MET Laboratories, Inc. *Safety Certification - EMI - Telecom Environmental Simulation*

914 WEST PATAPSCO AVENUE ● BALTIMORE, MARYLAND 21230-3432 ● PHONE (410) 354-3300 ● FAX (410) 354-3313
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3162 BELICK STREET ● SANTA CLARA, CALIFORNIA 95054 ● PHONE (408) 748-3585 ● FAX (510) 489-6372
13301 MCCALLEN PASS ● AUSTIN, TEXAS 78753 ● PHONE (512) 287-2500 ● FAX (512) 287-2513

December 11, 2013

Teltronic, S.A.U.
Poligono Malpica, Calle F-Oeste
50016, Zaragoza Spain

Dear José Román,

Enclosed is the EMC Wireless test report for compliance testing of the Teltronic, S.A.U., BSR75-8, tested to the requirements of Title 47 of the Code of Federal Regulations (CFR), Part 90 and RSS-119, Issue 9 June 2007 for Land Mobile Radio Services.

Thank you for using the services of MET Laboratories, Inc. If you have any questions regarding these results or if MET can be of further service to you, please feel free to contact me.

Sincerely yours,
MET LABORATORIES, INC.

Jennifer Warnell
Documentation Department

Reference: (\Teltronic, S.A.U.\EMC39732-FCC90/RSS-119 Rev. 3)

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Electromagnetic Compatibility Criteria
Class II Permissive Change Test Report

For the

Teltronic, S.A.U.
BSR75-8

Tested under

The FCC Verification Rules
Contained in Title 47 of the CFR,
Part 90 and RSS-119
for Private Land Mobile Radio Services

MET Report: EMC39732-FCC90/RSS-119 Rev. 3

December 11, 2013

Prepared For:
Teltronic, S.A.U.
Poligono Malpica, Calle F-Oeste
50016, Zaragoza Spain

Prepared By:
MET Laboratories, Inc.
914 W. Patapsco Ave.
Baltimore, MD 21230

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MET Report: EMC39732-FCC90/RSS-119 Rev. 3

Benjamin Taylor, Project Engineer
Electromagnetic Compatibility Lab

Jennifer Warnell
Documentation Department

Engineering Statement: The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of Part 90 of the FCC Rules and RSS-199 of the Industry Canada standards under normal use and maintenance.

Asad Bajwa,
Director, Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	November 15, 2013	Initial Issue.
1	December 4, 2013	Revised to reflect engineer corrections.
2	December 9, 2013	Revised to reflect customer corrections.
3	December 11, 2013	Editorial correction.

Table of Contents

All references to section numbers are taken directly from the standard/specification used. Only sections requiring testing or evaluation are included.

List of Tables

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List of Terms and Abbreviations

AC	**A**lternating **C**urrent
ACF	**A**ntenna **C**orrection **F**actor
Cal	**Cal**ibration
d	**M**easurement **D**istance
dB	**D**eci**b**els
dBµA	**D**eci**b**els above one **micro**amp
dBµV	**D**eci**b**els above one **micro**volt
dBµA/m	**D**eci**b**els above one **micro**amp **per m**eter
dBµV/m	**D**eci**b**els above one **micro**volt **per m**eter
DC	**D**irect **C**urrent
E	**E**lectric Field
DSL	**D**igital **S**ubscriber **L**ine
ESD	**E**lectro**s**tatic **D**ischarge
EUT	**E**quipment **U**nder **T**est
f	**F**requency
FCC	**F**ederal **C**ommunications **C**ommission
GRP	**G**round **R**eference **P**lane
H	Magnetic Field
HCP	**H**orizontal **C**oupling **P**lane
Hz	**H**er**z**
IEC	**I**nternational **E**lectrotechnical **C**ommission
kHz	**k**ilo**h**er**z**
kPa	**k**ilo**pa**scal
kV	**k**ilo**v**olt
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
MHz	**M**ega**h**ertz
µH	**microh**enry
µ	**microf**arad
µs	**micros**econds
NEBS	**N**etwork **E**quipment-**B**uilding **S**ystem
PRF	**P**ulse **R**epetition **F**requency
RF	**R**adio **F**requency
RMS	**R**oot-**M**ean-**S**quare
TWT	**T**raveling **W**ave **T**ube
V/m	**V**olts **per m**eter
VCP	**V**ertical **C**oupling **P**lane

I. Executive Summary

1. Testing Summary

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 90 and IC RSS-119. All tests were conducted using measurement procedure ANSI TIA/EIA-603-A-2004.

Title 47 of the CFR, Part 90, and FCC 04-265 Reference and Test Description	Industry Canada References	Compliance
§2.1046, §90.205 RF Output Power	RSS-119, Section 5.4	Compliant
§2.1047, §90.207 Modulation Characteristics, Audio Frequency & Filter Response	RSS-119, Section 5.2	Not Applicable
§2.1049, 90.210(d) Occupied Bandwidth (Emission Mask)	RSS-119, Section 5.5 RSS-GEN 99% Bandwidth	Compliant
§2.1051, §90.210(d) Spurious Emissions at Antenna Terminals	RSS-GEN, Section 7.2.3.1, Antenna Conducted Emissions	Compliant
§90.221 Adjacent Channel Power	RSS-119, Section 5.8	Compliant
§2.1055, §90.213 Frequency Stability	RSS-119, Section 5.3	Not Applicable
§2.1053, §90.210 Field Strength of Spurious Radiation	RSS-119, Section 5.8	Compliant
§90.214 Transient Frequency Behavior	RSS-119, Section 5.9	Not Applicable
§2.1091 RF Exposure	RSS-102 Issue 4, March 2010	Not Applicable
N/A	Receiver Spurious Emissions RSS-119, Section 5.11	Compliant

II. Equipment Configuration

2. Equipment Configuration

2.1. Overview

MET Laboratories, Inc. was contracted by Teltronic, S.A.U. to perform testing on the BSR75-8 under quote number 1TEL1507.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Teltronic, S.A.U., BSR75-8.

An EMC evaluation to determine compliance of the TB 4.9 with the requirements of FCC Part 90, was conducted. (All references are to the most current version of Title 47 of the Code of Federal Regulations in effect). In accordance with §2.1033, the following data is presented in support of the Certification of the TB4.9. Teltronic, S.A.U. should retain a copy of this document and it should be kept on file for at least five years after the manufacturing of the EUT has been **permanently** discontinued. The results obtained relate only to the item(s) tested.

Model(s) Tested:	BSR75-8	
Model(s) Covered:	BSR75-8	
Filing Option:	Class II Permissive Change	
EUT Specifications:	Primary Power Source: 26.4 VDC	
	FCC ID: WT7PTRNKTBSR75450 IC: 8624A-PTRNKTBSR75450	
	Type of Modulations:	TI D-LMR: π/4-DQPSK TETRA: π/4-DQPSK
	EUT Frequency Ranges:	450 – 470 MHz
Analysis:	The results obtained relate only to the item(s) tested.	
Environmental Test Conditions:	Temperature (15-35º C)	
	Relative Humidity (30-60%)	
	Barometric Pressure (860-1060 mbar)	
Evaluated by:	Benjamin Taylor	
Report Date(s):	December 11, 2013	

2.2. Test Site

All testing was performed at MET Laboratories, Inc., 914 W. Patapsco Ave., Baltimore, MD 21230. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

Radiated Emissions measurements were performed in a semi-anechoic chamber (equivalent to an Open Area Test Site). In accordance with §2.948(a)(3), a complete site description is contained at MET Laboratories.

2.3. Description of Test Sample

The Teltronic, S.A.U. BSR75-8, Equipment Under Test (EUT), is an RF transceiver for base stations in radio communication systems. It offers a transmitter output power up to 75 W and it is intended for mounting in a 19-inch rack.

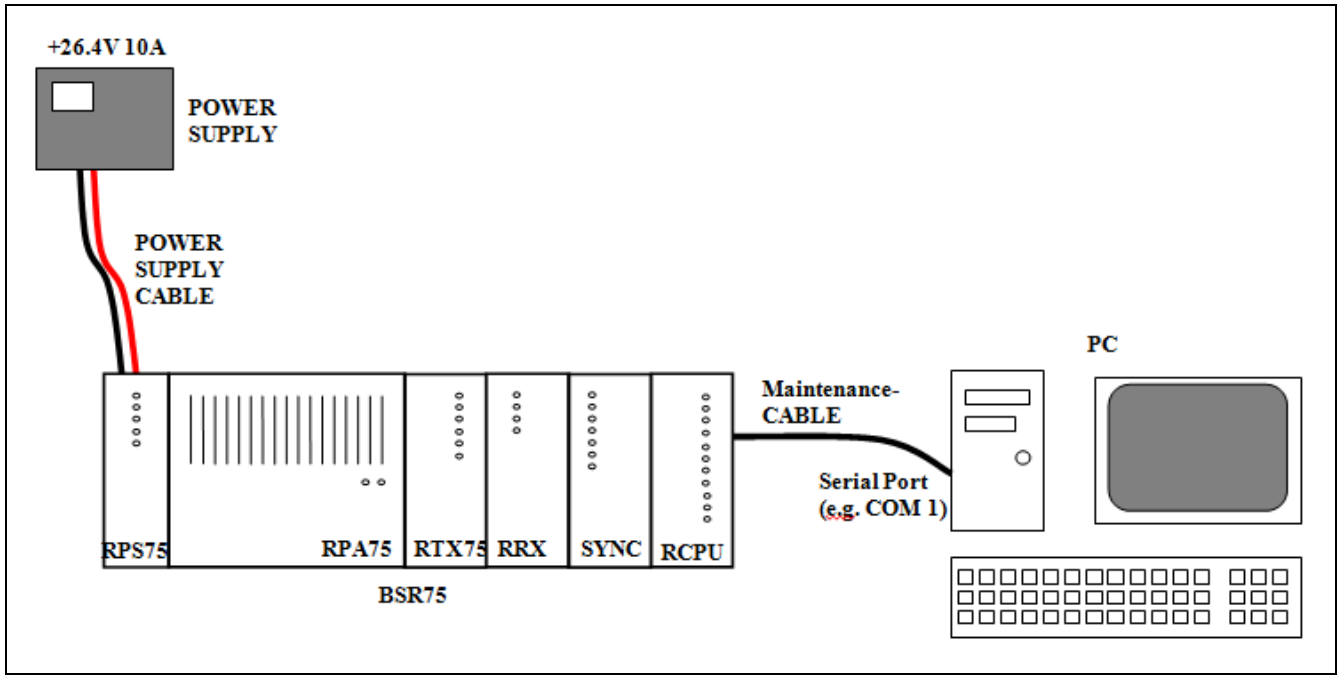


Figure 1. Block Diagram of Test Configuration

2.4. Equipment Configuration

Ref. ID	Name / Description	Model Number	Serial Number
D138861PT	BSR75 -8	--	840834

Table 1. Equipment Configuration

2.5. Support Equipment

Teltronic, S.A.U. supplied the support equipment necessary for the operation and testing of the BSR75-8. All support equipment supplied is listed in the following Support Equipment List.

Ref. ID	Name / Description	Manufacturer	Model Number
D013000	BSR75 power cable	Teltronic / PowerTrunk	D013000
208852	Ethernet cable (red, 0.5m)	--	208852
208849	Ethernet cable (blue, 1m)	--	208849
12099	TNC Charge (50Ω, 20W)	--	12099
D013001	Maintenance cable VT100	Teltronic / PowerTrunk	D013001

Table 2. Support Equipment

2.6. Mode of Operation

The BSR75 can be operated in a transmission and reception test mode, called Test_BSR Mode, simulating normal operation. Besides, it can be operated in an only-reception test mode, the MED_BER Mode.

In Test_BSR Mode, the BSR75 continuously transmits, through the TX antenna connector, a RF signal with the configured modulation, power level and carrier frequency. Besides, the receiver is active and able to process any signal with the proper modulation present at the RX antenna connector.

2.7. Method of Monitoring EUT Operation

The BSR75 is controlled and monitored using a VT-100 terminal emulator, such as Windows HyperTerminal or PComm or PuTTY. The VT-100 terminal screen continuously shows the operation mode of the BSR75 and if some error occurs, an alarm indication is displayed.

Besides, there are several LED in the front panel of the BSR75 modules. A red LED indicates that there is a failure, except for the "CNC ERROR" LED in the RCPU module, which should be active when the BSR75 is operated in a test mode without connection to the control node of the radio communication system.

2.8. Modifications

2.8.1. Modifications to EUT

No modifications were made to the EUT.

2.8.2. Modifications to Test Standard

No modifications were made to the test standard.

2.9. Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to Teltronic, S.A.U. upon completion of testing.

III. Electromagnetic Compatibility Criteria for Intentional Radiators

3. Electromagnetic Compatibility RF Power Output Requirements

3.1. RF Output Power

FCC §2.1046, §90.205
Test Requirement(s): §2.1046 and §90.205

IC RSS-119, Issue 11, June 2011
Test Requirement(s): Section 5.4

Test Procedures: As required by 47 CFR §2.1046, *RF power output measurements* were made at the RF output terminals using a Spectrum Analyzer.

A laptop was connected to EUT to control the RF power output and frequency channel. The EUT was connected to a Spectrum Analyzer via an attenuator to measure power. Measurements were made at the low, mid and high channels of each appropriate frequency range. Plots were correct for attenuator and cable loss.

Test Results: Equipment is compliant with the requirements of this section.

All RF Power output measurements were direct connection to RF output Terminal of EUT from a Spectrum Analyzer.

