Excellence in Compliance Testing

Certification Test Report

FCC ID: WC6-ETRX
IC: 7749A-ETRX

FCC Rule Part: 15.247
IC Radio Standards Specification: RSS-210

ACS Report Number 08-0221 - 15C

Manufacturer: **Performance Meter, Inc.**
Model(s): **ETRX**

Test Begin Date: June 4, 2008
Test End Date: June 5, 2008

Report Issue Date: August 6, 2008

FOR THE SCOPE OF ACCREDITATION UNDER LAB Code 200612-0

This report is not be used to claim certification, approval, or endorsement by NVLAP, NIST or any government agency.

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This report contains 22 pages

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1.0 GENERAL

1.1 Purpose
The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations and Industry Canada's Radio Standards Specification RSS-210.

1.2 Product Description

1.2.1 General
The ETRX of Performance Meter, Inc was specifically designed for automated meter reading applications. The ETRX wireless link is the stationary device used to collect and store meter and other data. The ETRX transmits that data to separate receiver stations.

Manufacturer Information:
Performance Meter, Inc.
P.O. Box 427
Beaumont, CA 92223-0427

Test Sample Condition:
The test samples were provided in good working order with no visible defects.

Detailed photographs of the EUT are filed separately with this filing.

1.2.2 Intended Use
Automated meter reading.

1.3 Test Methodology and Considerations
The ETRX utilizes an integral antenna therefore a sample with a temporary SMA RF connector was provided for RF conducted measurements.

The ETRX can be used with a plastic or brass meter registers. Both configurations were tested and the worst case data is presented in this report.

2.0 TEST FACILITIES

2.1 Location
The radiated and conducted emissions test sites are located at the following address:

Advanced Compliance Solutions
5015 B.U. Bowman Drive
Buford, GA 30518
Phone: (770) 831-8048
Fax: (770) 831-8598

2.2 Laboratory Accreditations/Recognitions/Certifications
The Semi-Anechoic Chamber Test Site, Open Area Test Site (OATS) and Conducted Emissions Site have been fully described, submitted to, and accepted by the FCC, Industry Canada and the Japanese Voluntary Control Council for Interference by information technology equipment. In addition, ACS is compliant to ISO 17025 as certified by the National Institute of Standards and Technology under their National Voluntary Laboratory Accreditation Program. The following certification numbers have been issued in recognition of these accreditations and certifications:

FCC Registration Number: 894540
Industry Canada Lab Code: IC 4175
VCCI Member Number: 1831
- VCCI OATS Registration Number R-1526
- VCCI Conducted Emissions Site Registration Number: C-1608

NVLAP Lab Code: 200612-0

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The Semi-Anechoic Chamber Test Site consists of a 20' x 30' x 18' shielded enclosure. The chamber is lined with Toyo Ferrite Grid Absorber, model number FFG-1000. The ferrite tile grid is 101 x 101 x 19mm thick and weighs approximately 550 grams. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber.

The turntable is 150cm in diameter and is located 160cm from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is all steel, flush mounted table installed in an all steel frame. The table is remotely operated from inside the control room located 25' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Behind the turntable is a 3' x 6' x 4' deep shielded pit used for support equipment if necessary. The pit is equipped with 1 - 4" PVC chases from the turntable to the pit that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit.

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3-1 below:

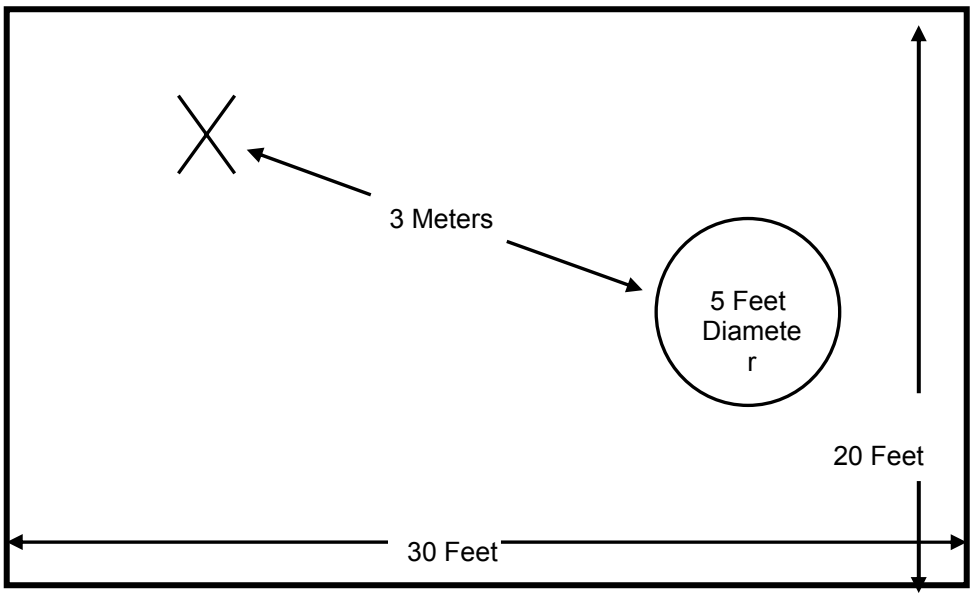


Figure 2.3-1: Semi-Anechoic Chamber Test Site

2.3.2 Open Area Tests Site (OATS)

The open area test site consists of a 40' x 66' concrete pad covered with a perforated electro-plated galvanized sheet metal. The perforations in the sheet metal are 1/8" holes that are staggered every 3/16". The individual sheets are placed to overlap each other by 1/4" and are riveted together to provide a continuous seam. Rivets are spaced every 3" in a 3 x 20 meter perimeter around the antenna mast and EUT area. Rivets in the remaining area are spaced as necessary to properly secure the ground plane and maintain the electrical continuity.

The entire ground plane extends 12' beyond the turntable edge and 16' beyond the antenna mast when set to a 10 meter measurement distance. The ground plane is grounded via 4 - 8' copper ground rods, each installed at a corner of the ground plane and bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is an all aluminum 10' flush mounted table installed in an all aluminum frame. The table is remotely operated from inside the control room located 40' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Adjacent to the turntable is a 7' x 7' square and 4' deep concrete pit used for support equipment if necessary. The pit is equipped with 5 - 4" PVC chases from the pit to the control room that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit. The pit is covered with 2 sheets of 1/4" diamond style re-enforced steel sheets. The sheets are painted to match the perforated steel ground plane; however the underside edges have been masked off to maintain the electrical continuity of the ground plane. All reflecting objects are located outside of the ellipse defined in ANSI C63.4.

