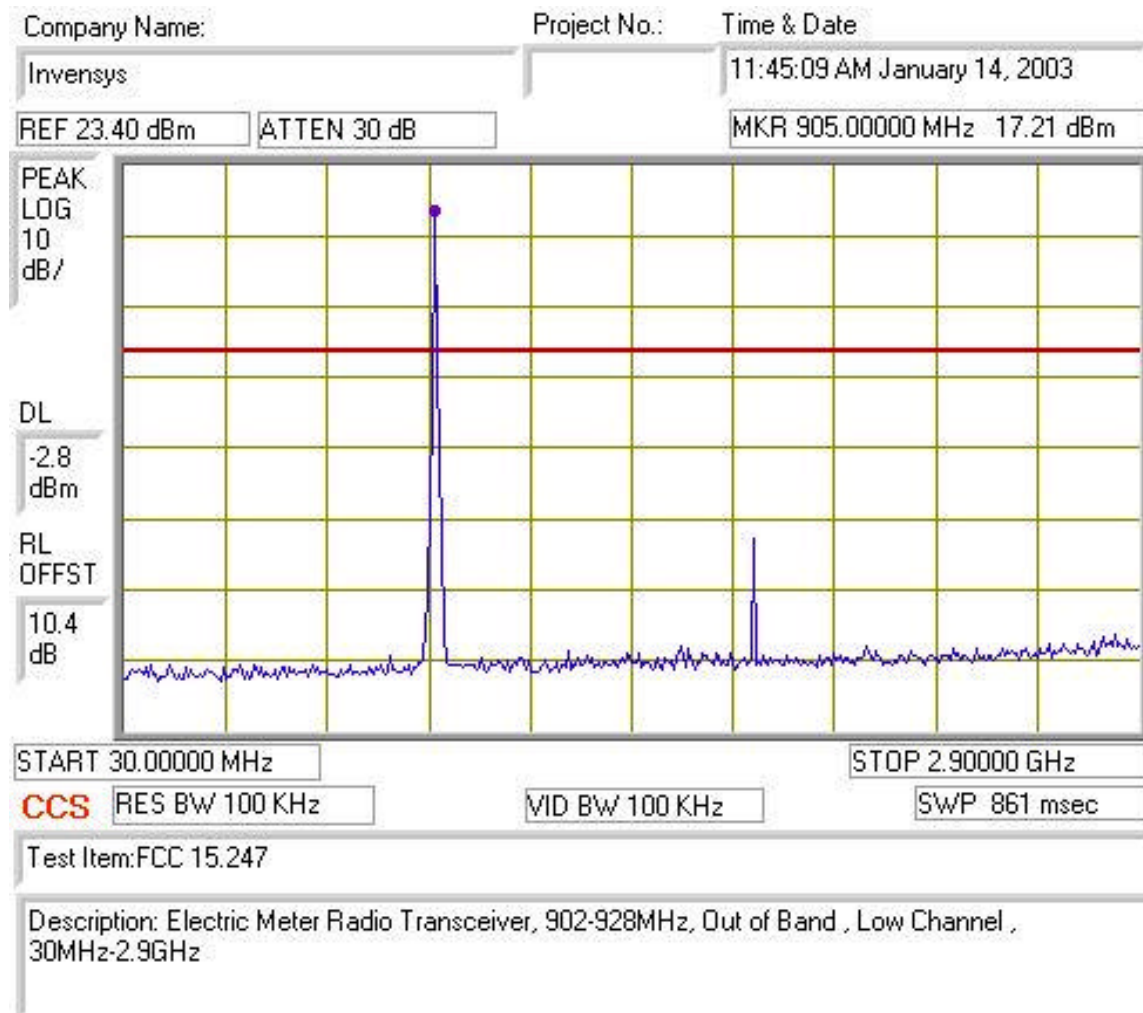
Readings were taken out to 10fo.