Test Engineer(s): Benjamin Taylor

Test Date(s): 10/02/13

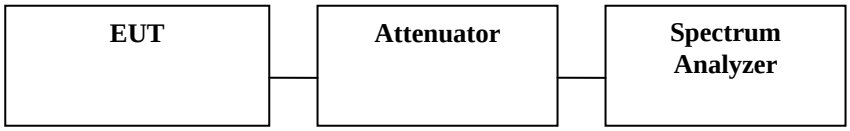
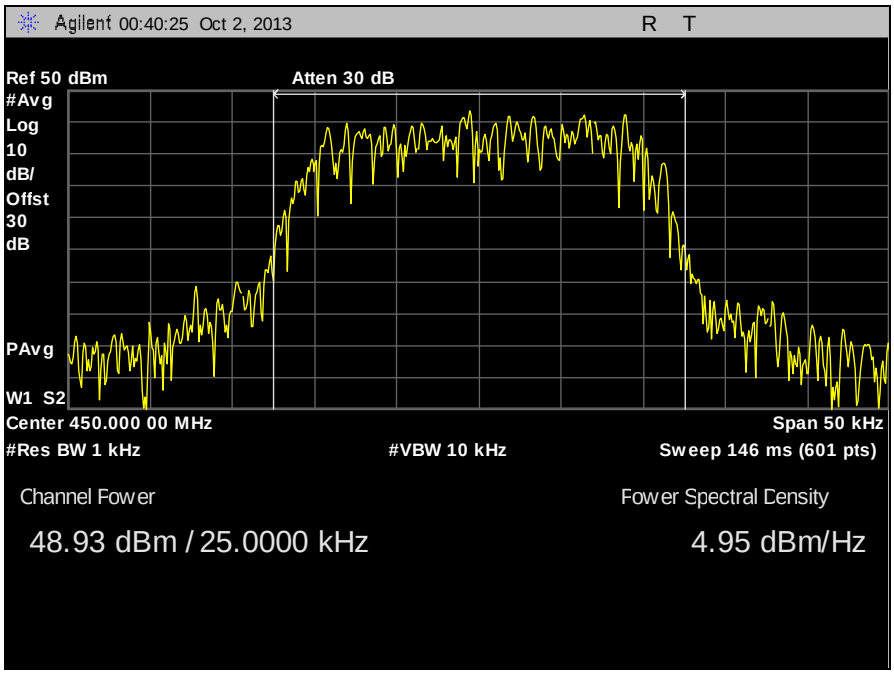


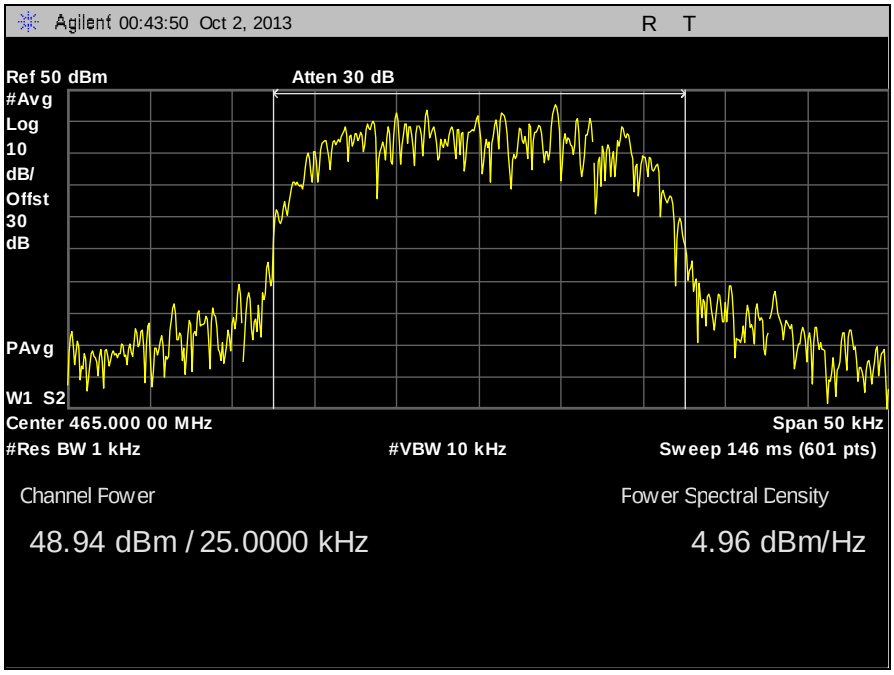
Figure 2. RF Power Output Test Setup

TETRA – Part 90 & RSS-119		
Channel	**Frequency (MHz)**	**Power (dBm)**
Low	450	48.93
Mid	465	48.94
High	470	48.87

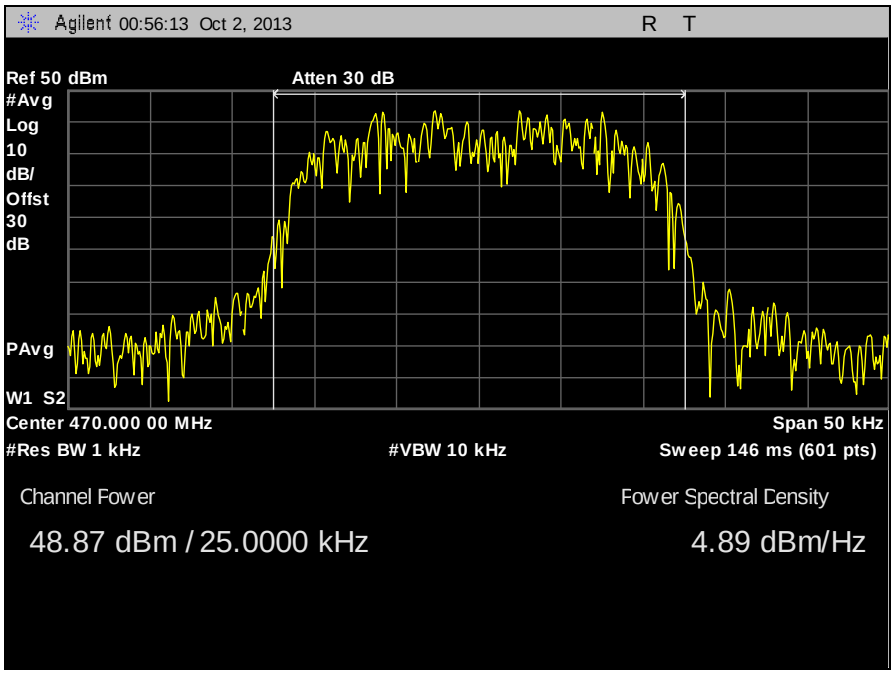
Table 3. RF Output Power, Test Results



Plot 1. RF Power Output, TETRA, 22 kHz, Low Channel, 450 MHz, Average



Plot 2. RF Power Output, TETRA, 22 kHz, Mid Channel, 465 MHz, Average



Plot 3. RF Power Output, TETRA, 22 kHz, High Channel, 470 MHz, Average

3.2. Modulation Characteristics

FCC §2.1047, §90.207
Test Requirement(s): **§2.1047 and §90.207**

IC RSS-119, Issue 11, June 2011
Test Requirement(s): **Section 5.2**

Test Results: Equipment was not applicable with Section §2.1047, §90.207 nor RSS-119, since this is a Class II Permissive Change.

3.3. Occupied Bandwidth

FCC §2.1049
Test Requirement(s): **§2.1049**

FCC §90
Test Requirement(s): **§90.209**

IC RSS-119, Issue 11, June 2011
Test Requirement(s): **Section 5.5 & RSS-GEN**

Test Procedures: As required by 47 CRF 2.1049, *occupied bandwidth measurements* were made at the RF output terminals using a Spectrum Analyzer.

A laptop was connected to EUT to control the RF frequency channel. The EUT was connected to a Spectrum Analyzer via attenuator. The RBW of the Spectrum Analyzer was set to at least 1% of the channel bandwidth. Measurements were carried out at the low, mid, and high channels of the TX band.

Test Results: Equipment is compliant with the requirements of this section.

Test Engineer(s): Benjamin Taylor

Test Date(s): 10/02/13

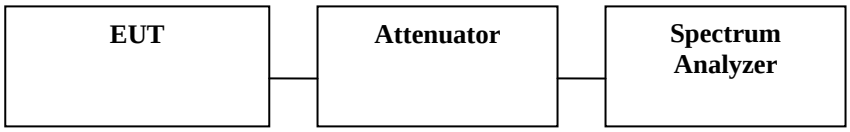
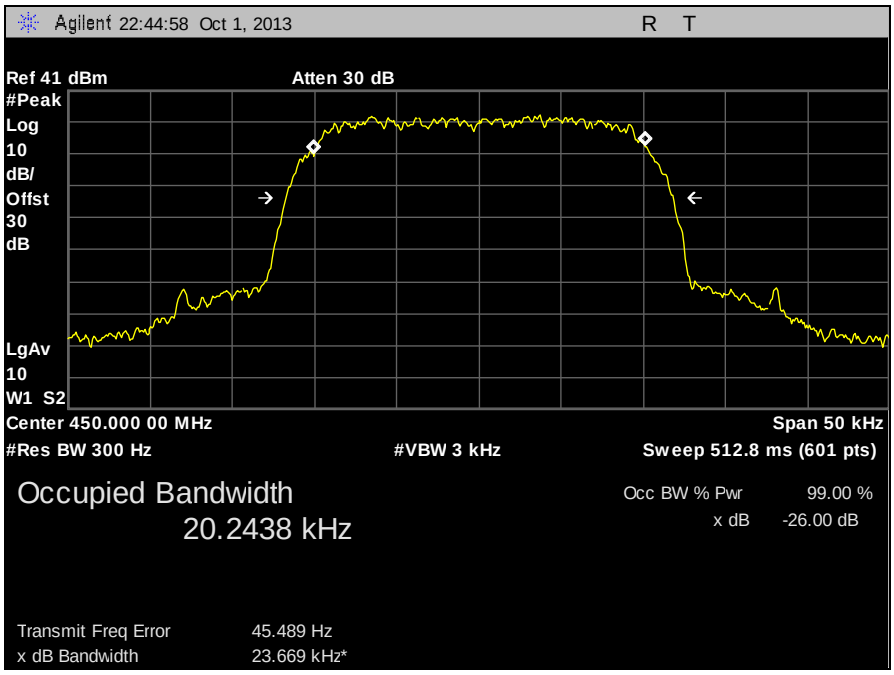


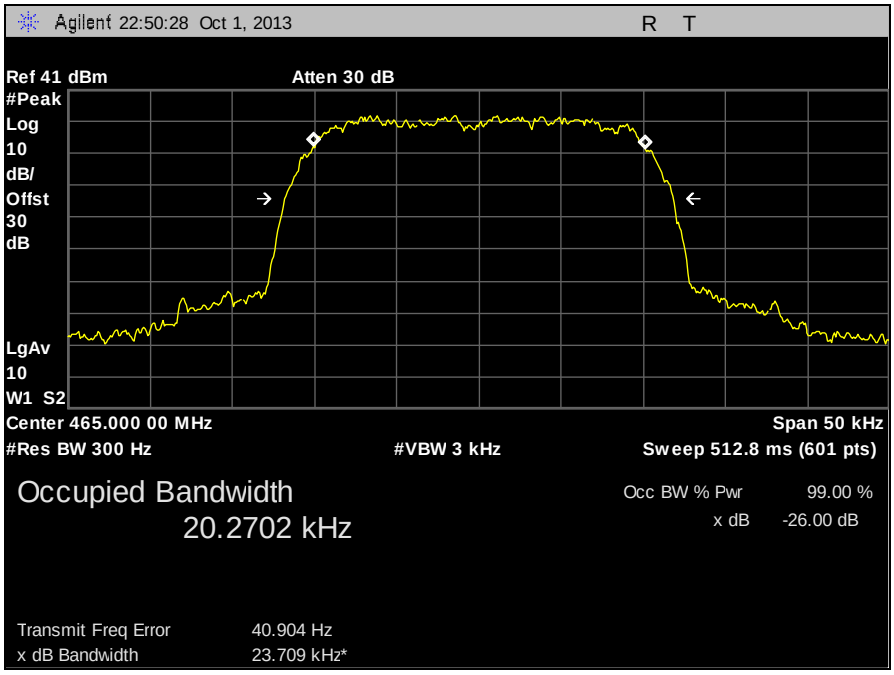
Figure 3. Occupied Bandwidth Test Setup

TETRA - Part 90 & RSS-119			
Channel	**Frequency (MHz)**	**-26dB Bandwidth (kHz)**	**99% Occupied Bandwidth (kHz)**
Low	450	23.669	20.4812
Mid	465	23.709	20.4153
High	470	23.410	20.3552

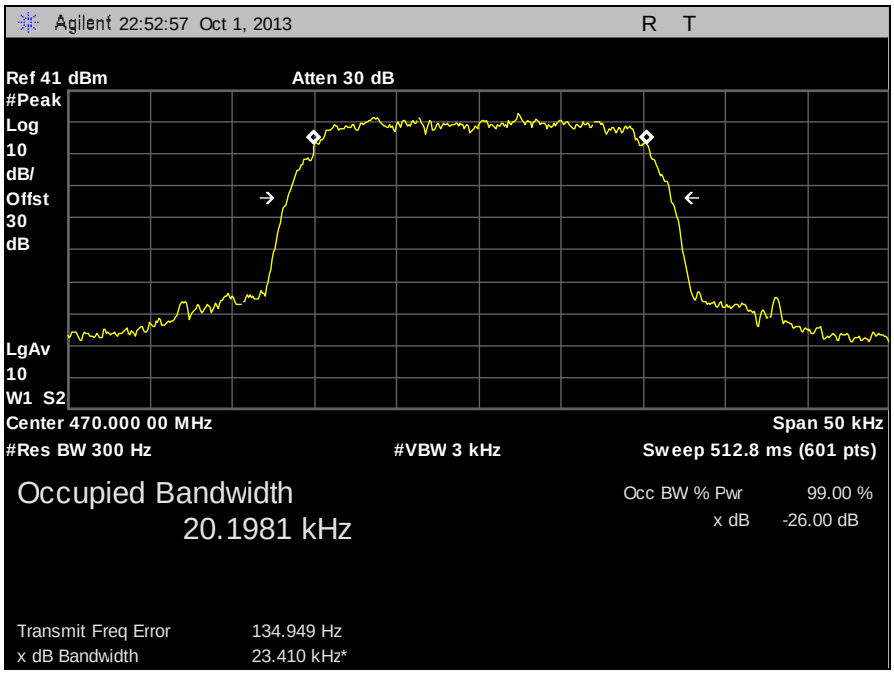
Table 4. Occupied Bandwidth, Test Results