A diagram of the Open Area Test Site is shown in Figure 2.3-2 below:

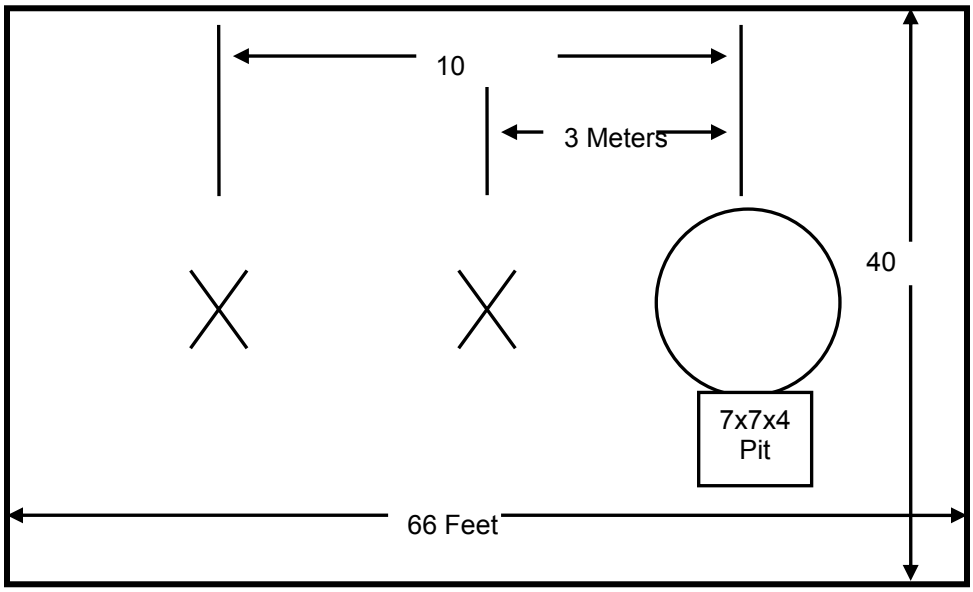


Figure 2.3-2: Open Area Test Site

2.4 Conducted Emissions Test Site Description

The AC mains conducted EMI site is located in the main EMC lab. It consists of an 8' x 8' solid aluminum horizontal group reference plane (GRP) bonded every 3" to an 8' X 8' vertical ground plane.

The site is of sufficient size to test table top and floor standing equipment in accordance with section 6.1.4 of ANSI C63.4.

A diagram of the room is shown below in figure 4.1.3-1:

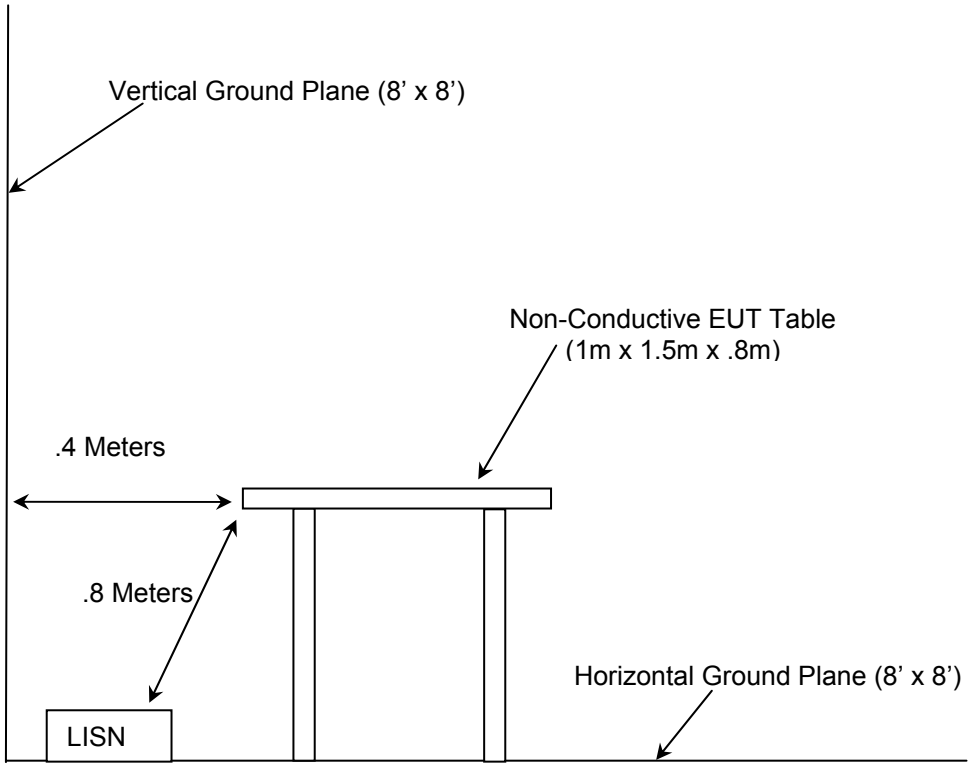


Figure 2.4-1: AC Mains Conducted EMI Site

3.0 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.4-2003: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9KHz to 40GHz
- US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2008
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2008
- FCC OET Bulletin 65 Appendix C - Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields, 2001
- FCC Public Notice DA 00-705 - Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems, March 30, 2000
- Industry Canada Radio Standards Specification: RSS-210 - Low-power License-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment, Issue 7 June 2007

4.0 LIST OF TEST EQUIPMENT

All test equipment used for regulatory testing is calibrated yearly or according to manufacturer's specifications.

Table 4-1: Test Equipment

Equipment Calibration Information					
ACS#	**Mfg.**	**Eq. type**	**Model**	**S/N**	**Cal. Due**
1	Rohde & Schwarz	Spectrum Analyzers	ESMI - Display	833771/007	10-26-2008
2	Rohde & Schwarz	Spectrum Analyzers	ESMI-Receiver	839587/003	10-26-2008
22	Agilent	Amplifiers	8449B	3008A00526	10-25-2008
25	Chase	Antennas	CBL6111	1043	06-06-2008
30	Spectrum Technologies	Antennas	DRH-0118	970102	05-07-2009
73	Agilent	Amplifiers	8447D	2727A05624	12-19-2008
167	ACS	Cable Set	Chamber EMI Cable Set	167	01-04-2009
283	Rohde & Schwarz	Spectrum Analyzers	FSP40	1000033	11-09-2008
291	Florida RF Cables	Cables	SMRE-200W-12.0-SMRE	None	11-21-2008
292	Florida RF Cables	Cables	SMR-290AW-480.0-SMR	None	11-21-2008
331	Microwave Circuits	Filters	H1G513G1	31417	08-27-2008
422	Florida RF	Cables	SMS-200AW-72.0-SMR	805	02-25-2009

5.0 SUPPORT EQUIPMENT

Table 5-3: Support Equipment

Manufacturer	Equipment Type	Model Number	Serial Number	FCC ID
EUT Was Stand-Alone and Self Supporting				