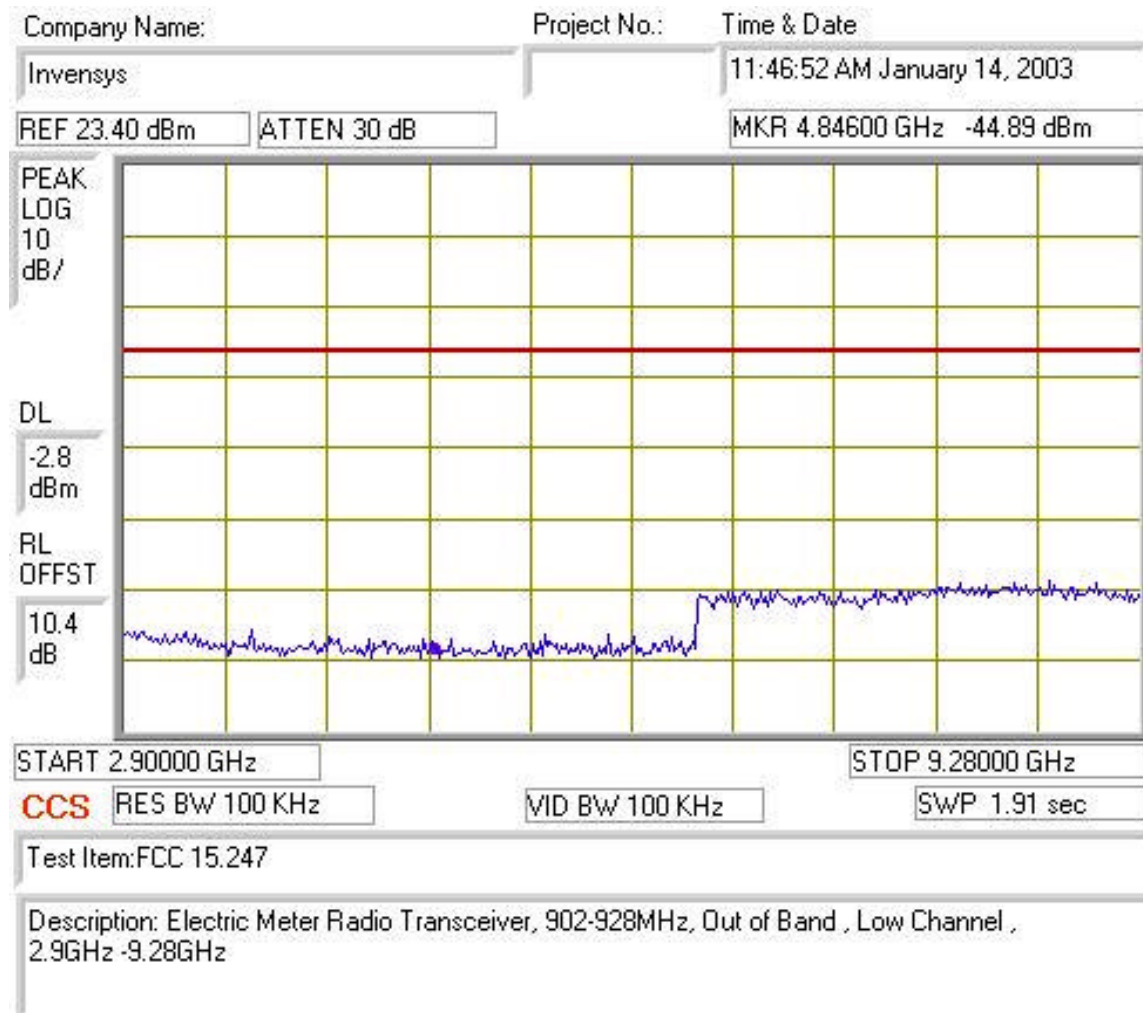
2. The process in (1) was repeated for MID channel and HIGH channel.