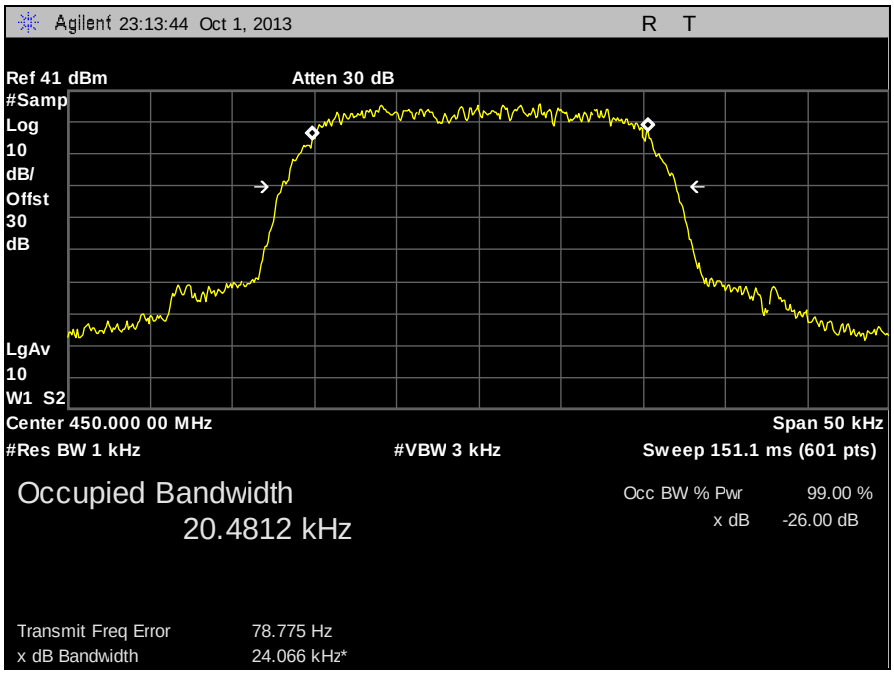
Plot 4. Occupied Bandwidth, TETRA, 22 kHz, Low Channel, 450 MHz, 26 dB



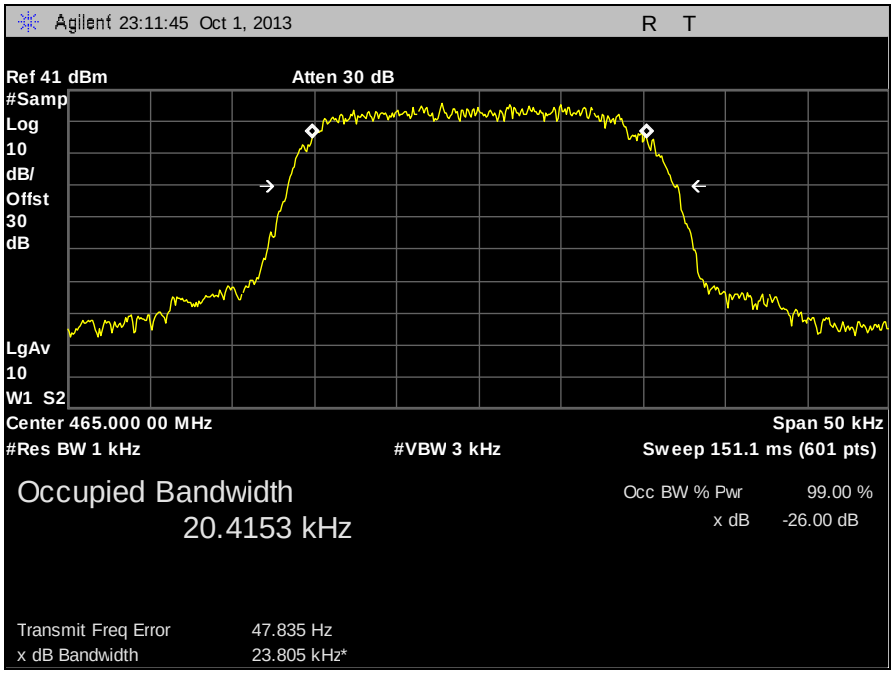
Plot 5. Occupied Bandwidth, TETRA, 22 kHz, Mid Channel, 465 MHz, 26 dB



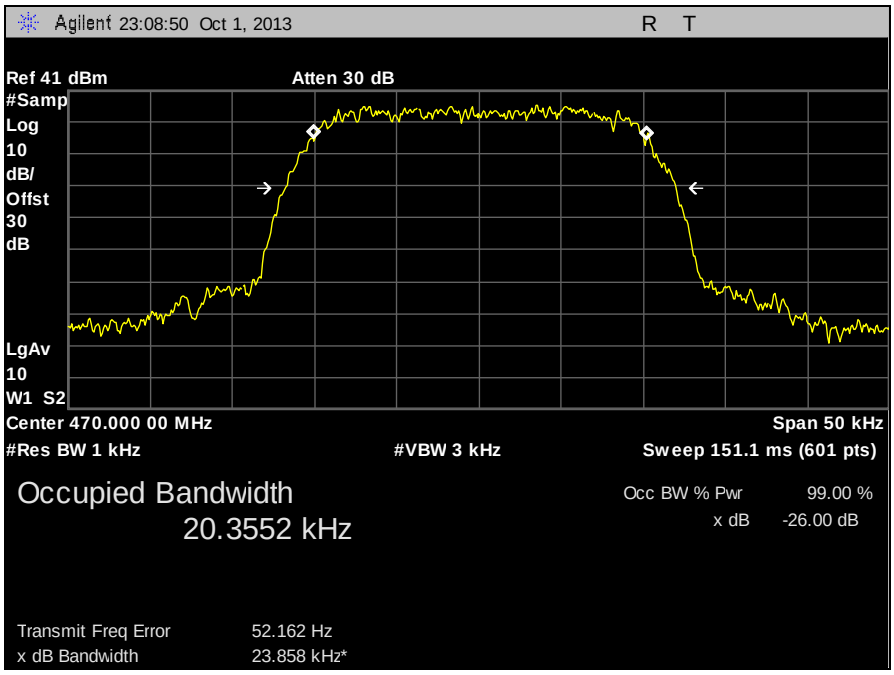
Plot 6. Occupied Bandwidth, TETRA, 22 kHz, High Channel, 470 MHz, 26 dB



Plot 7. 99% Bandwidth, TETRA, 22 kHz, Low Channel, 450 MHz



Plot 8. 99% Bandwidth, TETRA, 22 kHz, Mid Channel, 465 MHz



Plot 9. 99% Bandwidth, TETRA, 22 kHz, High Channel, 470 MHz

3.4. Spurious Emissions at Antenna Terminals

FCC §2.1051, §90.221

Test Requirement(s): **§2.1051 Measurements required: Spurious emissions at antenna terminals:** The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in §2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

§90.221(a) For the frequency bands indicated below, operations using equipment designed to operate with a 25 kHz channel bandwidth may be authorized up to a 22 kHz bandwidth if the equipment meets the adjacent channel power (ACP) limits below. The table specifies a value for the ACP as a function of the displacement from the channel center frequency and a measurement bandwidth of 18 kHz.

(b)(1) Maximum adjacent power levels for frequencies in the 450-470 MHz band:

Frequency offset	Maximum ACP (dBc) for devices 1 watt and less	Maximum ACP (dBc) for devices above 1 watt
25 kHz	−55 dBc	−60 dBc
50 kHz	−70 dBc	−70 dBc
75 kHz	−70 dBc	−70 dBc

(2) In any case, no requirement in excess of −36 dBm shall apply.

(c)(1) Maximum adjacent power levels for frequencies in the 809-824/854-869 MHz band:

IC RSS-GEN, Issue 3, Dec. 2010, Section 4.9

Test Requirement(s): **Section 4.9 and RSS-119 Issue 11, June 2011 Section 5.8**

4.9 Transmitter Unwanted Emissions

The measurement method shall be described in the test report. When the applicable unwanted emissions limits are defined in relative terms, the same parameter, peak power or average power, used for the transmitter output power measurement, shall be used for unwanted emission measurements.

In measuring unwanted emissions, the spectrum shall be investigated from 30 MHz or the lowest radio frequency signal generated in the equipment, whichever is lower, without going below 9 kHz, up to at least the frequency given in (a) and (b):

a. If the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
b. If the equipment operates at or above 10 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.

Particular attention should be paid to harmonics and sub-harmonics of the carrier frequency, as well as to those frequencies removed from the carrier by multiples of the oscillator frequency. Radiation at the frequencies of multiplier stages should also be checked.

The amplitude of spurious emissions attenuated more than 20 dB below the permissible value need not be reported.

When limits are expressed in absolute terms, compliance with the emission limits shall be demonstrated using a CISPR quasi-peak detector and the related measurement bandwidth for emissions below 1000 MHz. As an alternative to CISPR quasi-peak measurement, compliance with the emission limits can be demonstrated using measuring equipment employing a peak detector function properly adjusted for factors such as pulse desensitization

as required, with an equal or greater measurement bandwidth relative to the applicable CISPR quasi-peak bandwidth.
Above 1000 MHz, compliance with the emission limits shall be demonstrated using an average detector with a minimum resolution bandwidth of 1 MHz.

5.8 Transmitter Unwanted Emissions

The spectrum plots of the unwanted emissions shall comply with the masks specified in RSS-119 Issue 11 June 2011 Table 3.

Descriptions of these permissible emission masks are given in the following sections.

Displacement frequency, f_d, is the difference between the channel frequency and the emission component frequency expressed in hertz, and p is the transmitter output power in watts.

5.8.10 Emission Mask Y for Equipment with a 25 kHz Channel Spacing and an Occupied Bandwidth greater than 20 kHz

Equipment with a 25 kHz channel spacing and an occupied bandwidth greater than 20 kHz shall have the power of any emission attenuated below the transmitter output power P (dBW) as specified in Table 16.

Table 5 – Emission Mask Y

Displacement Frequency, f_d (kHz)	**Minimum Attenuation (dB)**	**Resolution Bandwidth (Hz)**
$12.375 < f_d \leq 13.975$	whichever is the lesser attenuation: $30 + 16.67(f_d - 12.375)$ or $55 + 10 \log_{10}(p)$	Specified in Section 4.2.2
$f_d > 13.975$	whichever is the lesser attenuation: 57 or $55 + 10 \log_{10}(p)$	Specified in Section 4.2.2

Test Procedures: As required by 47 CFR §2.1051, *spurious emissions at antenna terminal measurements* were made at the RF output terminals using a Spectrum Analyzer.

A laptop was connected to EUT to control the RF power output and frequency channel. The EUT was connected to a Spectrum Analyzer through an attenuator. The Spectrum Analyzer was set to sweep 30 MHz and up to 10th harmonic of the fundamental or 40 GHz whichever is the lesser. Measurements were made in all applicable frequency bands.

Test Results: Equipment complies with Section §2.1051, §90.210 and RSS-119.

Test Engineer(s): Benjamin Taylor

Test Date(s): 10/02/13

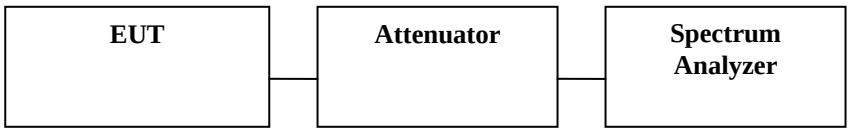
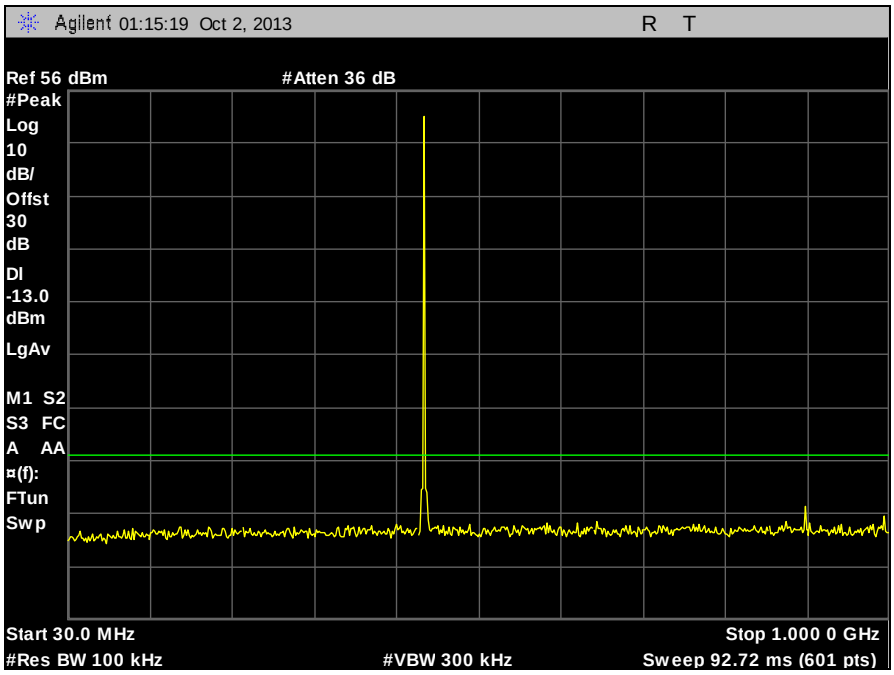
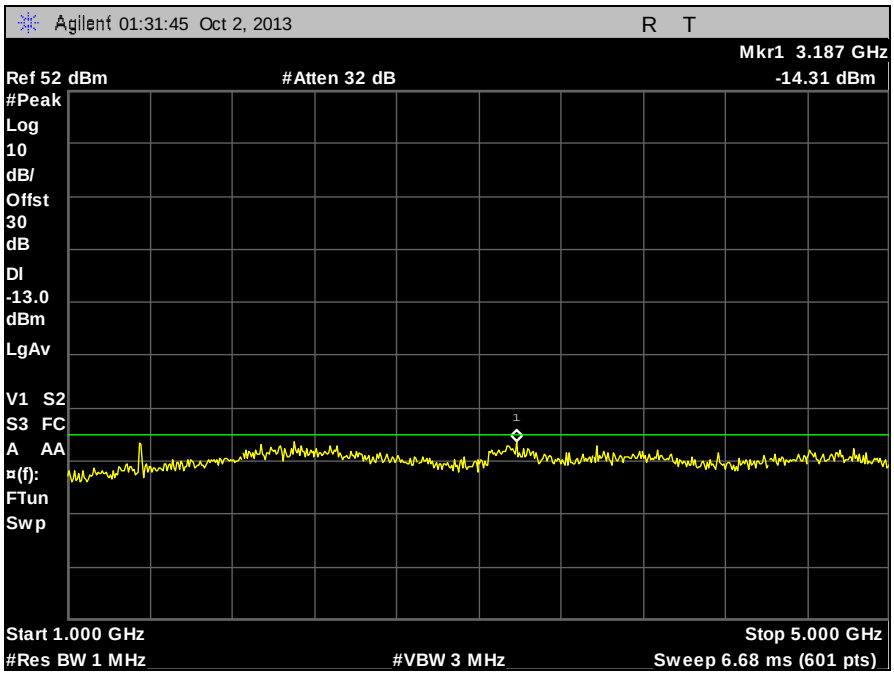