6.0 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

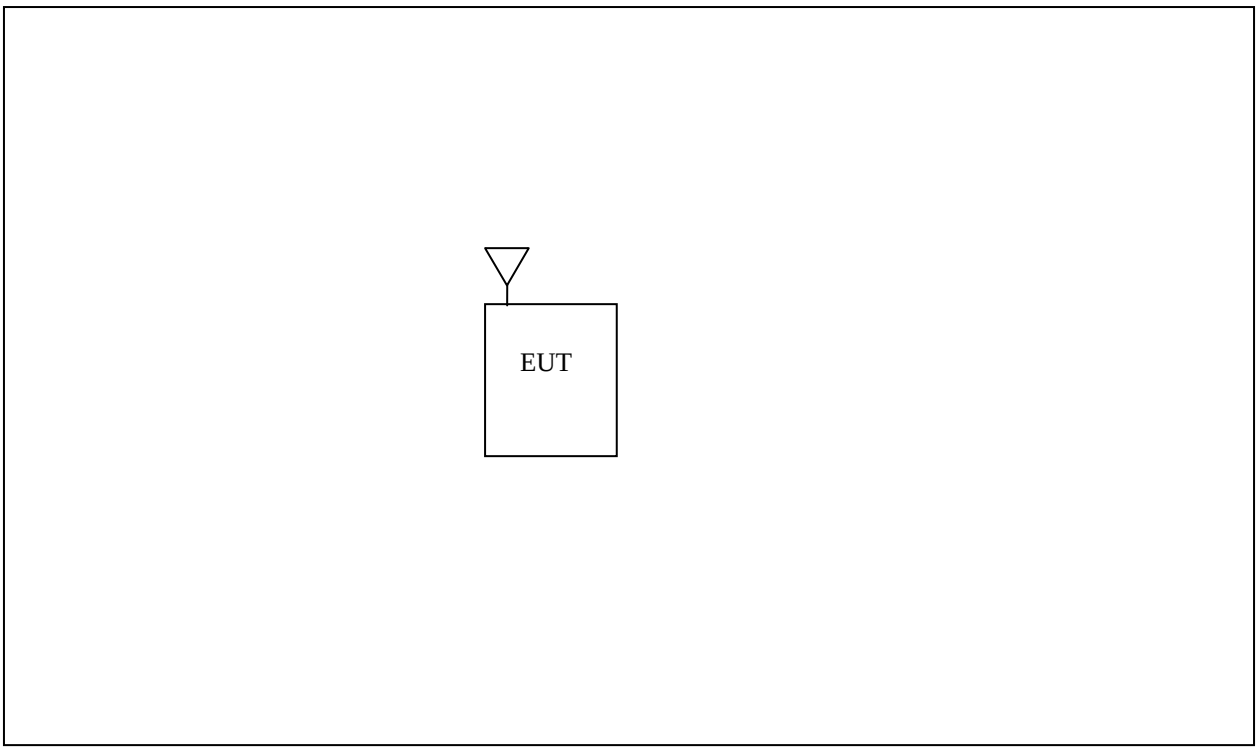


Figure 6-1: EUT Test Setup

*See Test Setup photographs for additional detail.

7.0 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

7.1 Antenna Requirement

The EUT employs a permanently attached board mounted helical 4dBi gain antenna which can not be modified.

7.2 Power Line Conducted Emissions

The EUT is powered by an internal battery and is therefore not designed to be connected to the public utility (AC) power line. No Power line conducted emissions testing was performed

7.3 Radiated Emissions - Unintentional Radiation

7.3.1 Test Methodology

Radiated emissions tests were performed over the frequency range of 30MHz to 5GHz. Measurements of the radiated field strength were made at a distance of 3m from the boundary of the equipment under test (EUT) and the receiving antenna. The antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. For frequencies below 1000 MHz a Quasi-peak detector was enabled and measurements were taken with the Spectrum Analyzer's resolution bandwidth set to 120 KHz. For frequencies above 1000MHz, measurements were made using an average detector and peak detector with RBW of 1 MHz.

7.3.2 Test Results

Results of the test are given in Table 7.3-1 below:

Table 7.3-1: Radiated Emissions Tabulated Data

Frequency MHz	Level dBµV/m	Limit dBµV/m	Margin dB	Height cm	Azimuth deg	Polarization (H/V)
30.013	14.55	40.0	25.45	100	93	H
97.101	10.76	43.5	32.74	100	0	V
125.922	8.48	43.5	35.02	100	274	V
478.359	16.16	46.0	29.84	400	180	H
694.996	20.38	46.0	25.62	400	91	V
928.866	23.97	46.0	22.03	100	271	V

* Note: All emissions above 928.866 MHz were attenuated below the permissible limit.

7.4 Peak Output Power

7.4.1 Test Methodology (Conducted Method)

The 20dB bandwidth of the EUT was within the resolution bandwidth of spectrum analyzer, therefore the power measurement was made using the spectrum analyzer method. The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The resolution and video bandwidth were set to > 20 dB bandwidth of the emission measured. The device employs >50 channels therefore the power is limited to 1 Watt.

7.4.2 Test Results

Results are shown below in table 7.4-1 and the worst case was plotted and shown in figure 7.4-1 to 7.4-3 below:

Table 7.4-1: RF Output Power

Frequency [MHz]	Level [dBm]
902.1	8.32
915.0	7.77
927.9	7.07

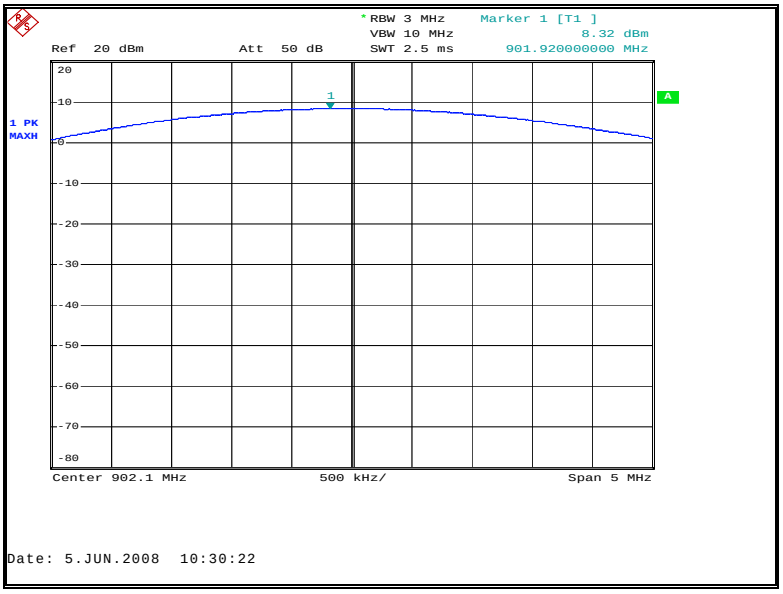


Figure 7.4-1: Output power – Low Channel

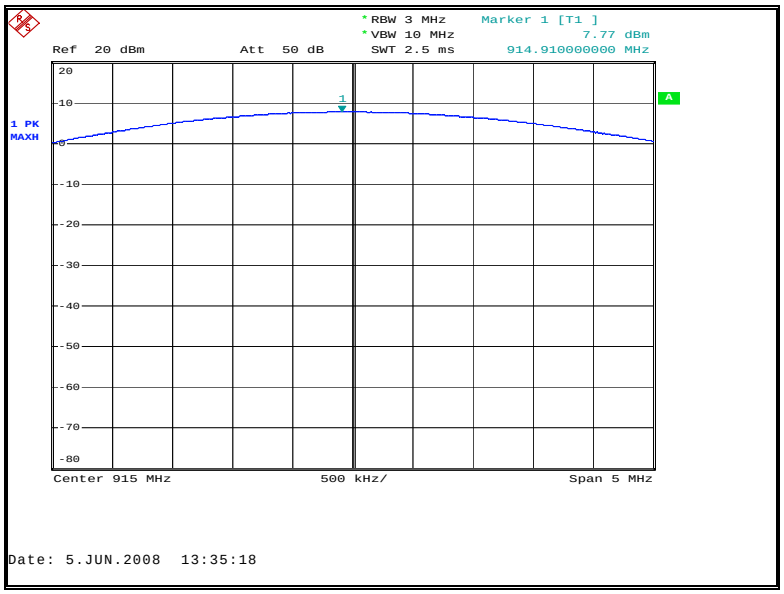


Figure 7.4-2: Output power – Mid Channel

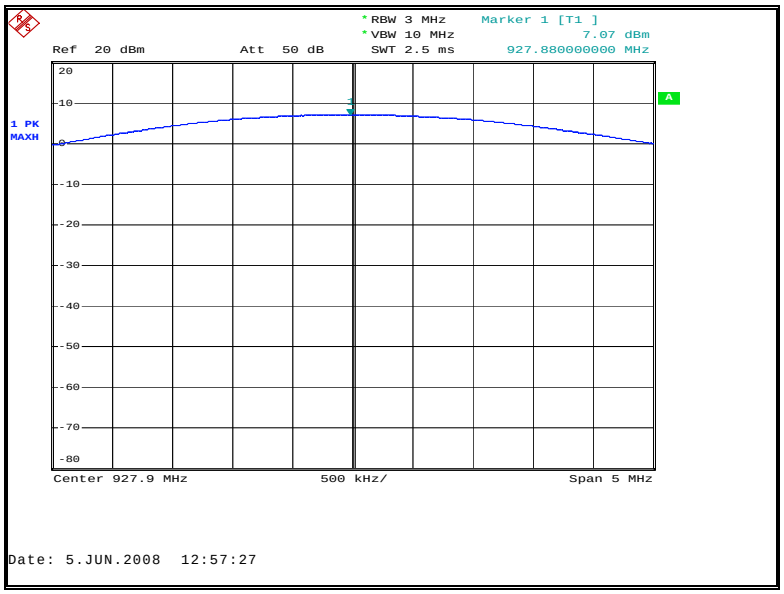


Figure 7.4-3: Output power – High Channel

7.5 Channel Usage Requirements

7.5.1 Carrier Frequency Separation

7.5.1.1 Test Methodology

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The span of the spectrum analyzer was set wide enough to capture two adjacent peaks and the RBW and VBW were set to ≥ 1% of the span.

7.5.1.2 Test Results

The maximum 20dB bandwidth of the hopping channel was measured to be 66.60kHz (See figure 7.5.4-1 to 7.5.4-3 below). The adjacent channel separation was measured to be 100.00kHz. Results are shown in figure 7.5.1-1 below:

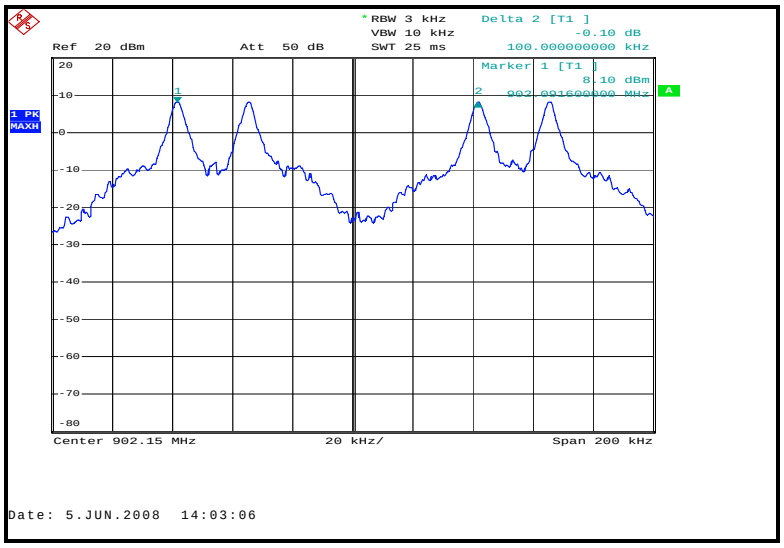
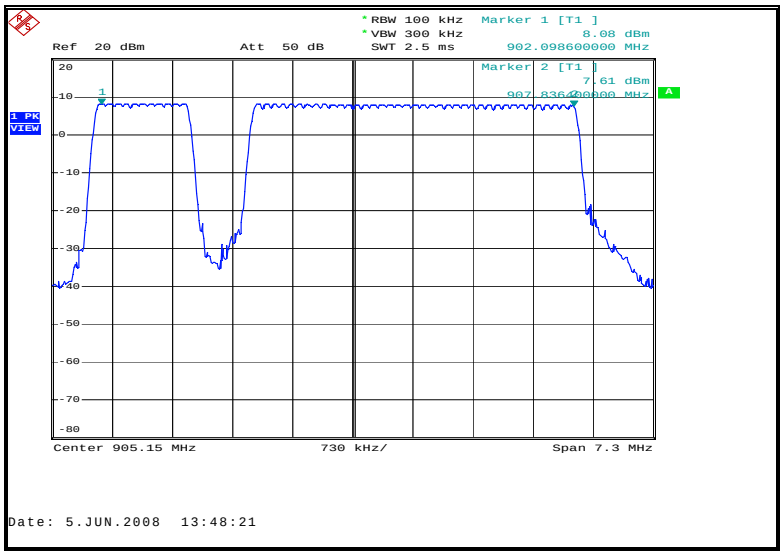


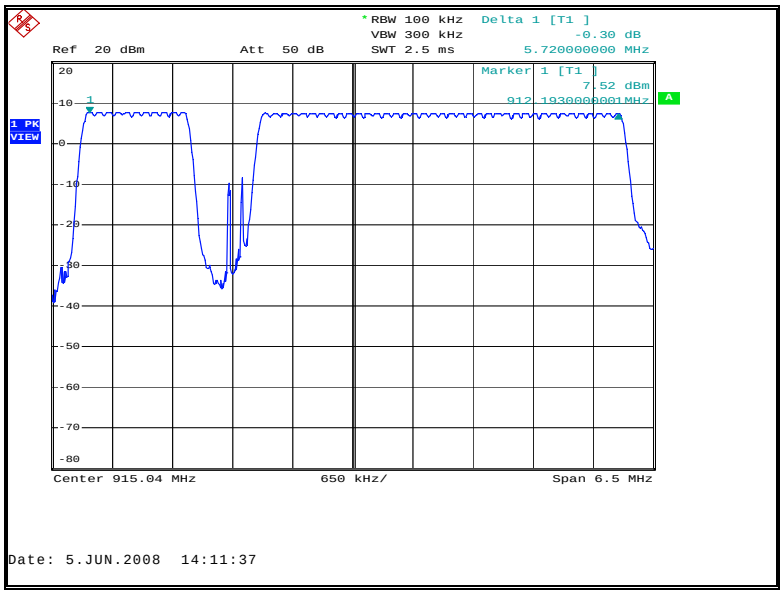
Figure 7.5.1-1: Carrier Frequency Separation

7.5.2 Number of Hopping Channels

The 20dB bandwidth of the device is less than 250 kHz. The device employs 50 hopping channels as required. The ETRX can be used at 3 different ranges in the 902 to 928MHz band. Results are shown in Figures 7.5.2-1 to 7.5.2-3 below:



7.5.2-1: Number of Hopping Channels
(902.1 to 907.84MHz)



7.5.2-2: Number of Hopping Channels
(912.19 to 917.91MHz)

