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

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December 13, 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., TRM-300 409 - 470 MHz, tested to the requirements of Title 47 of the Code of Federal Regulations (CFR), Part 15 Subpart B and ICES-003, Issue 5 August 2012 for a Class B Digital Device, Part 90 and RSS-119, Issue 11, June 2011 for Land Mobile Radio Services, and Part 22 Subpart E for Paging and Radiotelephone Service.

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.\EMC39733-FCC 15/22/90-IC RSS-119/ICES-003 Rev. 5)

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Electromagnetic Compatibility Criteria
Test Report

For the

Teltronic, S.A.U.
TRM-300 409 - 470 MHz

Tested under

The FCC and IC Verification Rules
Contained in Title 47 of the CFR, Part 15 B and ICES-003
for a Class B Digital Device
&
Part 90 and RSS-119
for Private Land Mobile Radio Services
&
Part 22 Subpart E for Paging and Radiotelephone Service

MET Report: EMC39733-FCC 15/22/90-IC RSS-119/ICES-003 Rev. 5

December 13, 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: EMC39733-FCC 15/22/90-IC RSS-119/ICES-003 Rev. 5

Len Knight, 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 15 B, Part 22, and Part 90 of the FCC Rules and ICES-003 and RSS-119 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
∅	October 17, 2013	Initial Issue.
1	November 12, 2013	Revised to reflect customer corrections.
2	November 26, 2013	Revised to reflect customer corrections.
3	December 3, 2013	Revised to reflect engineer corrections.
4	December 9, 2013	Revised to reflect engineer corrections.
5	December 13, 2013	Revised to correct MPE.

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**ert**z**
IEC	**I**nternational **E**lectrotechnical **C**ommission
kHz	**k**ilo**h**ert**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 47CFR Part 15, Part 22 and Part 90, and IC RSS-119 and ICES-003. All tests were conducted using measurement procedure ANSI TIA/EIA-603-A-2004.

Title 47 of the CFR, Part 15, Part 22, Part 90, and FCC 04-265 Reference and Test Description	Industry Canada References	Compliance
47 CFR Part 15.107 (a) Conducted Emissions	ICES-003, Issue 5 August 2012	Compliant
47 CFR Part 15.109 (a) Radiated Emissions	ICES-003, Issue 5 August 2012	Compliant
§2.1046, §22.565, §90.205 RF Output Power	RSS-119, Section 5.4	Compliant
§2.1047, §22.357, §90.207 Modulation Characteristics, Audio Frequency & Filter Response	RSS-119, Section 5.2	Compliant
§2.1049, 90.210(d) Occupied Bandwidth (Emission Mask)	RSS-119, Section 5.5 RSS-GEN 99% Bandwidth	Compliant
§2.1051, §22.359, §90.210(d) Spurious Emissions at Antenna Terminals	RSS-GEN, 4.9 RSS-119, Section 4.2 & 5.8	Compliant
§90.221 Adjacent Channel Power FCC Report & Order 12-114	N/A	Compliant
§2.1055, §22.355, §90.213 Frequency Stability	RSS-119, Section 5.3	Compliant
§2.1053, §22.359, §90.210 Field Strength of Spurious Radiation	RSS-119, Section 5.8	Compliant
§90.214 Transient Frequency Behavior	RSS-119, Section 5.9	Compliant
§2.1091 RF Exposure	RSS-102 Issue 4, March 2010	Compliant
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 TRM-300 409 - 470 MHz under quote number 1TEL0805R2.

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., TRM-300 409 - 470 MHz.