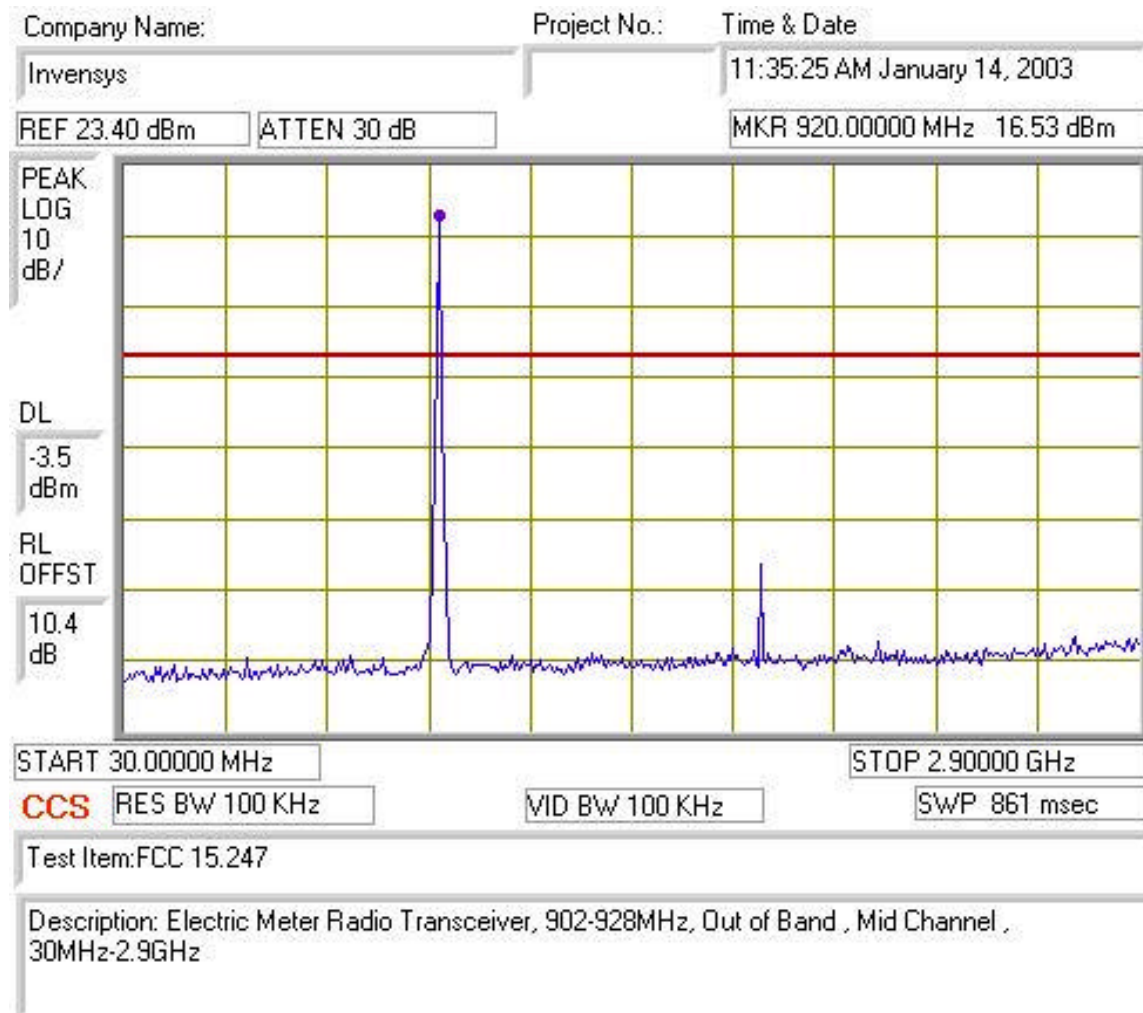
Test Results

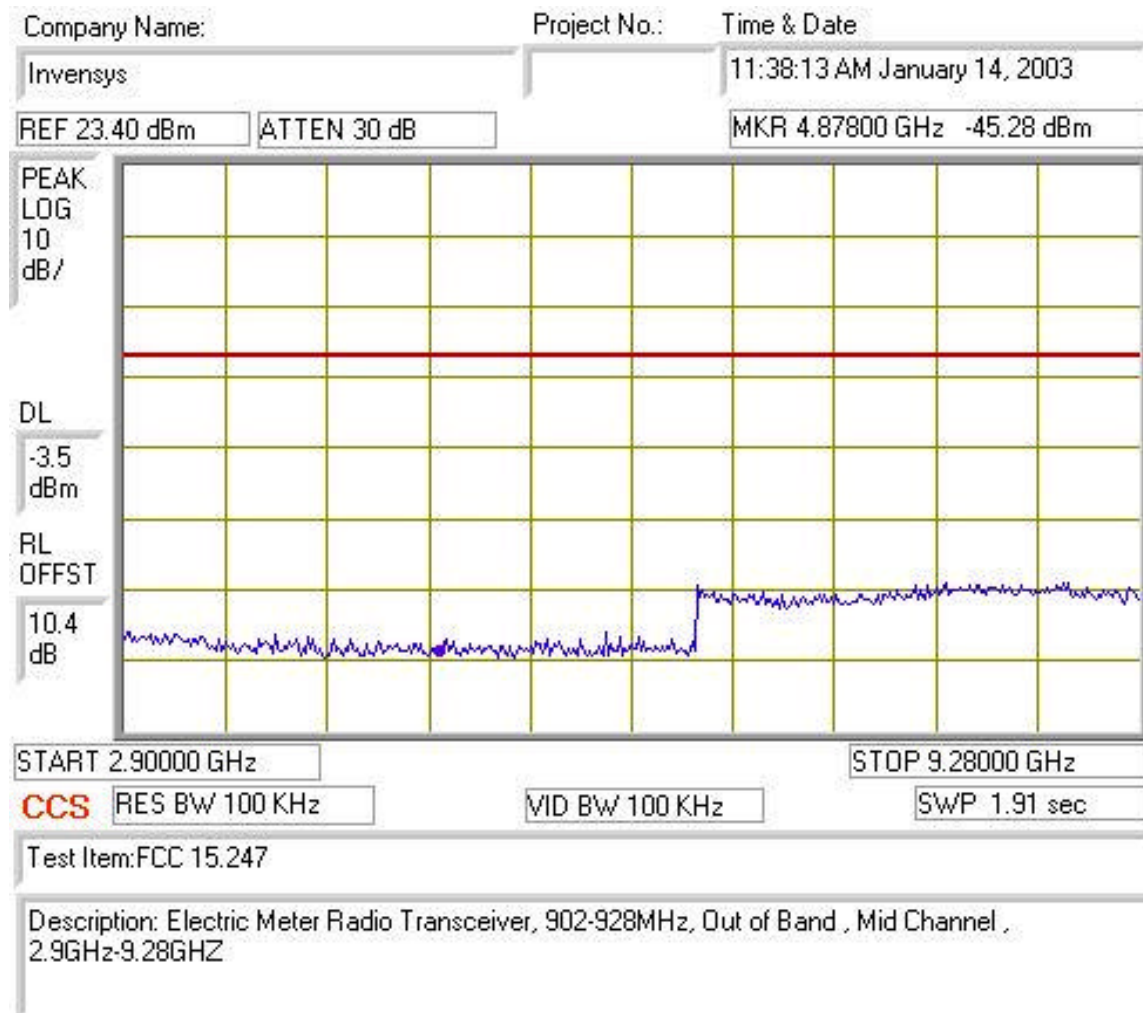
Refer to attached data sheets. Data shows out of band emissions