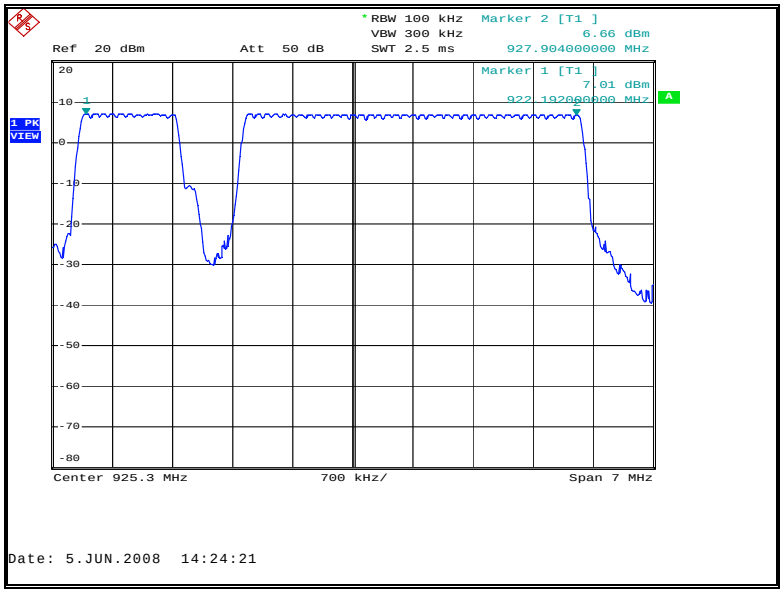


Figure 7.5.2-3: Number of Hopping Channels
(922.19 to 927.9MHz)

7.5.3 Channel Dwell Time

The EUT test mode did not provide a mode for proper measurement of the channel dwell time. Instead an engineering analysis is provided in the Theory of Operation included with this filing. The engineering analysis worst case channel dwell time was calculated to be 49.6ms.

7.5.4 20dB & 99% Occupied Bandwidth

7.5.4.1 Test Methodology

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The spectrum analyzer span was set to 2 to 3 times the estimated 20 dB bandwidth of the emission. The RBW was to ≥ 1% of the estimated 20 dB bandwidth. The trace was set to max hold with a peak detector active. The Delta function of the analyzer was utilized to determine the 20 dB bandwidth of the emission. The span and RBW were examined and re-adjusted if necessary to meet the requirements of 2 to 3 times the 20 bandwidth for the span and ≥ 1% of the 20 dB bandwidth for the RBW.

7.5.4.2 Test Results

The maximum 20dB bandwidth was found to be approximately 66.6kHz. Results are shown below in Table 7.5.4-1 and Figures 7.5.4-1 through 7.5.4-6.

Table 7.5.4-1

Frequency (MHz)	20dB Bandwidth (kHz)	99% Occupied Bandwidth (kHz)
902.1	66.6	68.4
915.0	64.2	62.1
927.9	63.6	59.4