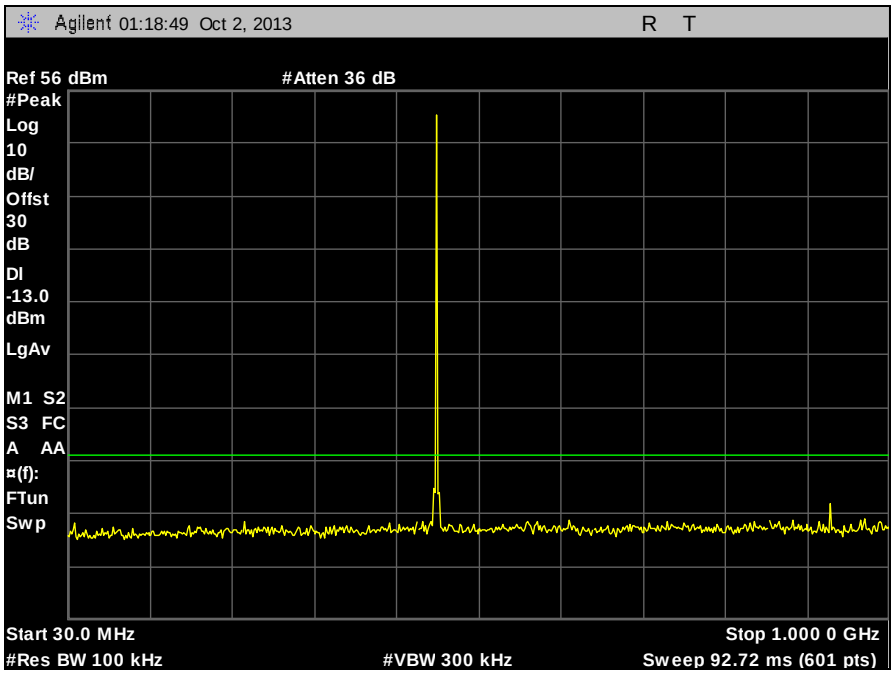
Figure 4. Spurious Emissions at Antenna Terminals Test Setup



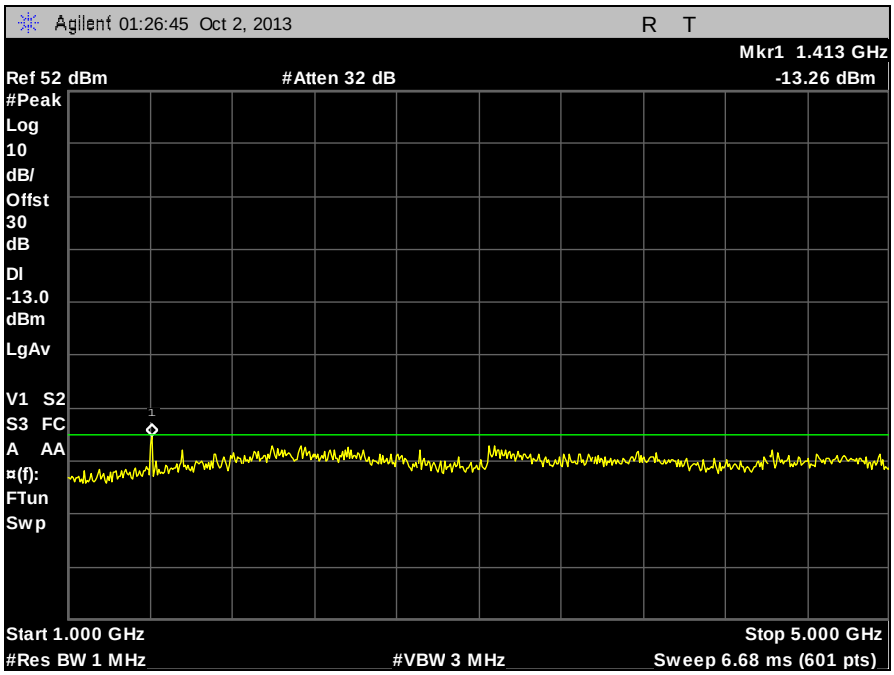
Plot 10. Conducted Spurious Emissions, TETRA, 22 kHz, Low Channel, 450 MHz, 30 MHz – 1 GHz



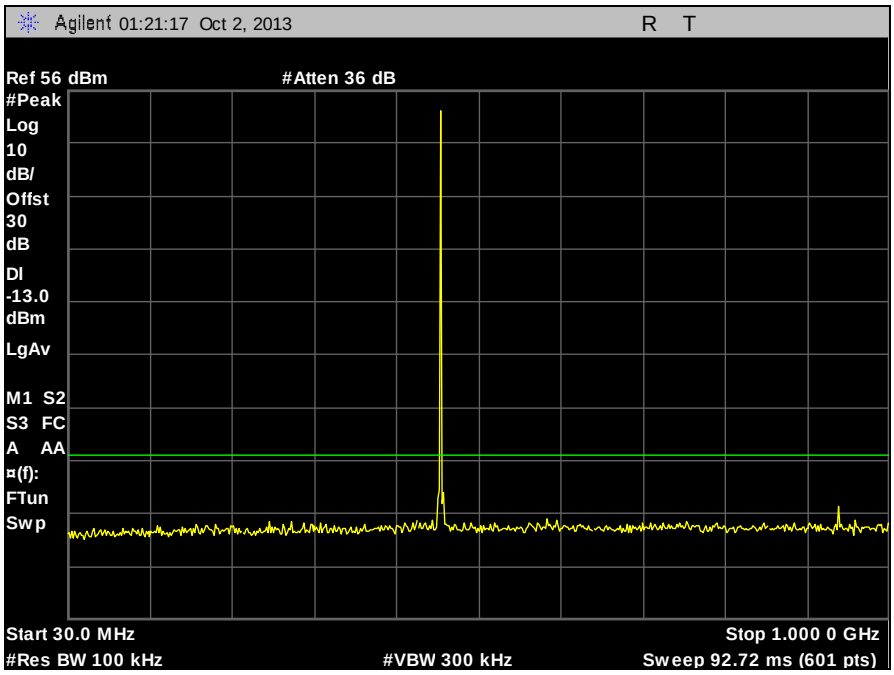
Plot 11. Conducted Spurious Emissions, TETRA, 22 kHz, Low Channel, 450 MHz, 1 GHz – 5 GHz



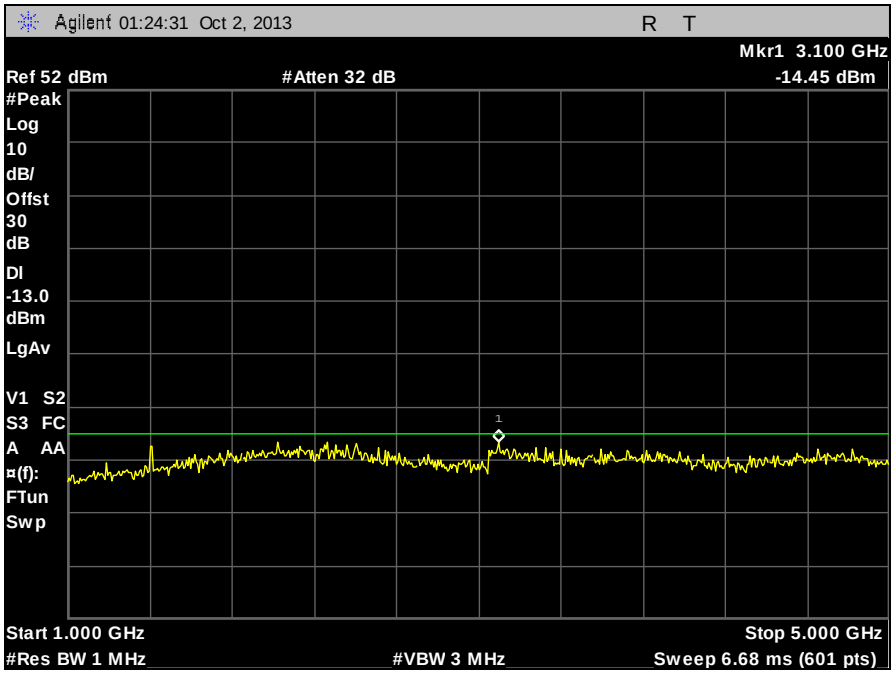
Plot 12. Conducted Spurious Emissions, TETRA, 22 kHz, Mid Channel, 465 MHz 30 MHz – 1 GHz



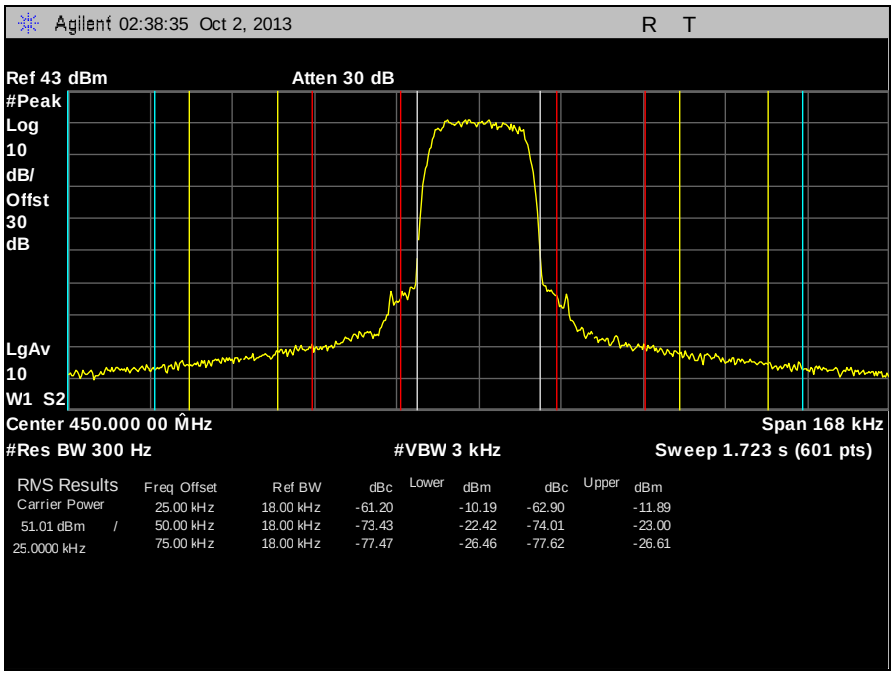
Plot 13. Conducted Spurious Emissions, TETRA, 22 kHz, Mid Channel, 465 MHz, 1 GHz – 5 GHz



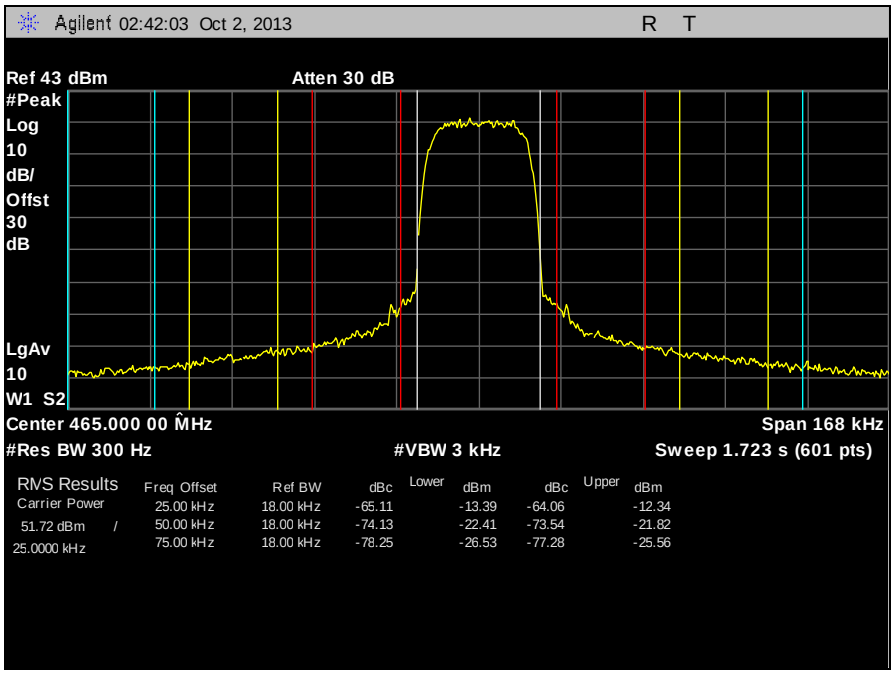
Plot 14. Conducted Spurious Emissions, TETRA, 22 kHz, High Channel, 470 MHz, 30 MHz – 1 GHz