are suppressed well below the -20 dBc minimum required by the Rules.

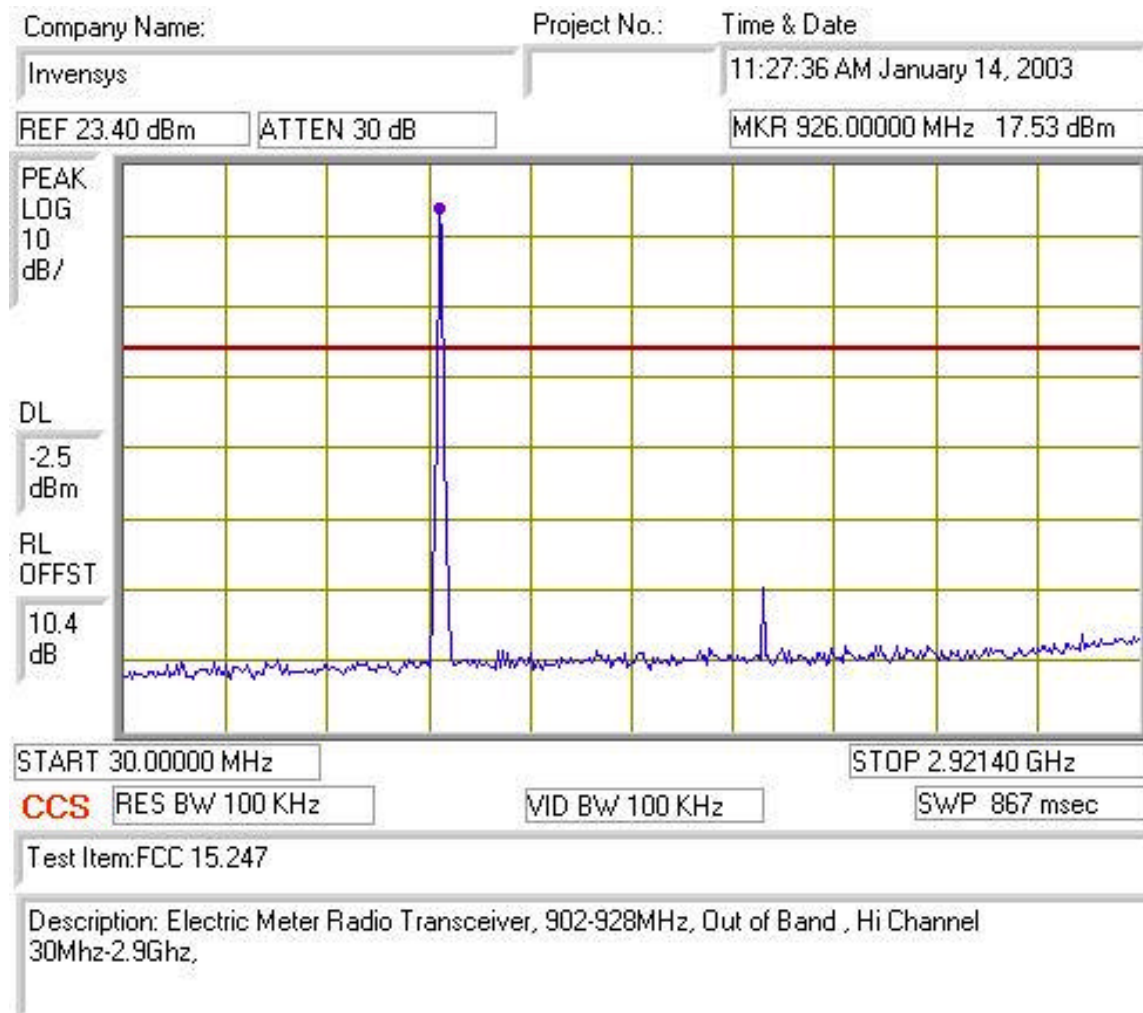
Channel	Frequency, MHz
LOW	903.8
MID	915
HIGH	926.2