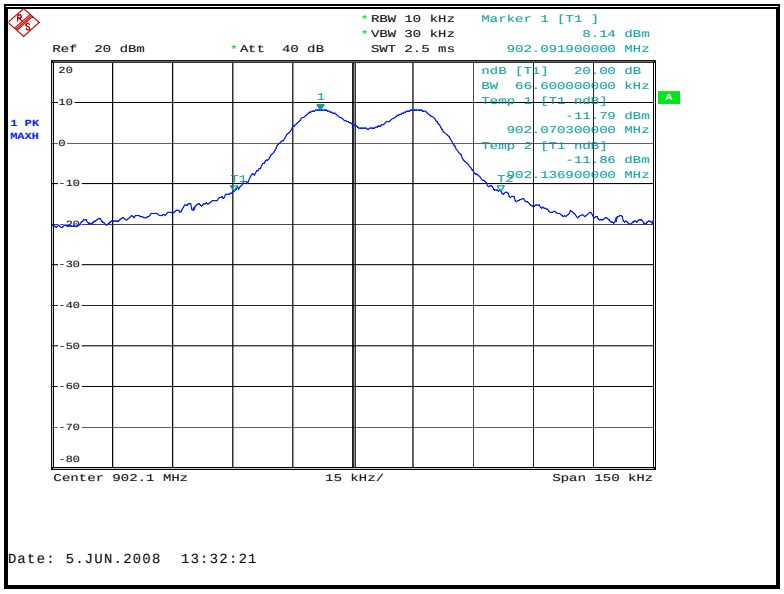


Figure 7.5.4-1: 20dB Bandwidth Low Channel

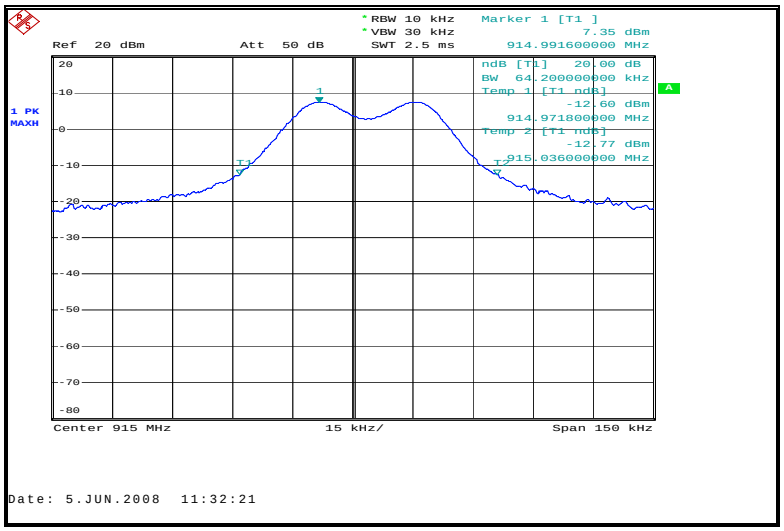


Figure 7.5.4-2: 20dB Bandwidth Mid Channel

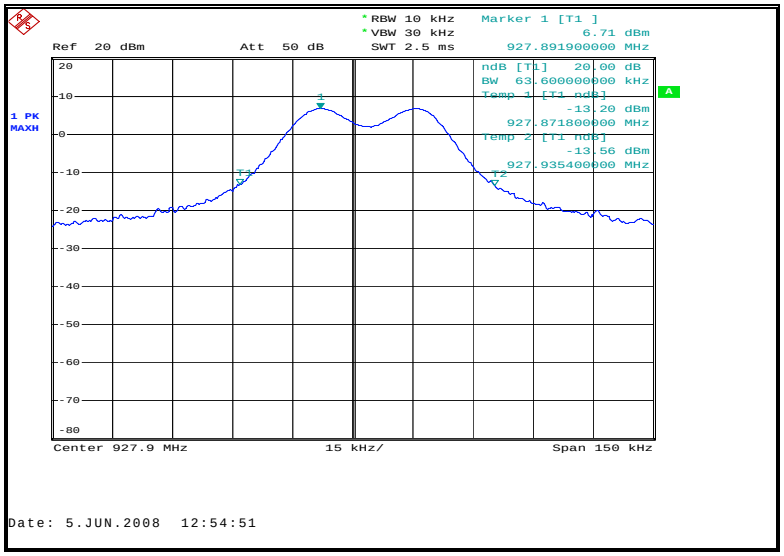


Figure 7.5.4-3: 20dB Bandwidth High Channel

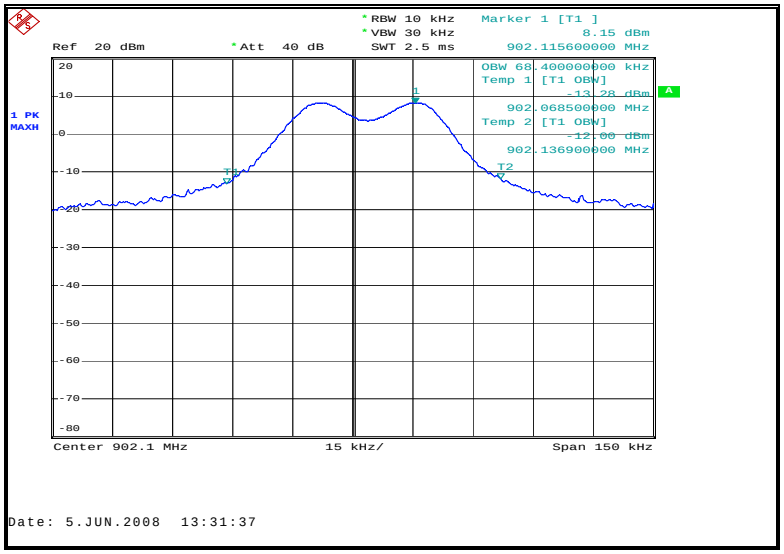


Figure 7.5.4-4: 99% Occupied Bandwidth Low Channel

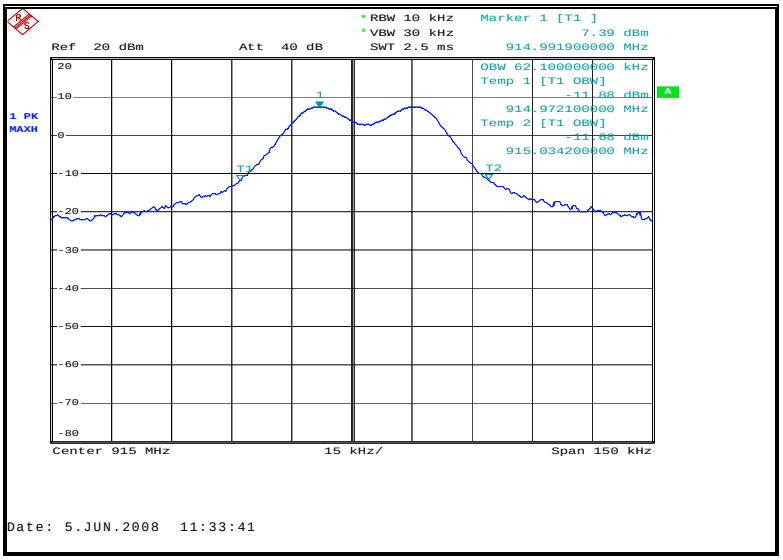


Figure 7.5.4-5: 99% Occupied Bandwidth Mid Channel

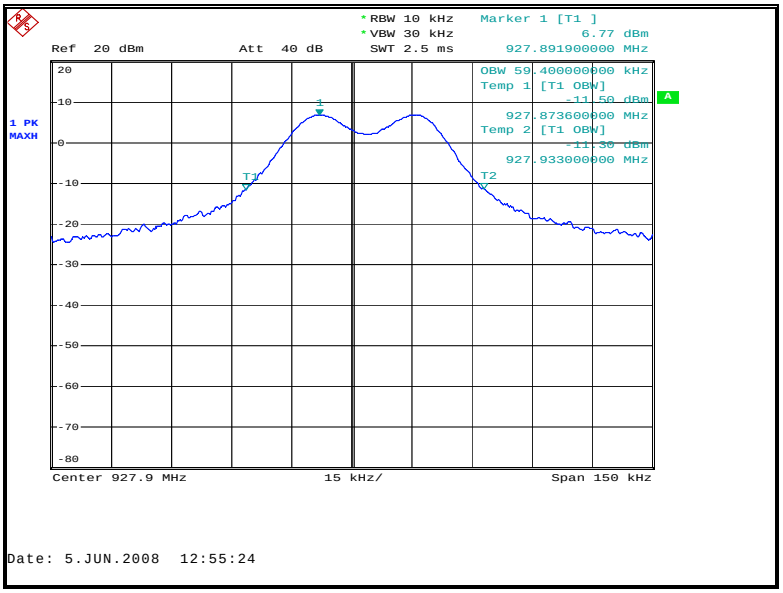


Figure 7.5.4-6: 99% Occupied Bandwidth High Channel

7.6 Band-Edge Compliance and Spurious Emissions

7.6.1 Band-Edge Compliance of RF Conducted Emissions

7.6.1.1 Test Methodology

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The EUT was investigated at the lowest and highest channel available to determine band-edge compliance. For each measurement the spectrum analyzer's RBW was set to 30 kHz, which is ≥ 1% of the span, and the VBW was set to 100kHz.

In a 100 kHz bandwidth at the lower and upper band-edge, the radio frequency power that was produced by the EUT is at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of desired power.