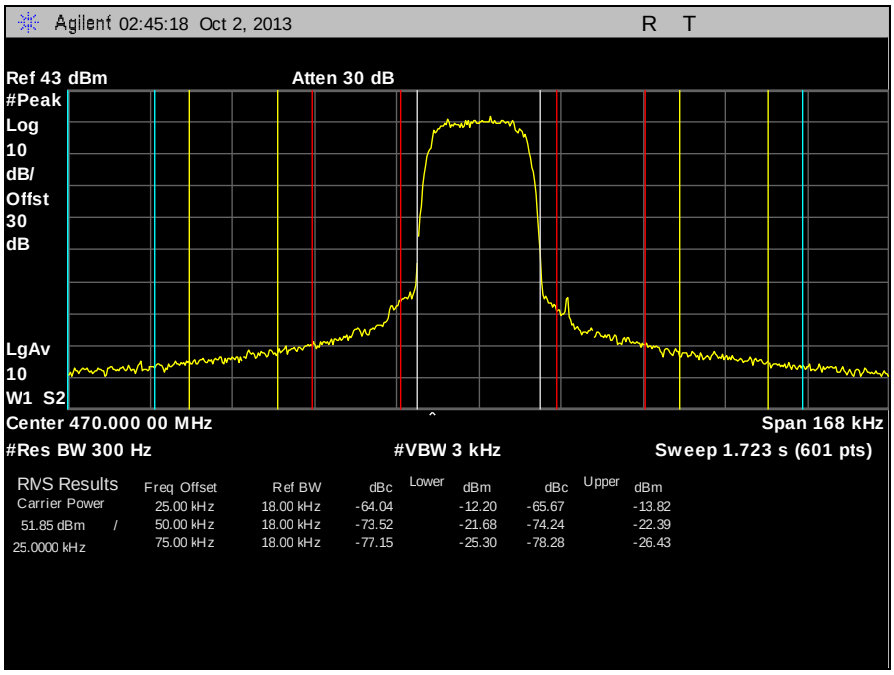
Plot 15. Conducted Spurious Emissions, TETRA, 22 kHz, High Channel, 470 MHz, 1 GHz – 5 GHz



Plot 16. ACP, TETRA, 22 kHz, Low Channel, 450 MHz

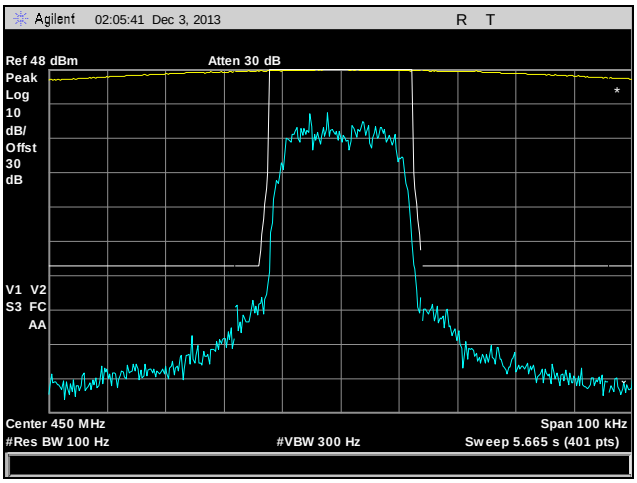


Plot 17. ACP, TETRA, 22 kHz, Mid Channel, 465 MHz

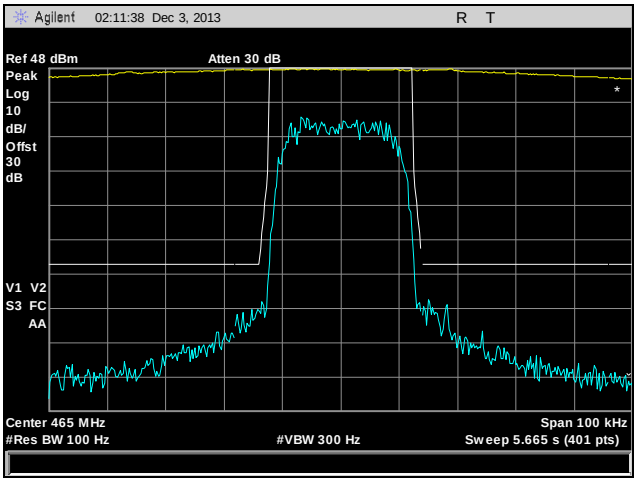


Plot 18. ACP, TETRA, 22 kHz, High Channel, 470 MHz

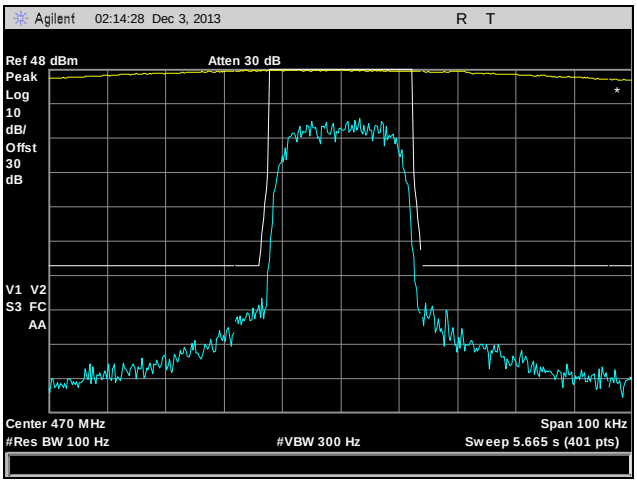
Mask Y



Plot 19. Mask Y, TETRA, 22 kHz, Low Channel, 450 MHz



Plot 20. Mask Y, TETRA, 22 kHz, Mid Channel, 465 MHz



Plot 21. Mask Y, TETRA, 22 kHz, High Channel, 470 MHz

3.5. Frequency Stability

FCC §2.1055, §90.213
Test Requirement(s): **§2.1055**

IC RSS-119, Section 5.3
Test Requirement(s): **RSS-119, Issue 11, June 2011, Section 5.3**

Test Results: Equipment was not applicable with Section §2.1055, §90.213 and RSS-119, since this is for a Class II Permissive Change. Original filing results show the stability is 0 PPM with a CW signal.

3.6. Field Strength of Spurious Radiation

FCC §2.1053, §90.210

Test Requirement(s): **§2.1053 Measurements required: Field strength of spurious radiation.**

§ 2.1053 (a) Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of § 2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from half-wave dipole antennas.

§ 2.1053 (b): The measurements specified in paragraph (a) of this section shall be made for the following equipment:

(1) Those in which the spurious emissions are required to be 60 dB or more below the mean power of the transmitter.

(2) All equipment operating on frequencies higher than 25 MHz.

(3) All equipment where the antenna is an integral part of, and attached directly to the transmitter.

(4) Other types of equipment as required, when deemed necessary by the Commission.

IC RSS-119, Section 5.8

Test Requirement(s): **RSS-119 Issue 11, June 2011 Section 5.8**

5.8 Transmitter Unwanted Emissions

The spectrum plots of the unwanted emissions shall comply with the masks specified in RSS-119 Issue 11 June 2011 Table 3.

Descriptions of these permissible emission masks are given in the following sections.

Displacement frequency, f_d, is the difference between the channel frequency and the emission component frequency expressed in hertz, and p is the transmitter output power in watts.

5.8.10 Emission Mask Y for Equipment with a 25 kHz Channel Spacing and an Occupied Bandwidth greater than 20 kHz

Equipment with a 25 kHz channel spacing and an occupied bandwidth greater than 20 kHz shall have the power of any emission attenuated below the transmitter output power P (dBW) as specified in Table 16.

Table 5 – Emission Mask Y

Displacement Frequency, f_d (kHz)	Minimum Attenuation (dB)	Resolution Bandwidth (Hz)
$12.375 < f_d \leq 13.975$	whichever is the lesser attenuation: $30 + 16.67(f_d - 12.375)$ or $55 + 10 \log_{10}(p)$	Specified in Section 4.2.2
$f_d > 13.975$	whichever is the lesser attenuation: 57 or $55 + 10 \log_{10}(p)$	Specified in Section 4.2.2

Test Procedures:

As required by 47 CFR §2.1053, *field strength of radiated spurious measurements* was made in accordance with the procedures of TIA/EIA-603-A-2001 "Land Mobile FM or PM Communications Equipment Measurement and Performance Standards".

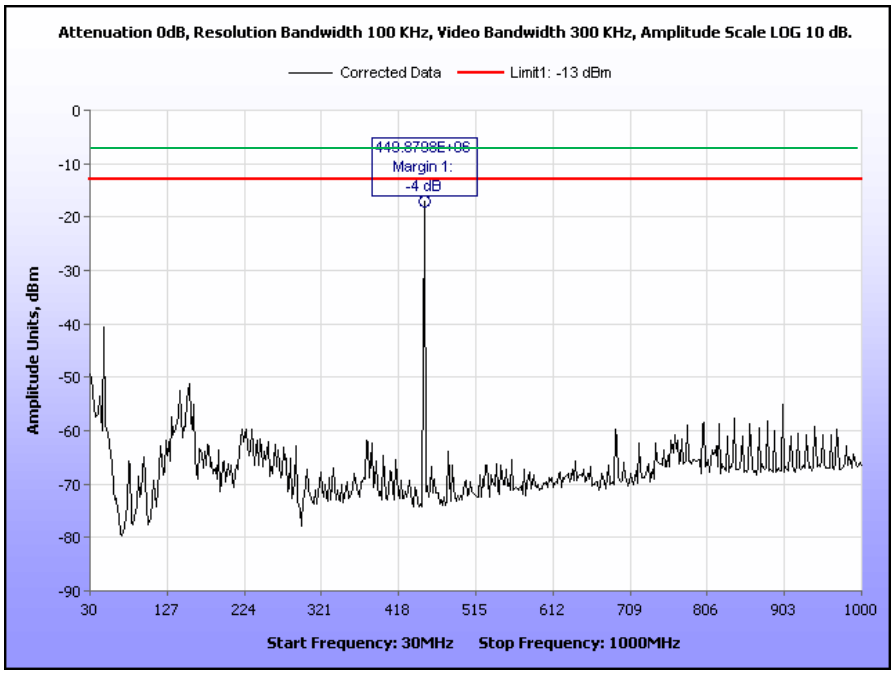
Radiated emission measurements were performed inside a 3 meter semi-anechoic chamber. The EUT's RF ports were terminated to 50ohm load. The EUT was tested using both bandwidths and at the low, mid, and high channels. The EUT was rotated about 360^0 and the receiving antenna scanned from 1-4m in order to capture the maximum emission. The plots are corrected for cable loss, antenna correction factor, and distance correction. The field strength was mathematically corrected to an E.I.R.P. Harmonic emissions up to the 10^{th} or 40GHz, which ever was the lesser, were investigated.

The spectrum analyzer was set to 1MHz RBW and 3MHz VBW above 1 GHz and 100 kHz RBW and 300 kHz VBW below 1 GHz. The spectrum was investigated from 30MHz to the 10^{th} harmonic of the carrier.

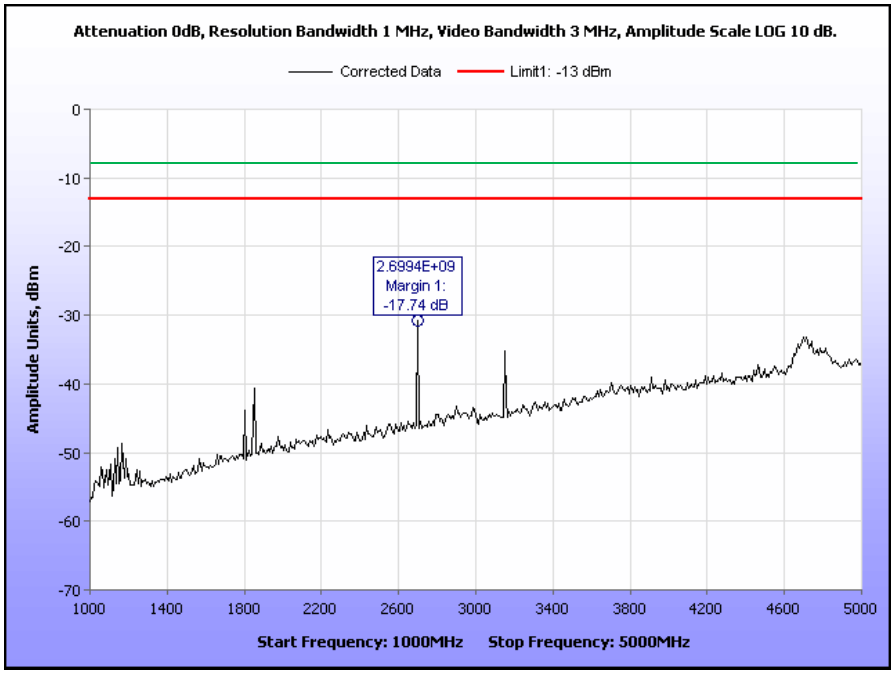
Test Results: Equipment complies with Section §2.1055, §90.210, and RSS-119.