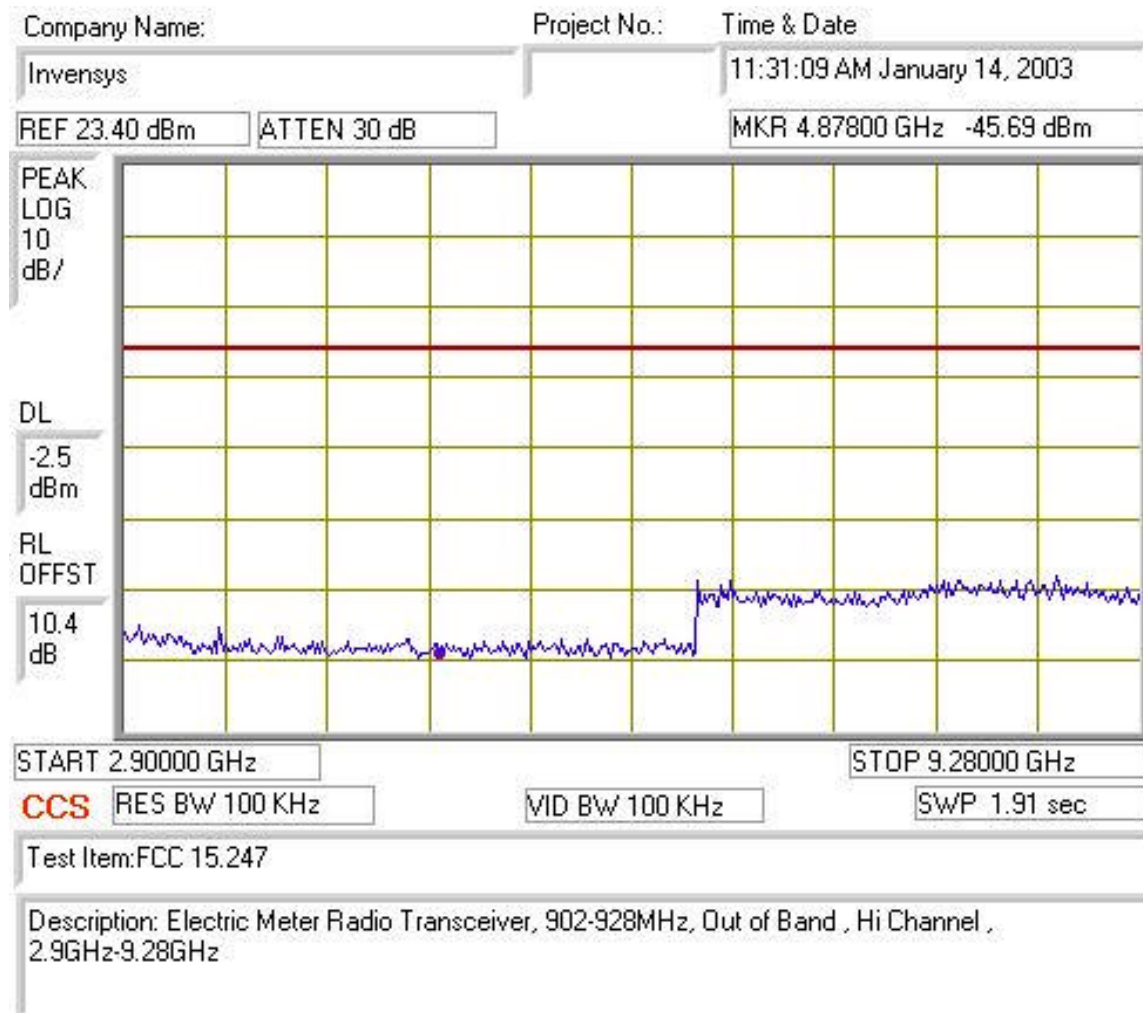
Out of Band Low Channel (1 of 2)