7.6.1.2 Test Results

Band-edge compliance is displayed in Figures 7.6.1-1 through 7.6.2-4

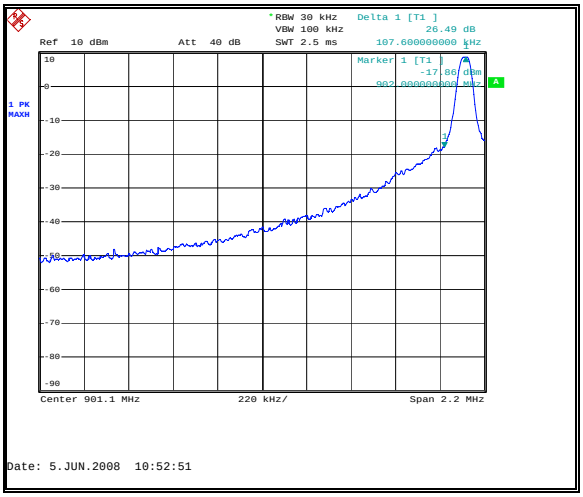


Figure 7.6.1-1: Lower Band-edge

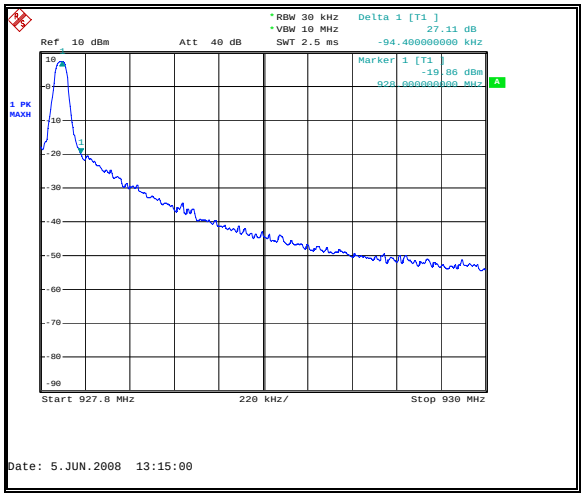


Figure 7.6.1-2: Upper Band-edge

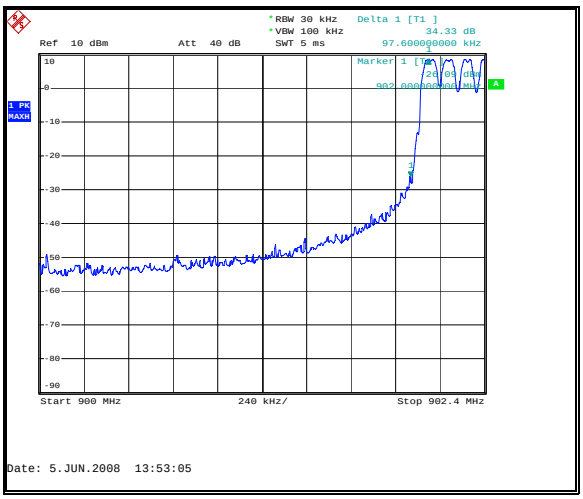


Figure 7.6.1-3: Lower Band-edge

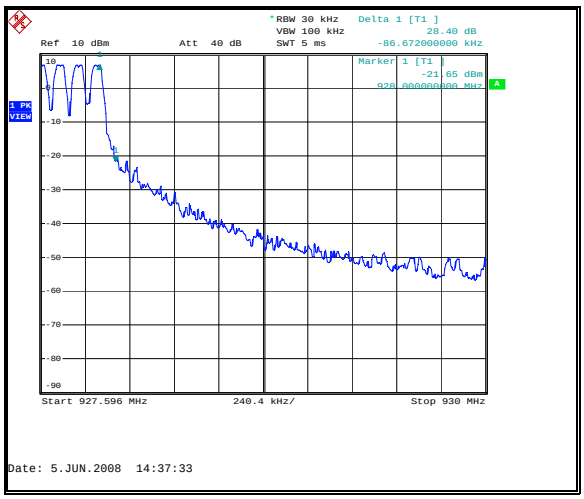


Figure 7.6.1-4: Upper Band-edge

7.6.2 RF Conducted Spurious Emissions

7.6.2.1 Test Methodology

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The EUT was investigated for conducted spurious emissions from 30MHz to 10GHz, 10 times the highest fundamental frequency. Measurements were made at the low, center and high channels of the EUT. For each measurement, the spectrum analyzer's RBW was set to 100kHz. A peak detector function was used with the trace set to max hold.

7.6.2.1 Test Results

All emission found were greater than 20dB down from the fundamental carrier. Results are shown below in Figure 7.6.2-1 through 7.6.2-6.