An EMC evaluation to determine compliance of the TB 4.9 with the requirements of Part 22 and 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:	TRM-300 409 - 470 MHz	
Model(s) Covered:	TRM-300 409 - 470 MHz	
Filing Option:	Original	
EUT Specifications:	Primary Power Source: 7.4 VDC	
	FCC ID: WT7PTRKTTRM300410 IC: 8624A-PTTRM410	
	Type of Modulations:	TI D-LMR: π/4-DQPSK TETRA: π/4-DQPSK
	EUT Frequency Ranges:	TI D-LMR (FCC Part 90):409-430; 450-470 MHz TI D-LMR (FCC Part 22):454-455;459-460 MHz TI D-LMR (IC): 409-430; 450-470 MHz TETRA (FCC Part 90):450-470 MHz TETRA (IC):409-430; 450-470 MHz
	Emission Designators:	TI D-LMR: 20K0D7W, 20K0D7E, 20K0D7D, 20K0Q7W, 20K0Q7E, 20K0Q7D TETRA: 22K0D7W, 22K0D7E, 22K0D7D, 22K0Q7W, 22K0Q7E, 22K0Q7D
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:	Len Knight	
Report Date(s):	December 13, 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. TRM-300 409 - 470 MHz, Equipment Under Test (EUT), is a radio modem, which is offered as a limited single-modular transmitter, subject to the licensed radio services rules.
It has not a user interface (display or keypad) and it is designed to be managed from a data application through the serial interface via AT commands or PPP connection. The equipment is ready to transmit and receive audio in PCM digital format.
A GPS receiver is also included.