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:**

HP 8593EM Spectrum Analyzer

2 ft length low loss A coaxial RF cable connected on EUT pcb at antenna connection

Test Procedure

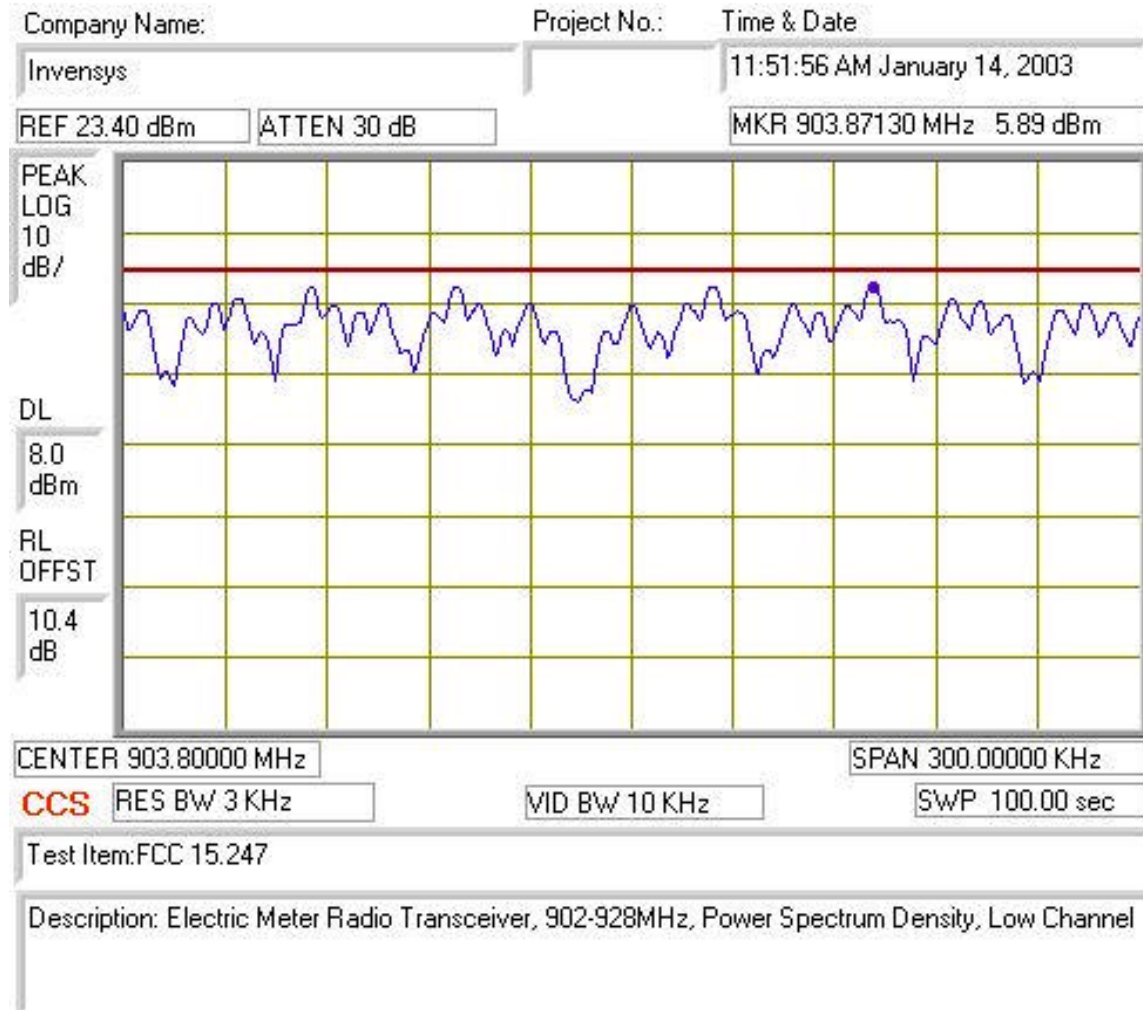
For the LOW channel, the emission peak was set to the center of the display. The SPAN was set to 300 kHz, the RES BW and VID BW were set to 3 kHz, and SWEEP TIME was set to 100 seconds. The maximum trace was recorded and compared to the 8 dBm limit.