Test Engineer(s): Benjamin Taylor

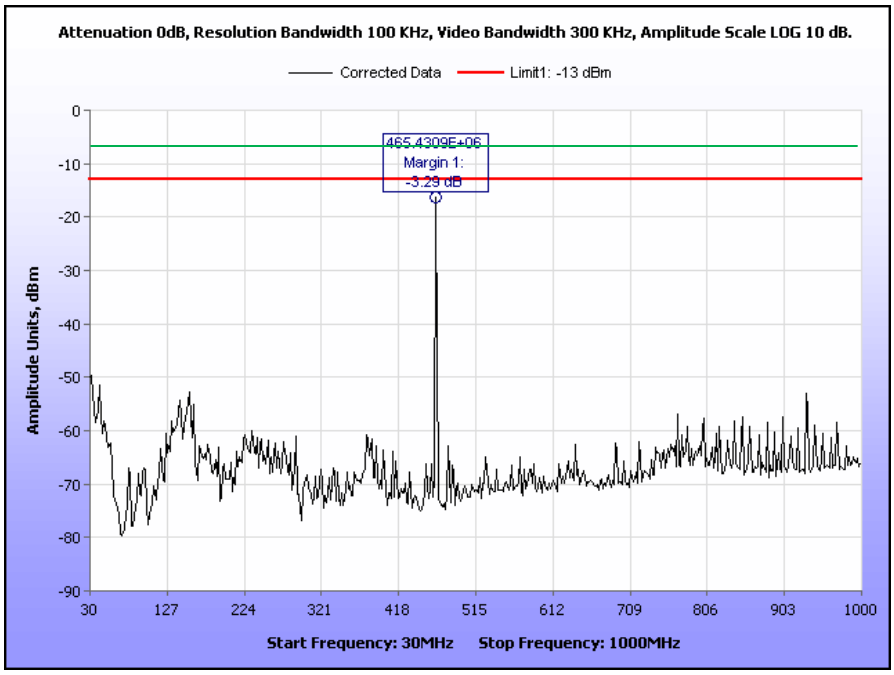
Test Date(s): 10/04/13



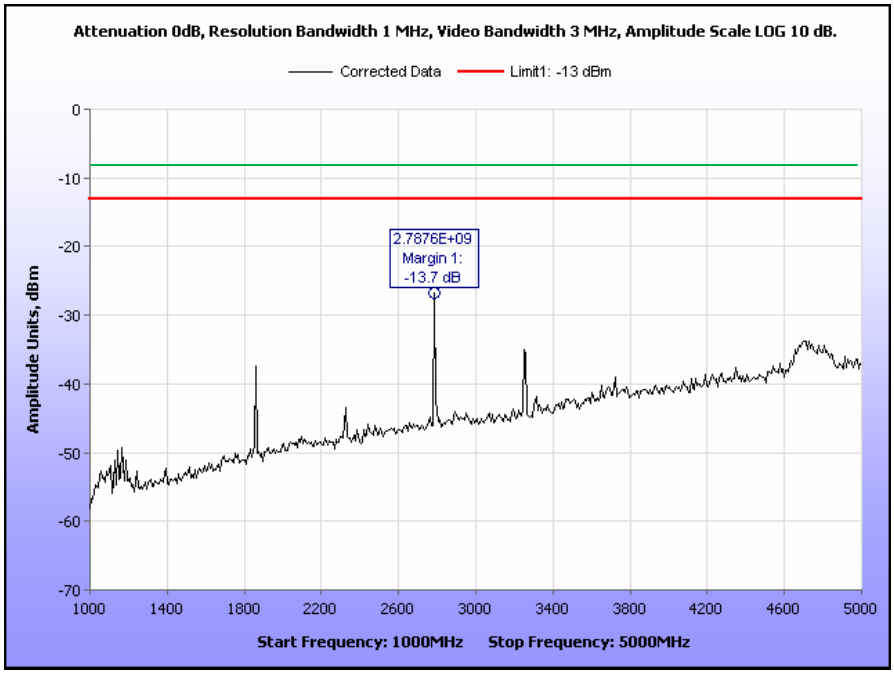
Plot 22. Radiated Spurious Emissions, TETRA, 22 kHz, Low Channel, 450 MHz, 30 MHz – 1 GHz



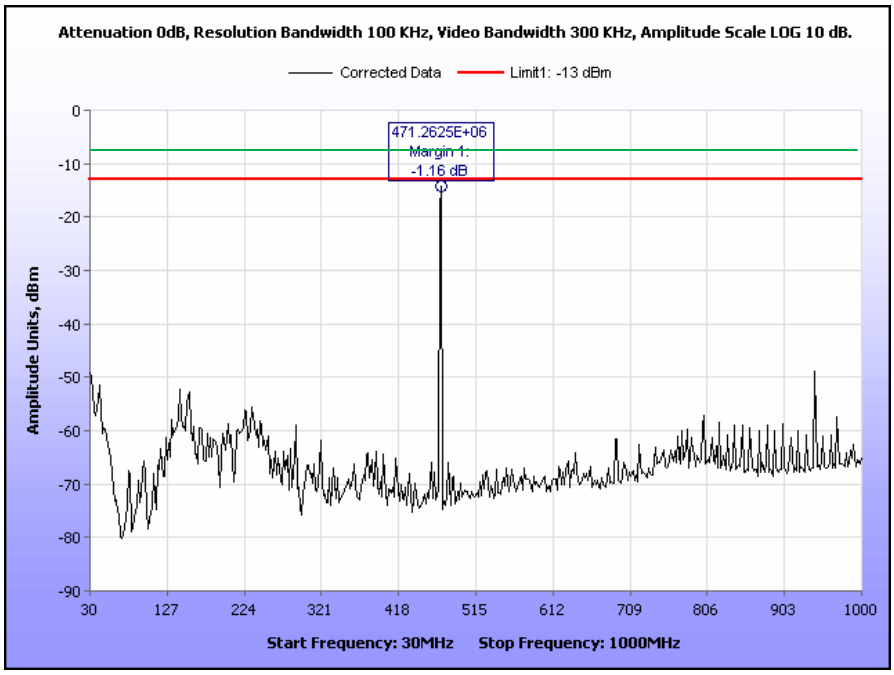
Plot 23. Radiated Spurious Emissions, TETRA, 22 kHz, Low Channel, 450 MHz, 1 GHz – 5 GHz



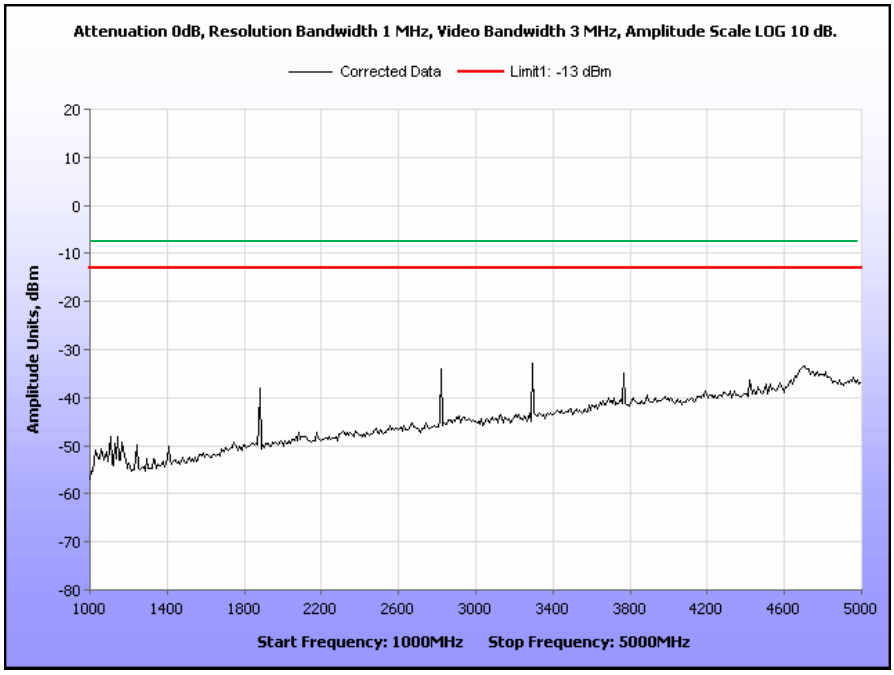
Plot 24. Radiated Spurious Emissions, TETRA, 22 kHz, Mid Channel, 465 MHz, 30 MHz – 1 GHz



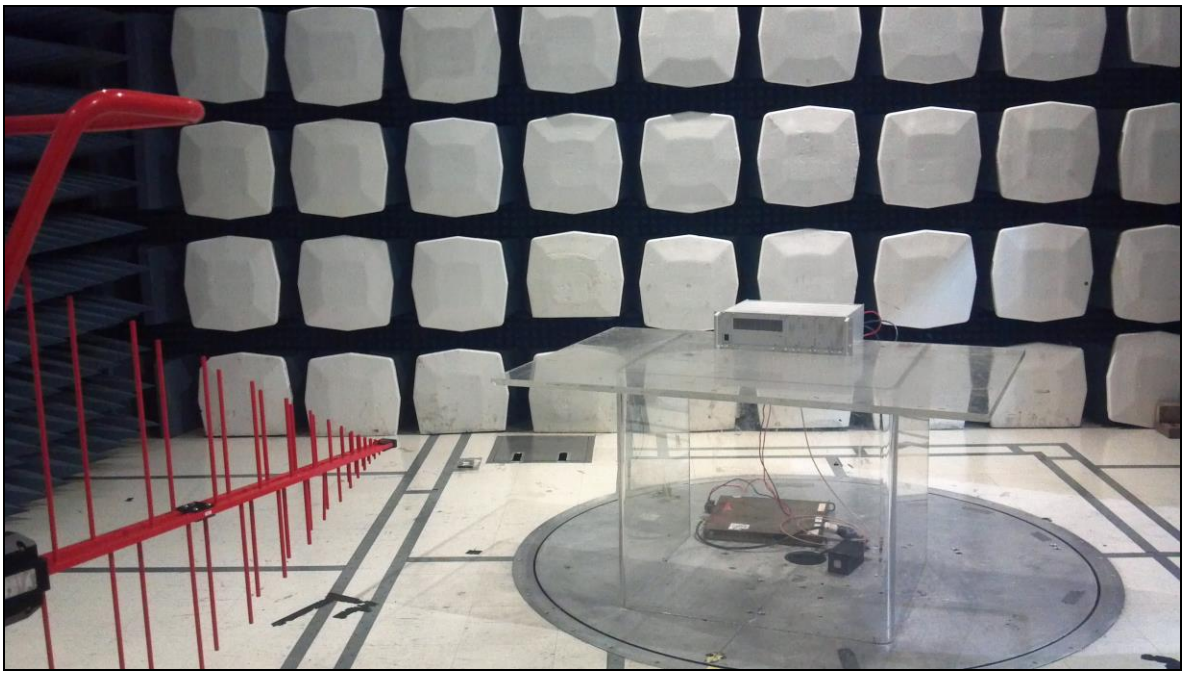
Plot 25. Radiated Spurious Emissions, TETRA, 22 kHz, Mid Channel, 465 MHz, 1 GHz – 5 GHz



Plot 26. Radiated Spurious Emissions, TETRA, 22 kHz, High Channel, 470 MHz, 30 MHz – 1 GHz



Plot 27. Radiated Spurious Emissions, TETRA, 22 kHz, High Channel, 470 MHz, 1 GHz – 5 GHz



Photograph 1. Radiated Test Setup

3.7. Transient Frequency Behavior

FCC §90.214
Test Requirement(s): **§90.214 Transient frequency behavior**

Transmitters designed to operate in the 150-174 MHz and 421-512 MHz frequency bands must maintain transient frequencies within the maximum frequency difference limits during the time intervals indicated:

Time intervals [1] [2]	Maximum frequency difference [3]	All equipment	
		150 to 174 MHz	421 to 512 MHz
Transient Frequency Behavior for Equipment Designed to Operate on 25 kHz Channels			
t_1 [4]	±25.0 kHz	5.0 ms	10.0 ms
t_2	±12.5 kHz	20.0 ms	25.0 ms
t_3 [4]	±25.0 kHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 12.5 kHz Channels			
t_1 [4]	±12.5 kHz	5.0 ms	10.0 ms
t_2	±6.25 kHz	20.0 ms	25.0 ms
t_3 [4]	±12.5 kHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 6.25 kHz Channels			
t_1 [4]	±6.25 kHz	5.0 ms	10.0 ms
t_2	±3.125 kHz	20.0 ms	25.0 ms
t_3 [4]	±6.25 kHz	5.0 ms	10.0 ms

1 t_{on} is the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.

t_1 is the time period immediately following t_{on}.

t_2 is the time period immediately following t_1.

t_3 is the time period from the instant when the transmitter is turned off until t_{off}.

t_{off} is the instant when the 1 kHz test signal starts to rise.

2 During the time from the end of $t_2$to the beginning of t_3, the frequency difference must not exceed the limits specified in § 90.213.

3 Difference between the actual transmitter frequency and the assigned transmitter frequency.

4 If the transmitter carrier output power rating is 6 watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

IC RSS-119, Section 5.9
Test Requirement(s): Transient Frequency Behaviour

When a transmitter is turned on, the radio frequency may take some time to stabilize. During this initial period, the frequency error or frequency difference (i.e. between the instantaneous and the steady state frequencies) shall not exceed the limits specified in Table 17.
Any suitable method of measurement can be used provided that it is fully described in the test report. A suitable and recommended method is given in TIA Standard 603.

Table 17 – Transient Frequency Behaviour

Channel Spacing (kHz)	Time Intervals [1], [2]	Maximum Frequency Difference (kHz)	Transient Duration Limit (ms)	
			138–174 MHz	406.1–512 MHz

Footnotes
back to footnote reference 1

1 t_{on}: the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.

t_1: the time period immediately following t_{on}.
t_2: the time period immediately following t_1.
t_3: the time period from the instant when the transmitter is turned off until t_{off}.
t_{off}: the instant when the 1 kHz test signal starts to rise.

back to footnote reference 2 If the transmitter carrier output power rating is 6 W or less, the frequency difference during the time periods t_1 and t_3 may exceed the maximum frequency difference for these time periods. The corresponding plot of frequency versus time during t_1 and t_3 shall be recorded in the test report.

Test Results: Equipment was not applicable with Section §90.214 and RSS-119, since this is a Class II Permissive Change.

3.8. RF Exposure

RF Exposure Requirements: **§1.1307(b)(1) and §1.1307(b)(2):** Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines.