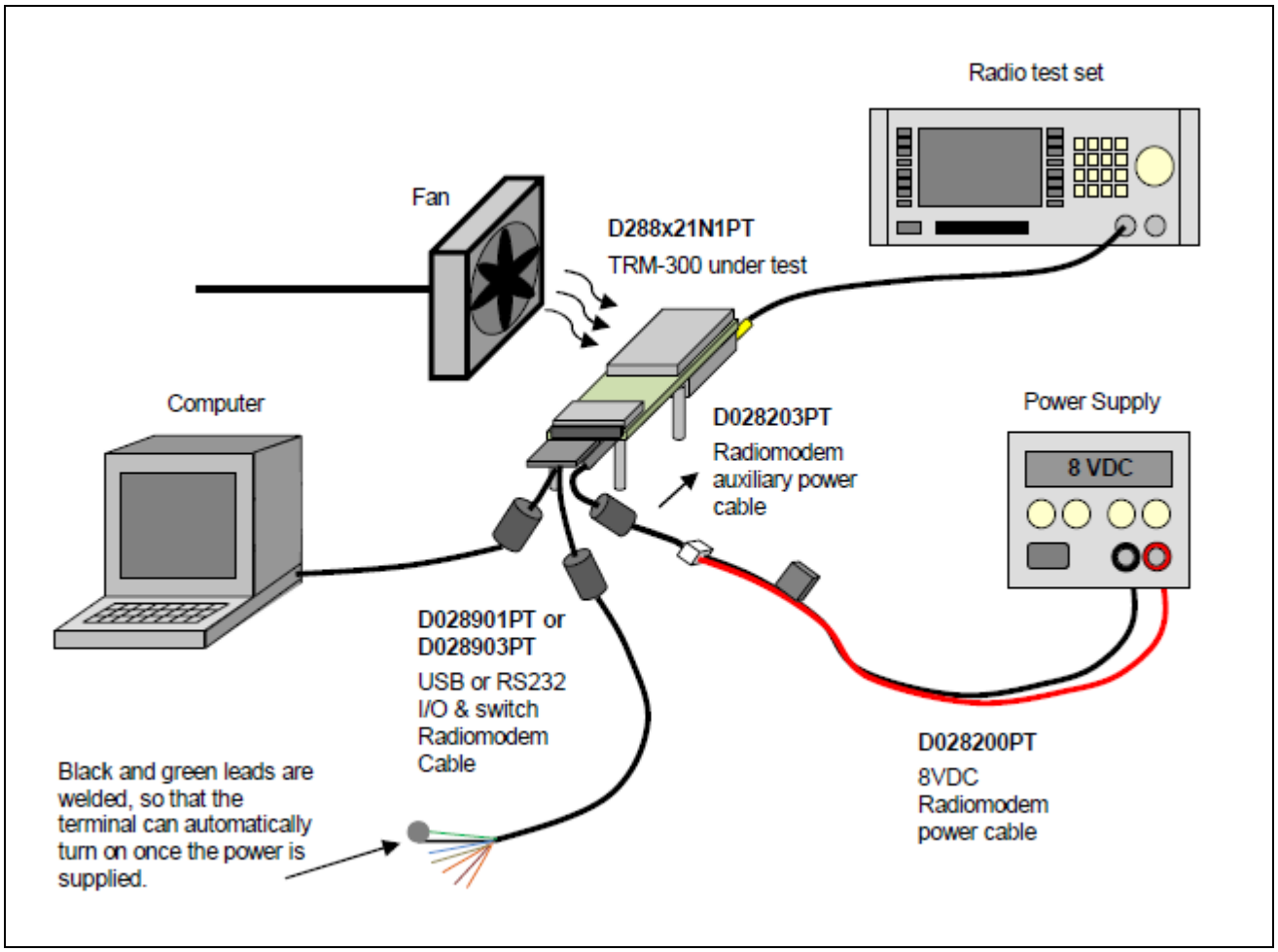


Figure 1. Connection Diagram for the Tests in TX Mode

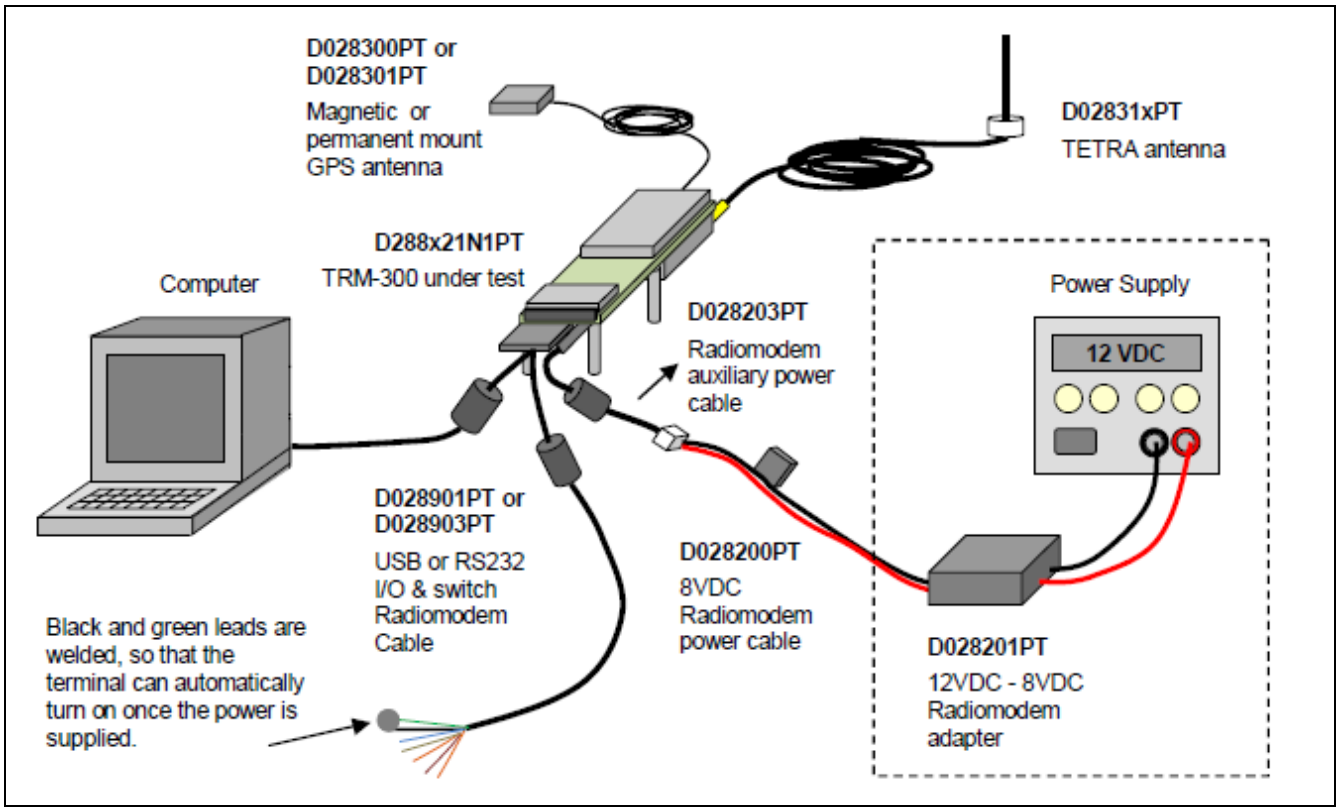


Figure 2. Configuration A: Supplying Power to the EUT from a DC Power Supply

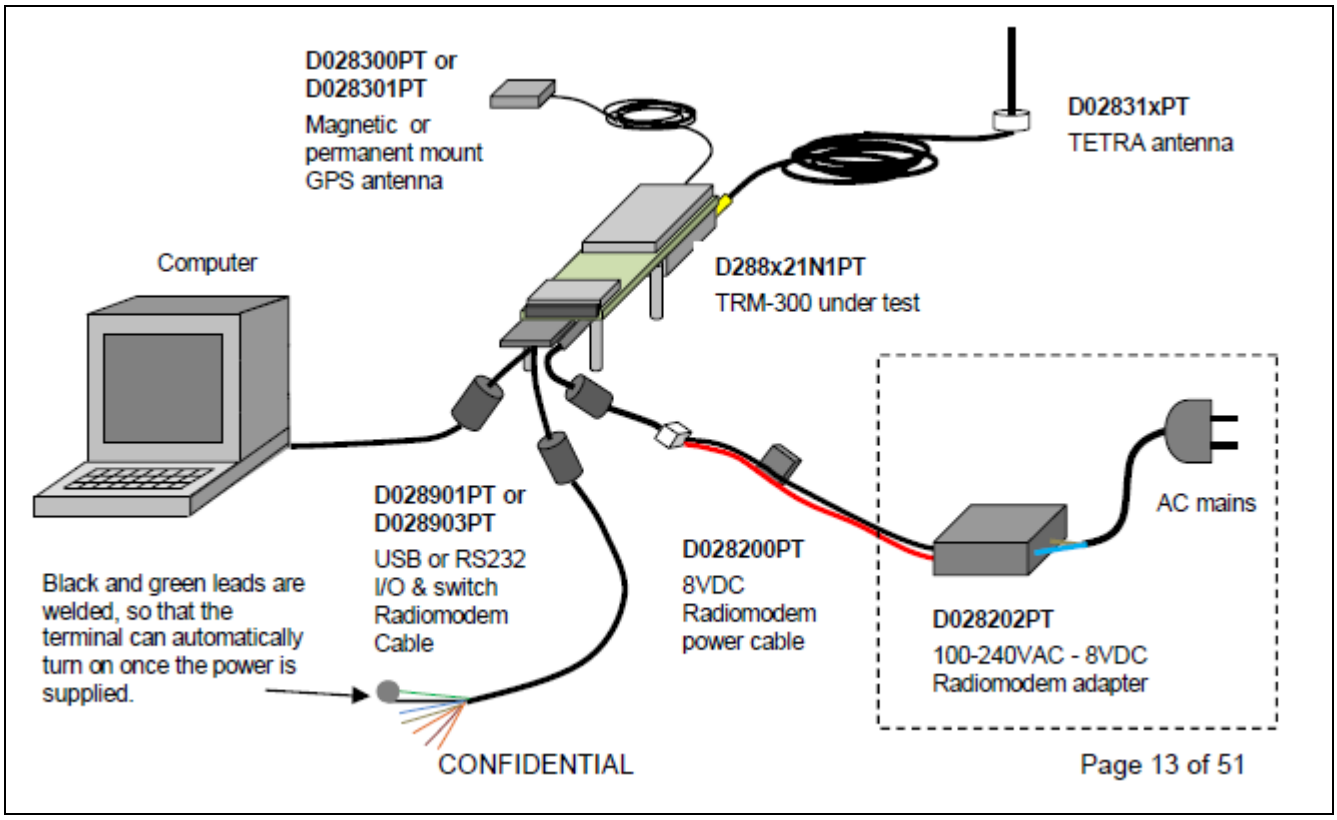


Figure 3. Configuration B: Supplying Power to the EUT from the AC Mains

2.4. Equipment Configuration

Ref. ID	Name / Description	Model Number	Serial Number
D288Y21N1PT	TRM-300 409-470MHz	--	000149.03.172108.0
D288Y21N1PT	TRM-300 409-470MHz	--	000149.03.172109.0
Each EUT includes:			
--	MAIN PCB	F072001	--
--	GPS PCB	F072004	--

Table 1. Equipment Configuration

2.5. Support Equipment

Teltronic, S.A.U. supplied the support equipment necessary for the operation and testing of the TRM-300 409 - 470 MHz. All support equipment supplied is listed in the following Support Equipment List.