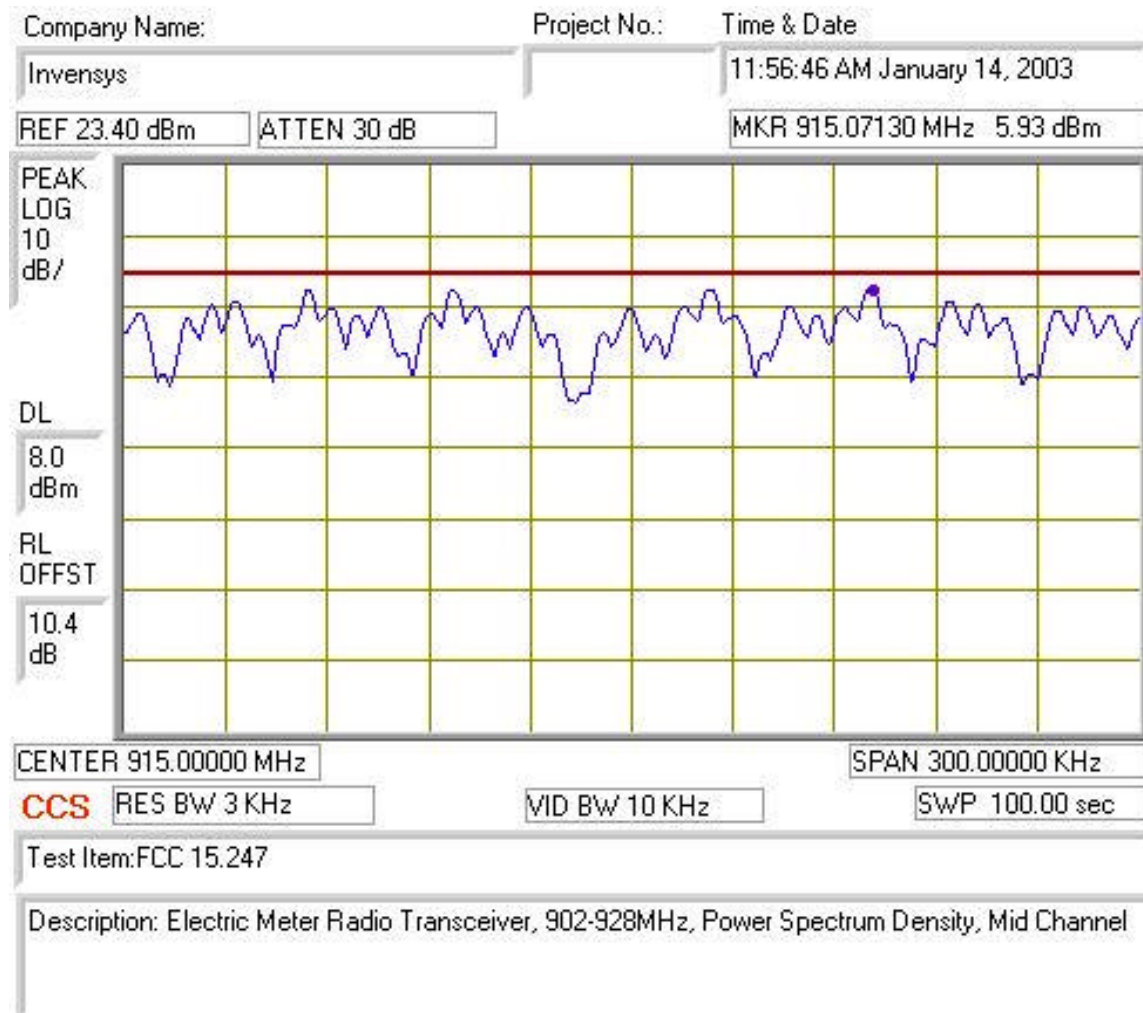
The test was repeated for MID and HIGH channel.