§2.1091 Radio frequency radiation exposure evaluation: mobile devices

RF Radiation Exposure Limit: **§1.1310:** As specified in this section, the Maximum Permissible Exposure (MPE) Limit shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in Sec. 1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of Sec. 2.1093 of this chapter.

RSS-102 Requirement: Devices that have a radiating element normally operating at separation distances greater than 20 cm between the user and the device shall undergo an RF exposure evaluation.

RF exposure evaluation shall be made in accordance with the latest version of IEEE C95.3.

For the purpose of this standard, Industry Canada has adopted the SAR and RF field strength limits established in Health Canada's RF exposure guideline, Safety Code 6.

Test Results: Equipment was not applicable with this Section, since this is a Class II Permissive Change.

3.9. Receiver Spurious Emission

RSS-119, Section 5.11
Test Requirement(s): Receiver spurious emissions shall comply with the limits specified in RSS-Gen.

RSS-GEN, Section 6.1
Test Requirement(s): The following receiver spurious emission limits shall be complied with:

(a) If a radiated measurement is made, all spurious emissions shall comply with the limits of Table 5.

Spurious Frequency (MHz)	Field Strength (microvolt/m at 3 metres)
30 – 88	100
88 – 216	150
216 – 960	200
Above 960	500

Table 5. Spurious Emission Limits for Receivers

(b) If a conducted measurement is made, no spurious output signals appearing at the antenna terminals shall exceed 2 nanowatts per any 4 kHz spurious frequency in the band 30-1000 MHz, or 5 nanowatts above 1 GHz.

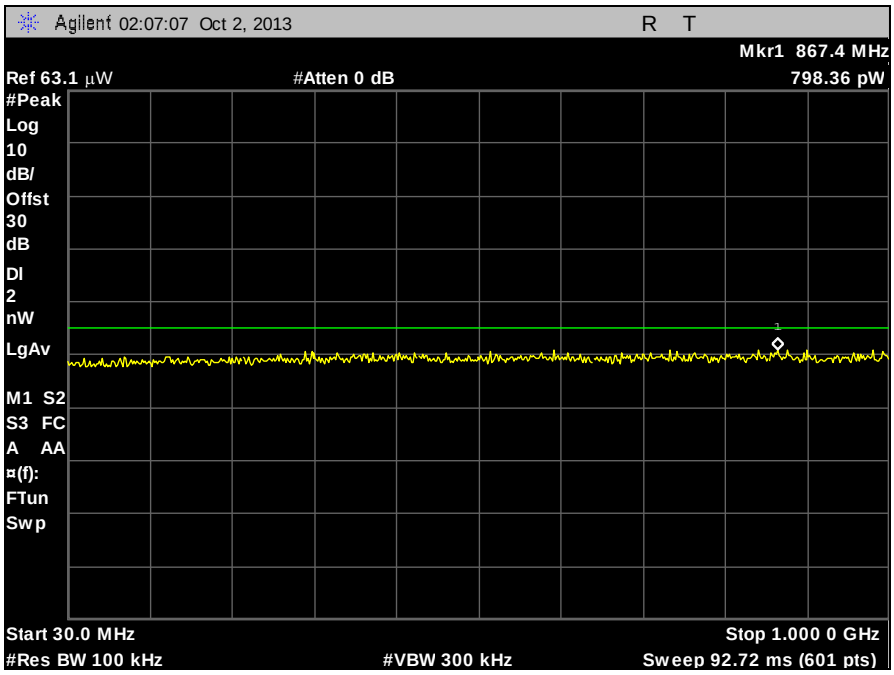
RSS-GEN, Section 4.10
Test Requirement(s): The receiver shall be operated in the normal receive mode near the mid-point of the band in which the receiver is designed to operate.
Radiated emission measurements are to be performed on a test site registered with Industry Canada. As an alternative, the conducted measurement method may be used when the antenna is detachable. In such a case, the receiver spurious signal may be measured at the antenna port.
If the receiver is super-regenerative, stabilize it by coupling to it an unmodulated carrier on the receiver frequency (antenna conducted measurement) or by transmitting an unmodulated carrier on the receiver frequency from an antenna in the proximity of the receiver (radiated measurement). Taking care not to overload the receiver, vary the amplitude and frequency of the stabilizing signal to obtain the highest level of the spurious emissions from the receiver.
For either method, the search for spurious emissions shall be from the lowest frequency internally generated or used in the receiver (e.g.. local oscillator, intermediate or carrier frequency), or 30 MHz, whichever is higher, to at least 3 times the highest tuneable or local oscillator frequency, whichever is higher, without exceeding 40 GHz.
For emissions below 1000 MHz, measurements shall be performed using a CISPR quasi-peak detector and the related measurement bandwidth. As an alternative to CISPR quasi-peak measurement, compliance with the emission limit can be demonstrated using measuring equipment employing a peak detector function properly adjusted for factors such as pulse desensitization as required, with an equal or greater measurement bandwidth relative to the applicable CISPR quasi-peak bandwidth.
Above 1000 MHz, measurements shall be performed using an average detector with a minimum resolution bandwidth of 1 MHz.

Test Procedures: The EUT was programmed for receive mode only. Conducted measurements were taken at the antenna port of the EUT. 100 kHz resolution bandwidth was used from 30 MHz - 1 GHz and 300 kHz resolution was used for measurements done above 1 GHz. All plots are corrected for cable loss.

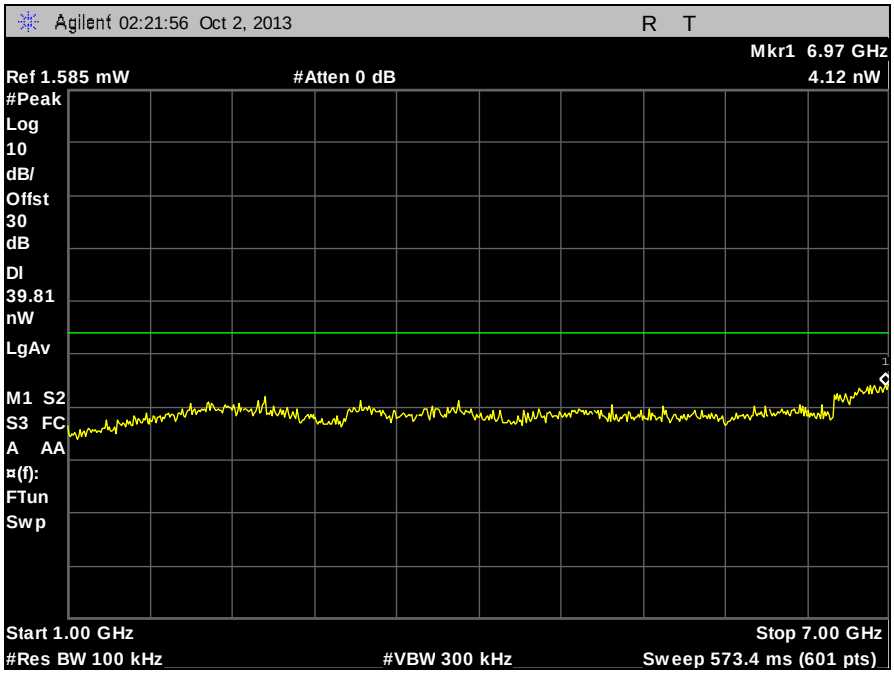
Test Results: Equipment is compliant with the Receiver Spurious Emissions Requirements of RSS-GEN and RSS-119.

Test Engineer(s): Benjamin Taylor

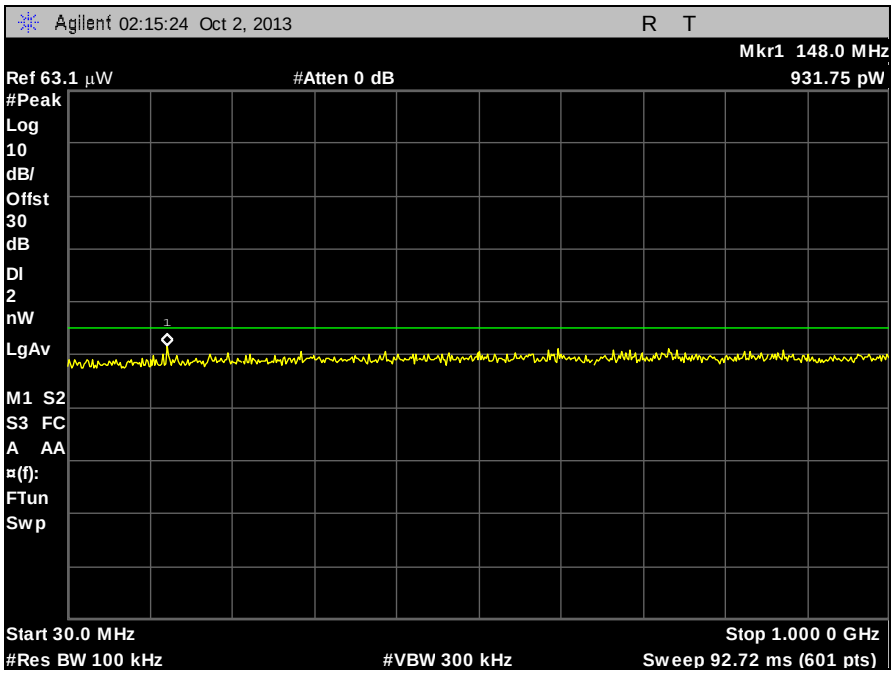
Test Date(s): 10/01/13



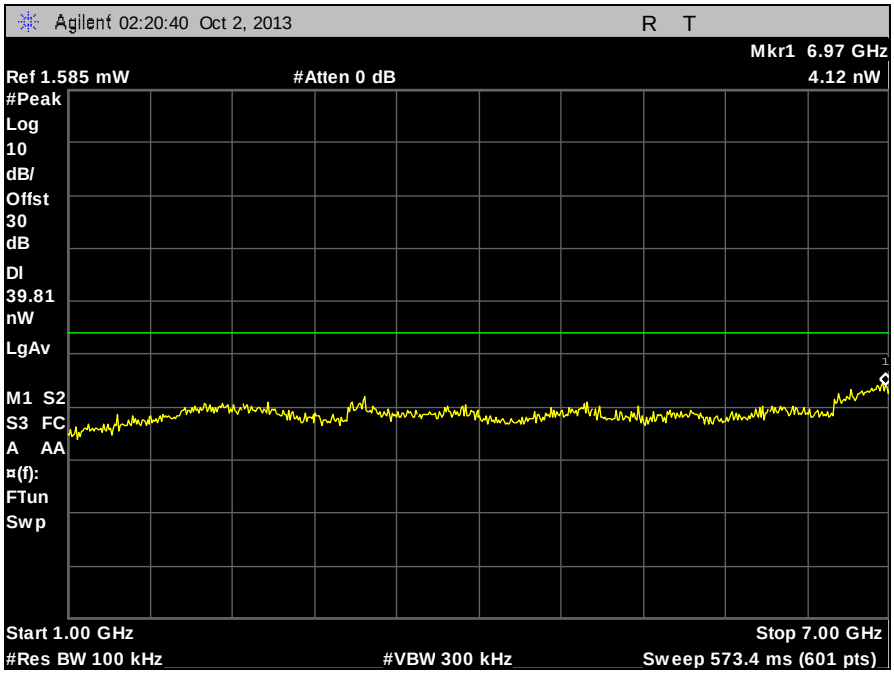
Plot 28. Receiver Spurious Emissions, TETRA, 22 kHz, Low Channel, 450 MHz, 30 MHz – 1 GHz



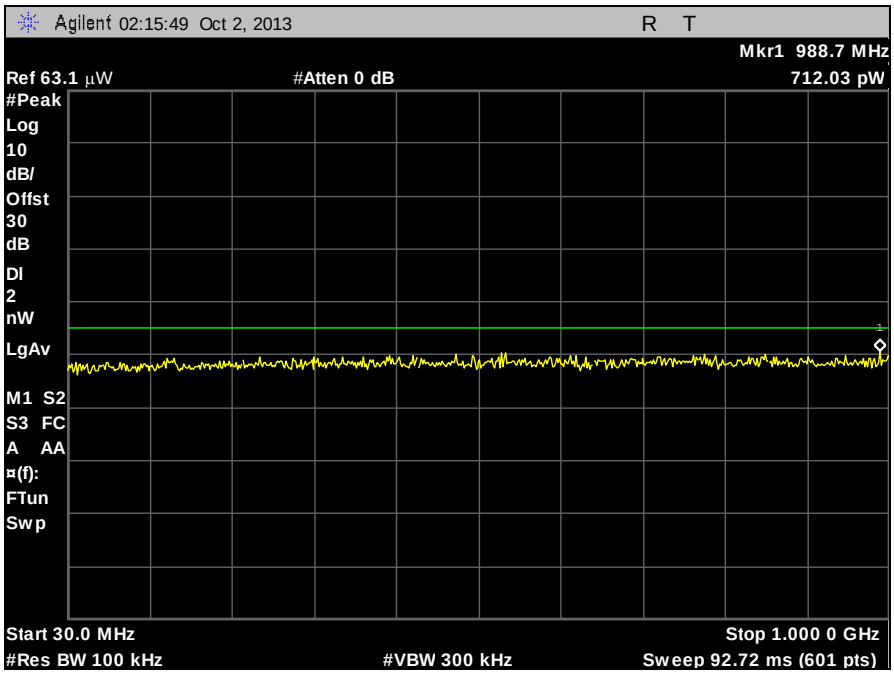
Plot 29. Receiver Spurious Emissions, TETRA, 22 kHz, Low Channel, 450 MHz, 1 GHz – 7 GHz