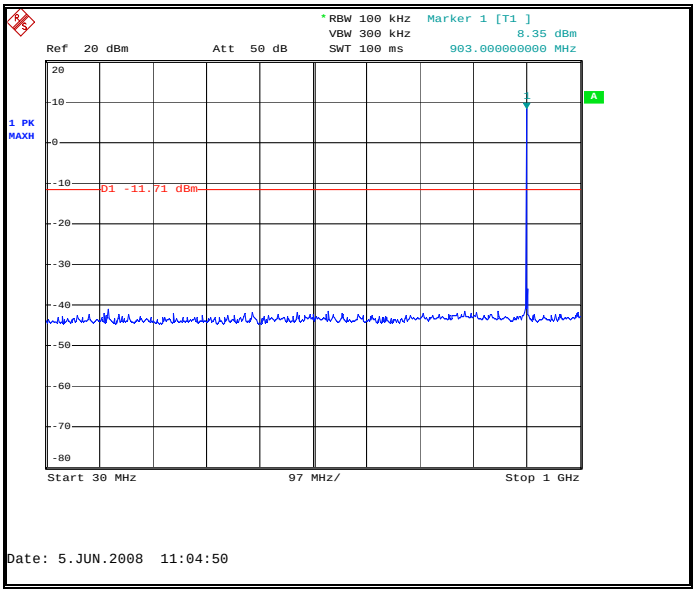


Figure 7.6.2-1 RF Conducted Spurious Emissions – Low Channel

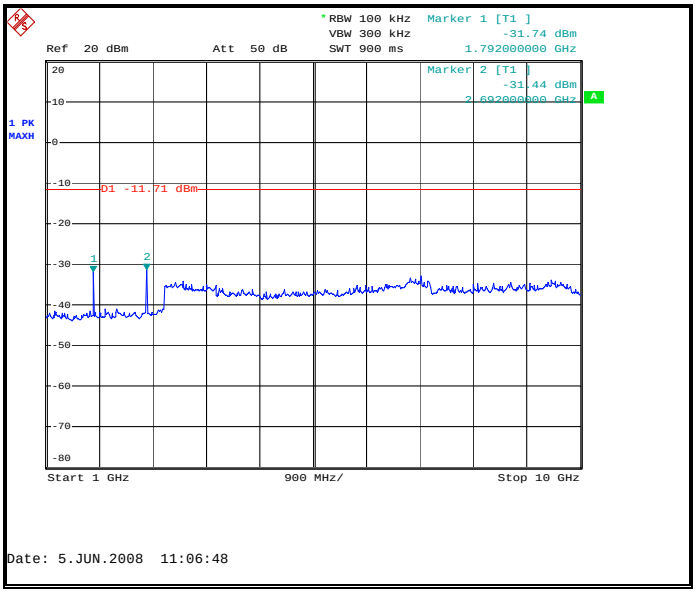


Figure 7.6.2-2 RF Conducted Spurious Emissions – Low Channel

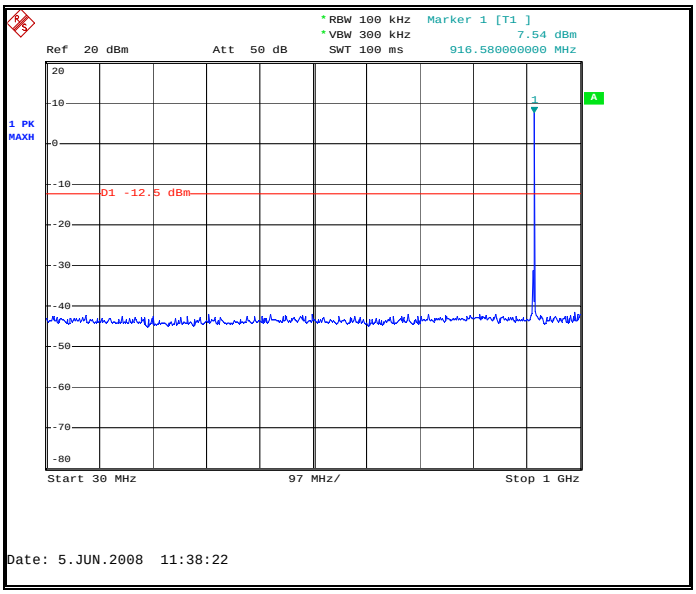


Figure 7.6.2-3 RF Conducted Spurious Emissions – Mid Channel

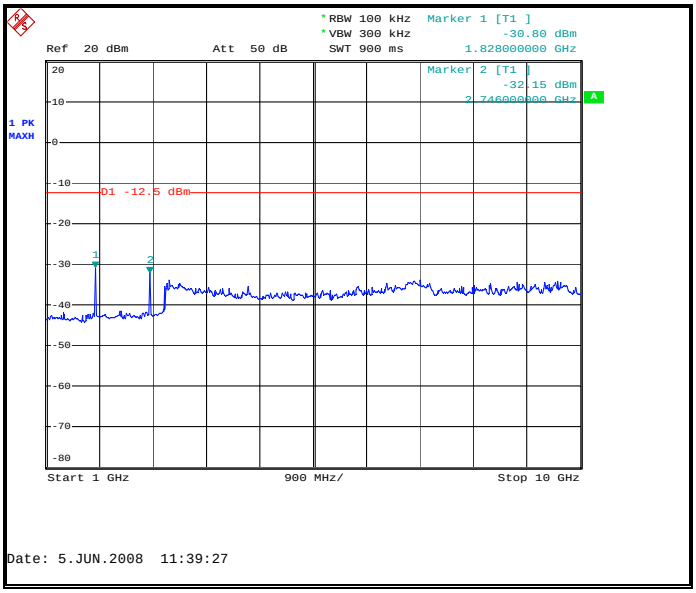


Figure 7.6.2-4 RF Conducted Spurious Emissions – Mid Channel

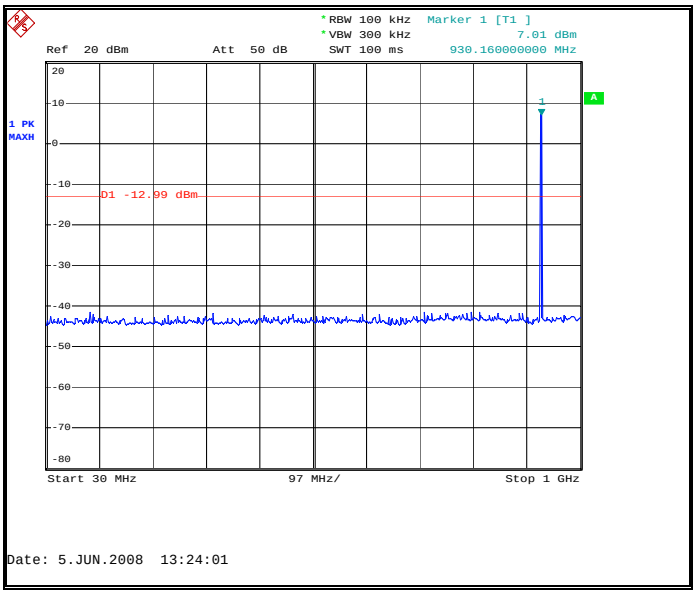


Figure 7.6.2-5 RF Conducted Spurious Emissions – High Channel

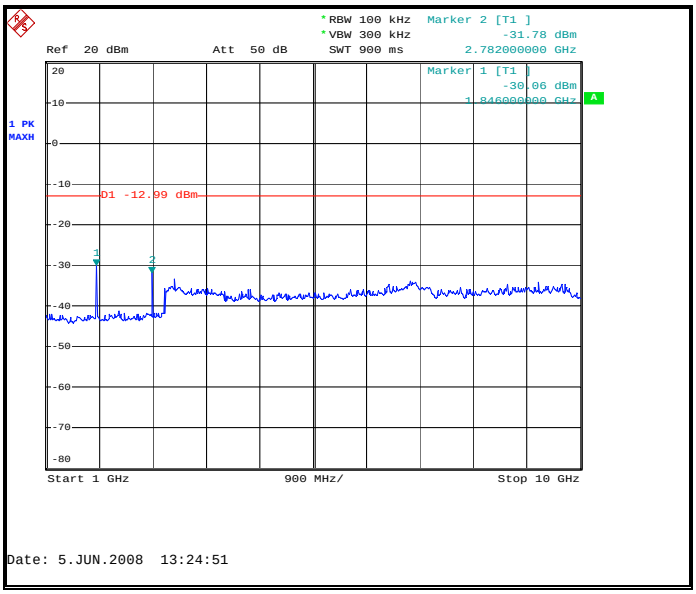


Figure 7.6.2-6 RF Conducted Spurious Emissions – High Channel

7.6.3 Radiated Spurious Emissions – Intentional Radiation (Restricted Bands)

7.6.3.1 Test Methodology

Radiated emissions tests were made over the frequency range of 30MHz to 10GHz, 10 times the highest fundamental frequency.

The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. For frequencies below 1000MHz, quasi-peak measurements were made using a resolution bandwidth (RBW) of 120 kHz and a video bandwidth (VBW) of 300 kHz. For frequencies above 1000MHz, average measurements were made using an RBW of 1 MHz and a VBW of 10 Hz and peak measurements were made with RBW of 1 MHz and a VBW of 1 MHz.

The EUT was caused to generate a continuous carrier signal on the hopping channel.

7.6.3.2 Duty Cycle Correction

For average radiated measurements, the measured level was reduced by a factor 6.02dB to account for the duty cycle of the EUT. Referencing the dwell time justification in section 7.5.3 above the worst case duty cycle within 100ms is 50% or 50ms. The duty cycle correction factor is determined using the formula: 20log (0.5)=-6.02dB.

The more detailed justification of duty cycle can be found in the dwell time justification attached to the Theory of Operations.

7.6.3.3 Test Results

Radiated spurious emissions found in the band of 30MHz to 10GHz are reported in Table 7.6.3-1

Table 7.6.3-1: Radiated Spurious Emissions

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Low Channel										
2706.3	51.99	49.89	H	0.32	52.31	44.19	74.0	54.0	21.69	9.81
2706.3	56.69	55.27	V	0.06	56.75	49.31	74.0	54.0	17.25	4.69
5412.6	47.09	39.20	H	7.96	55.05	41.14	74.0	54.0	18.95	12.86
5412.6	49.07	45.72	V	8.14	57.21	47.84	74.0	54.0	16.79	6.16
Middle Channel										
2745	52.75	51.08	H	0.46	53.21	45.52	74.0	54.0	20.79	8.48
2745	55.54	54.36	V	0.21	55.75	48.55	74.0	54.0	18.25	5.45
4575	45.97	39.71	H	5.63	51.60	39.32	74.0	54.0	22.40	14.68
4575	47.70	41.08	V	5.56	53.26	40.62	74.0	54.0	20.74	13.38
High Channel										
2783.7	53.03	50.93	H	0.60	53.63	45.51	74.0	54.0	20.37	8.49
2783.7	55.72	54.51	V	0.35	56.07	48.84	74.0	54.0	17.93	5.16
4639.5	46.98	41.03	H	5.77	52.75	40.78	74.0	54.0	21.25	13.22
4639.5	47.98	42.58	V	5.72	53.70	42.28	74.0	54.0	20.30	11.72

***** The magnitude of all emissions not reported were below the noise floor of the measurement system.

7.6.3.4 Sample Calculation:

$R_C = R_U + CF_T$

Where:

CF_T	=	Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only)
R_U	=	Uncorrected Reading
R_C	=	Corrected Level
AF	=	Antenna Factor
CA	=	Cable Attenuation
AG	=	Amplifier Gain
DC	=	Duty Cycle Correction Factor

Example Calculation

PEAK:
Corrected Level: 51.99+ .32= 52.31dBuV
Margin: 74dBuV – 52.31dBuV = 21.69dB

AVERAGE:
Corrected Level: 49.89+ .32-6.02= 44.19dBuV
Margin: 54dBuV – 44.19dBuV = 9.81dB

8.0 CONCLUSION
In the opinion of ACS, Inc. the ETRX, manufactured by Performance Meter, Inc. meets the requirements of FCC Part 15 subpart C and Industry Canada's Radio Standards Specification RSS-210.

END REPORT