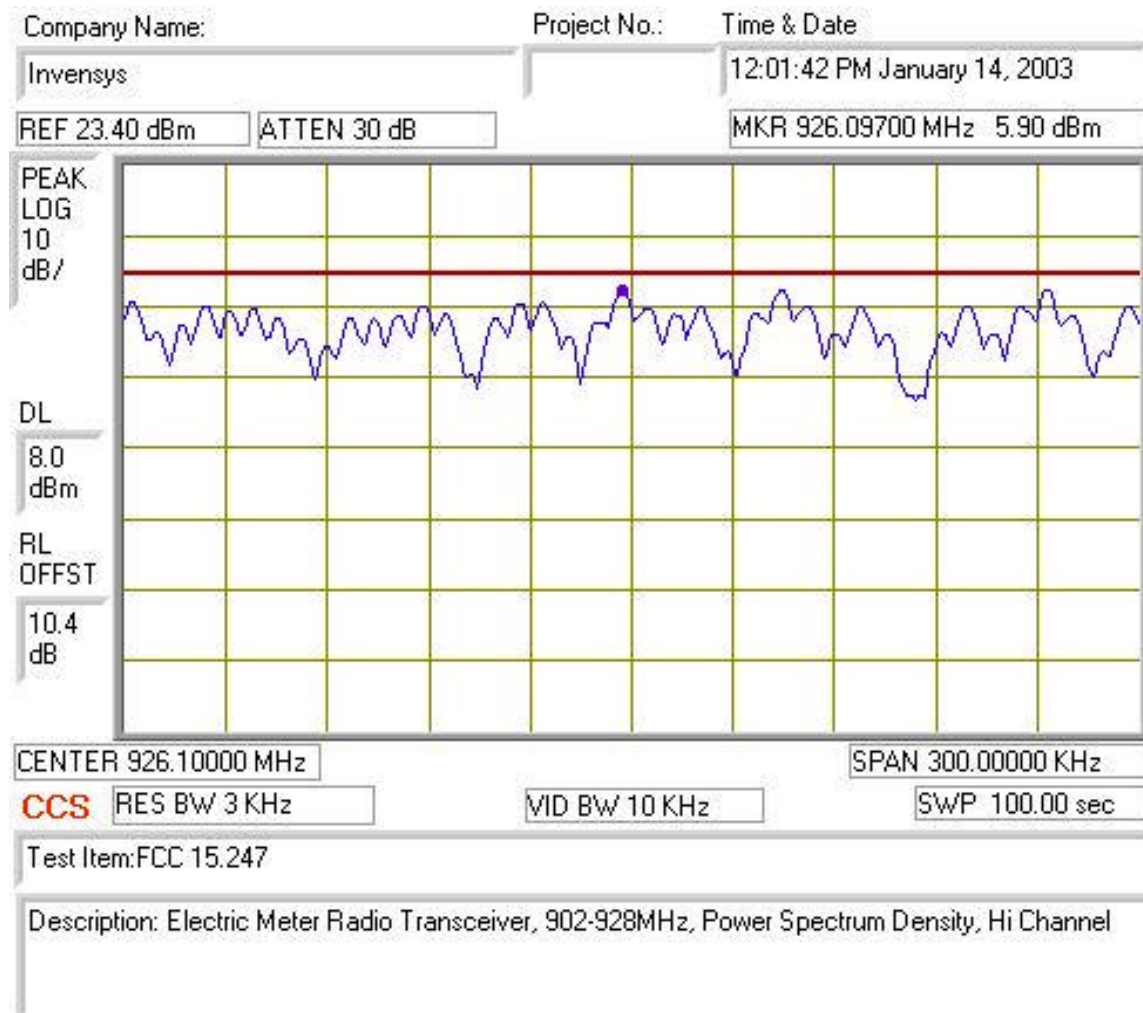
Test Results

Maximum measured PSD was approximately 5.9 dBm. Refer to attached spectrum analyzer charts.

Channel	Frequency, MHz
LOW	903.8
MID	915
HIGH	926.2

Power Spectral Density, LOW Channel

Power Spectral Density, MID Channel

Power Spectral Density, HIGH Channel

RF Exposure (MPE) Calculations

905 - 924.6 MHz DTS Radio

Applicant: **Invensys Metering Systems**

FCC ID: **KCHMXU530E**

RF Hazard Distance Calculation (worst case)

mW/cm2 from Table1: 0.60

Max RF Power P, dBm	TX Antenna G, dBi	MPE Safe Distance, cm
21.6	2.2	5.6

Basis of Calculations:

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

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

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

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