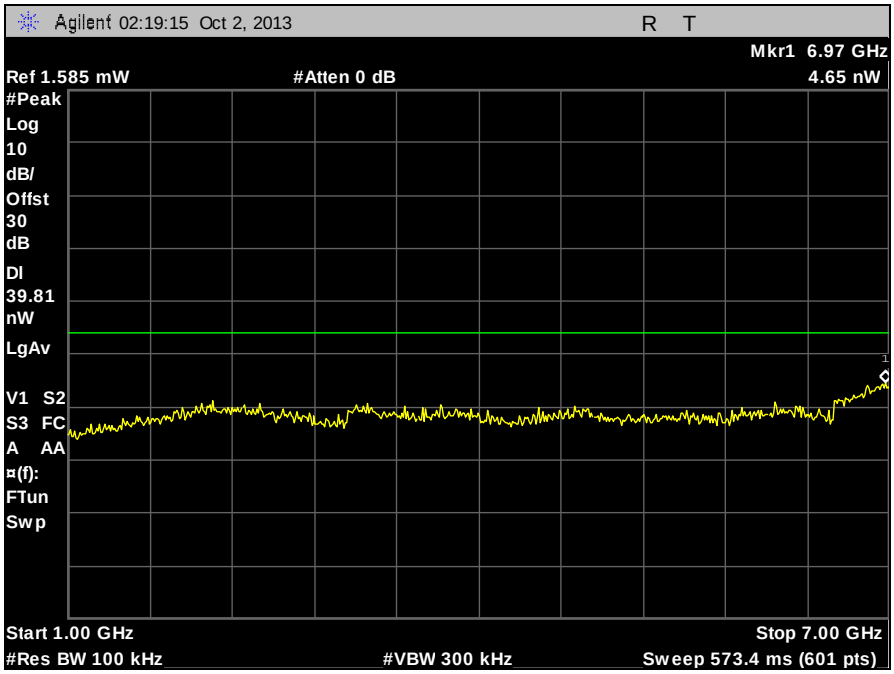
Plot 30. Receiver Spurious Emissions, TETRA, 22 kHz, Mid Channel, 465 MHz, 30 MHz – 1 GHz



Plot 31. Receiver Spurious Emissions, TETRA, 22 kHz, Mid Channel, 465 MHz, 1 GHz – 7 GHz



Plot 32. Receiver Spurious Emissions, TETRA, 22 kHz, High Channel, 470 MHz, 30 MHz – 1 GHz



Plot 33. Receiver Spurious Emissions, TETRA, 22 kHz, High Channel, 470 MHz, 1 GHz – 7 GHz

IV. Test Equipment

4. Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ISO/IEC 17025:2005.

MET Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1T4409	EMI RECEIVER	ROHDE & SCHWARZ	ESIB7	07/16/2012	07/16/2014
1T4787	HYGROMETER / THERMOMETER / BAROMETER / DEW POINT PEN	CONTROL COMPANY	15-078-198, FB70423, 245CD	02/15/2012	02/15/2014
1T4814	COMB GENERATOR	COM-POWER	CGO-5100	SEE NOTE	
1T4300A	SEMI-ANECHOIC CHAMBER # 1 (FCC)	EMC TEST SYSTEMS	NONE	07/24/2012	07/24/2015
1T4751	ANTENNA - BILOG	SUNOL SCIENCES	JB6	01/08/2013	07/08/2014
1T4829	SPECTRUM ANALYZER	AGILENT	E4407B	05/14/2013	11/14/2014
1T4771	PSA SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4446A	02/15/2013	08/15/2014
1T4548	AC POWER SOURCE	CALIFORNIA INSTRUMENTS	1251P	SEE NOTE	
1T4813	TRUE RMS MULTIMETER	FLUKE	115	10/22/2012	04/22/2014
1T4505	TEMPERATURE CHAMBER	TEST EQUITY	115	12/02/2012	12/02/2013
1T4757	ANTENNA; HORN	ETS-LINDGREN	3117	09/03/2013	03/03/2015
1T4300	SEMI-ANECHOIC CHAMBER # 1 (NSA)	EMC TEST SYSTEMS	NONE	07/24/2012	01/24/2014
1T4148	SHIELD ROOM #2 SEMI-ANECHOIC	RANTEC	20	SEE NOTE	
1T4566	FIELD PROBE, 27 MHZ - 60 GHZ	AMPLIFIER RESEARCH	FP7060	10/08/2012	04/08/2014
1T4475	POWER METER	HEWLETT PACKARD	EPM-442A	09/12/2012	03/12/2014
1T4458	POWER SENSOR	AGILENT TECHNOLOGIES	E9304A	05/12/2012	11/12/2013
1T4299	SIGNAL GENERATOR	HEWLETT PACKARD	E4432B	04/24/2012	10/24/2013
RENTAL	MODULATION DOMAIN ANALYZER	HEWLETT PACKARD	53310A	04/30/2013	04/30/2014

Note: Functionally tested equipment is verified using calibrated instrumentation at the time of testing.

V. Certification & User's Manual Information

5. Certification Label & User's Manual Information

5.1. Certification Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart I — Marketing of Radio frequency devices:

§ 2.801 Radio-frequency device defined.

As used in this part, a radio-frequency device is any device which in its operation is capable of Emitting radio-frequency energy by radiation, conduction, or other means. Radio- frequency devices include, but are not limited to:

(a) The various types of radio communication transmitting devices described throughout this chapter.

(b) The incidental, unintentional and intentional radiators defined in Part 15 of this chapter.

(c) The industrial, scientific, and medical equipment described in Part 18 of this chapter.

(d) Any part or component thereof which in use emits radio-frequency energy by radiation, conduction, or other means.

§ 2.803 Marketing of radio frequency devices prior to equipment authorization.

(a) Except as provided elsewhere in this chapter, no person shall sell or lease, or offer for sale or lease (including advertising for sale or lease), or import, ship or distribute for the purpose of selling or leasing or offering for sale or lease, any radio frequency device unless:

(1) In the case of a device subject to certification, such device has been authorized by the Commission in accordance with the rules in this chapter and is properly identified and labeled as required by §2.925 and other relevant sections in this chapter; or

(2) In the case of a device that is not required to have a grant of equipment authorization issued by the Commission, but which must comply with the specified technical standards prior to use, such device also complies with all applicable administrative (including verification of the equipment or authorization under a Declaration of Conformity, where required), technical, labeling and identification requirements specified in this chapter.

(d) Notwithstanding the provisions of paragraph (a) of this section, the offer for sale solely to business, commercial, industrial, scientific or medical users (but not an offer for sale to other parties or to end users located in a residential environment) of a radio frequency device that is in the conceptual, developmental, design or pre-production stage is permitted prior to equipment authorization or, for devices not subject to the equipment authorization requirements, prior to a determination of compliance with the applicable technical requirements *provided* that the prospective buyer is advised in writing at the time of the offer for sale that the equipment is subject to the FCC rules and that the equipment will comply with the appropriate rules before delivery to the buyer or to centers of distribution.

(e)(1) Notwithstanding the provisions of paragraph (a) of this section, prior to equipment authorization or determination of compliance with the applicable technical requirements any radio frequency device may be operated, but not marketed, for the following purposes and under the following conditions:

(i) Compliance testing;

(ii) Demonstrations at a trade show provided the notice contained in paragraph (c) of this section is displayed in a conspicuous location on, or immediately adjacent to, the device;

(iii) Demonstrations at an exhibition conducted at a business, commercial, industrial, scientific or medical location, but excluding locations in a residential environment, provided the notice contained in paragraphs (c) or (d) of this section, as appropriate, is displayed in a conspicuous location on, or immediately adjacent to, the device;

(iv) Evaluation of product performance and determination of customer acceptability, provided such operation takes place at the manufacturer's facilities during developmental, design or pre-production states; or

(v) Evaluation of product performance and determination of customer acceptability where customer acceptability of a radio frequency device cannot be determined at the manufacturer's facilities because of size or unique capability of the device, provided the device is operated at a business, commercial, industrial, scientific or medical user's site, but not at a residential site, during the development, design or pre-production stages.

(e)(2) For the purpose of paragraphs (e)(1)(iv) and (e)(1)(v) of this section, the term *manufacturer's facilities* includes the facilities of the party responsible for compliance with the regulations and the manufacturer's premises, as well as the facilities of other entities working under the authorization of the responsible party in connection with the development and manufacture, but not the marketing, of the equipment.

(f) For radio frequency devices subject to verification and sold solely to business, commercial, industrial, scientific and medical users (excluding products sold to other parties or for operation in a residential environment), parties responsible for verification of the devices shall have the option of ensuring compliance with the applicable technical specifications of this chapter at each end user's location after installation, provided that the purchase or lease agreement includes a provision that such a determination of compliance be made and is the responsibility of the party responsible for verification of the equipment.

The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart Y — Equipment Authorization Procedures:

§ 2.901 Basis and Purpose

(a) In order to carry out its responsibilities under the Communications Act and the various treaties and international regulations, and in order to promote efficient use of the radio spectrum, the Commission has developed technical standards for radio frequency equipment and parts or components thereof. The technical standards applicable to individual types of equipment are found in that part of the rules governing the service wherein the equipment is to be operated.[1] *In addition to the technical standards provided, the rules governing the service may require that such equipment be verified by the manufacturer or importer*, be authorized under a Declaration of Conformity, or receive an equipment authorization from the Commission by one of the following procedures: certification or registration.

(b) The following sections describe the verification procedure, the procedure for a Declaration of Conformity, and the procedures to be followed in obtaining certification from the Commission and the conditions attendant to such a grant, whichever is applicable.

§ 2.902 Certification.

(a) Certification is an equipment authorization issued by the Commission, based on representation and test data submitted by the applicant.

(b) Certification attaches to all units subsequently marketed by the grantee which are identical (see Section 2.908) to the sample tested except for permissive changes or other variations authorized by the Commission pursuant to Section 2.1043.

[1] In this case, the equipment is subject to the rules of Part 15. More specifically, the equipment falls under Subpart B (of Part 15), which deals with unintentional radiators.

§ 2.948 Description of measurement facilities.

(a) Each party making measurements of equipment that is subject to an equipment authorization under Part 15 or Part 18 of this chapter, regardless of whether the measurements are filed with the Commission or kept on file by the party responsible for compliance of equipment marketed within the U.S. or its possessions, shall compile a description of the measurement facilities employed.

(1) If the measured equipment is subject to the verification procedure, the description of the measurement facilities shall be retained by the party responsible for verification of the equipment.

(i) If the equipment is verified through measurements performed by an independent laboratory, it is acceptable for the party responsible for verification of the equipment to rely upon the description of the measurement facilities retained by or placed on file with the Commission by that laboratory. In this situation, the party responsible for the verification of the equipment is not required to retain a duplicate copy of the description of the measurement facilities.

(ii) If the equipment is verified based on measurements performed at the installation site of the equipment, no specific site calibration data is required. It is acceptable to retain the description of the measurement facilities at the site at which the measurements were performed.

(2) If the equipment is to be authorized by the Commission under the certification procedure, the description of the measurement facilities shall be filed with the Commission's Laboratory in Columbia, Maryland. The data describing the measurement facilities need only be filed once but must be updated as changes are made to the measurement facilities or as otherwise described in this section. At least every three years, the organization responsible for filing the data with the Commission shall certify that the data on file is current.

5.2. Label and User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart A — General:

§ 15.19 Labeling requirements.

(a) In addition to the requirements in Part 2 of this chapter, a device subject to certification or verification shall be labeled as follows:

(1) Receivers associated with the operation of a licensed radio service, e.g., FM broadcast under Part 73 of this chapter, land mobile operation under Part 90, etc., shall bear the following statement in a conspicuous location on the device:

This device complies with Part 15 of the FCC Rules. Operation is subject to the condition that this device does not cause harmful interference.

(2) A stand-alone cable input selector switch, shall bear the following statement in a conspicuous location on the device:

This device is verified to comply with Part 15 of the FCC Rules for use with cable television service.

(3) All other devices shall bear the following statement in a conspicuous location on the device:

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

(4) Where a device is constructed in two or more sections connected by wires and marketed together, the statement specified under paragraph (a) of this section is required to be affixed only to the main control unit.

(5) When the device is so small or for such use that it is not practicable to place the statement specified under paragraph (a) of this section on it, the information required by this paragraph shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user or, alternatively, shall be placed on the container in which the device is marketed. However, the FCC identifier or the unique identifier, as appropriate, must be displayed on the device.

§ 15.21 Information to user.

The users manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart B — Unintentional Radiators:

§ 15.105 Information to the user.

(a) For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

– Reorient or relocate the receiving antenna.
– Increase the separation between the equipment and receiver.
– Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
– Consult the dealer or an experienced radio/TV technician for help.

ICES-003 Procedural & Labeling Requirements

From the Industry Canada Electromagnetic Compatibility Advisory Bulletin entitled, "Implementation and Interpretation of the Interference-Causing Equipment Standard for Digital Apparatus, ICES-003" (EMCAB-3, Issue 2, July 1995):

> "At present, CISPR 22: 2002 and ICES technical requirements are essentially equivalent. Therefore, if you have CISPR 22: 2002 approval by meeting CISPR Publication 22, the only additional requirements are: to attach a note to the report of the test results for compliance, indicating that these results are deemed satisfactory evidence of compliance with ICES-003 of the Canadian Interference-Causing Equipment Regulations; to maintain these records on file for the requisite five year period; and to provide the device with a notice of compliance in accordance with ICES-003."

Procedural Requirements:

According to Industry Canada's Interference Causing Equipment Standard for Digital Apparatus ICES-003 Issue 5 August 2012:

Section 6.1: A record of the measurements and results, showing the date that the measurements were completed, shall be retained by the manufacturer or importer for a period of at least five years from the date shown in the record and made available for examination on the request of the Minister.

Section 6.2: A written notice indicating compliance must accompany each unit of digital apparatus to the end user. The notice shall be in the form of a label that is affixed to the apparatus. Where because of insufficient space or other constraints it is not feasible to affix a label to the apparatus, the notice may be in the form of a statement in the users' manual.

Labeling Requirements:

The suggested text for the notice, in English and in French, is provided below, from the Annex of ICES-003:

CAN ICES-3 (B)/NMB-3(B)

End of Report