Ref. ID	Name / Description	Manufacturer	Model Number
D02831WPT	¼-wave 380-430 MHz antenna	Panorama	EBMF-TET-5
D02831YPT	¼-wave 430-472 MHz antenna	Panorama	EBMF-U-5
D028300PT	Magnetic mount GPS antenna	Opaniel	118009065
D028301PT	Permanent mount GPS antenna	San Jose Navigation	RV-76ND
D028901PT	USB, I/O & Switch cable	Teltronic / PowerTrunk	D028901PT
D028903PT	RS-232, I/O & Switch cable	Teltronic / PowerTrunk	D028903PT
D028203PT	Auxiliary power cable	Teltronic / PowerTrunk	D028203PT
D028200PT	8VDC power cable	Teltronic / PowerTrunk	D028200PT
D028201PT	12VDC to 8VDC adapter	Alfatronix	DD 10/32-8 064
D028202PT	100~240VAC to 8VDC adapter	Sunpower	SPS-S060-7.5
D028001PT	Thermal dissipator Kit	Meccal	P12040

Table 2. Support Equipment

2.6. Mode of Operation

EUT can transmit and receive two possible modulations, with different authorized bandwidths:

- TETRA: 22 KHz
- TI D-LMR: 20 KHz

The EUT included test software which allowed the EUT to transmit on any frequency in the applicable ranges.

2.7. Method of Monitoring EUT Operation

There are two indicator lights on the Main_PCB, one on each side and both showing the same information. They indicate when the transmitter is active.
A third indicator light is present on the GPS_PCB, which indicates the GPS receiver status.

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 Unintentional Radiators

3. Electromagnetic Compatibility Criteria

3.1. Conducted Emissions Limits

Part §15.107 (a) Conducted Emissions

Test Requirement(s): **15.107 (a)** Except for Class A digital devices, for equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in Table 3. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals.

15.107 (b) For a Class A digital device that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in Table 3. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals. The lower limit applies at the band edges.

Frequency range (MHz)	Class A Conducted Limits (dBµV)		Class B Conducted Limits (dBµV)	
	Quasi-Peak	Average	Quasi-Peak	Average
0.15- 0.50	79	66	66 - 56	56 - 46
0.5 – 5	73	60	56	46
5 - 30	73	60	60	50
Note 1 — The lower limit shall apply at the transition frequencies. Note 2 — The limit decreases linearly with the logarithm if the frequency in the range 0.15 MHz to 0.5 MHz.				

Table 3. Conducted Limits for Radio Frequency Devices calculated from FCC Part 15 Subsections 15.107(a) (b)

ICES-003, Issue 5 August 2012

Test Requirement(s): **Section 6.1 – AC Power Line Conducted Emissions Limits**

Class A: An ITE meeting the conditions for Class A operation defined in Section 2.2 shall comply with the Class A conducted limits set out in Table 4.

Class A Conducted Limits		
Frequency (MHz)	Class A Conducted Limit (dBµV)	
	Quasipeak	Average
0.15 to 0.5	79	66
0.5 to 30	73	60

Table 4. AC Power Line Conducted Emissions Limits, Class A

Class B: An ITE that does not meet the conditions for Class A operation shall comply with the Class B conducted limits set out in Table 5.

Class B Conducted Limits		
Frequency (MHz)	Class B Conducted Limit (dBµV)	
	Quasipeak	Average
0.5	66 to 56*	56 to 46*
0.5 to 5	56	46
5 to 30	60	50
* Decreases with the logarithm of the frequency.		

Table 5. AC Power Line Conducted Emissions Limits, Class B

Test Procedures: The EUT was placed on a non-metallic table, 80 cm above the ground plane inside a semi-anechoic chamber. The method of testing, test conditions, and test procedures of ANSI C63.4 were used. The EUT was powered through a 50Ω/50µH LISN. An EMI receiver, connected to the measurement port of the LISN, scanned the frequency range from 150 kHz to 30 MHz in order to find the peak conducted emissions. All peak emissions within 6 dB of the limit were re-measured using a quasi-peak and/or average detector as appropriate.

Test Results: The EUT was compliant with the Class B requirement(s) of this section. Measured emissions were below applicable limits.

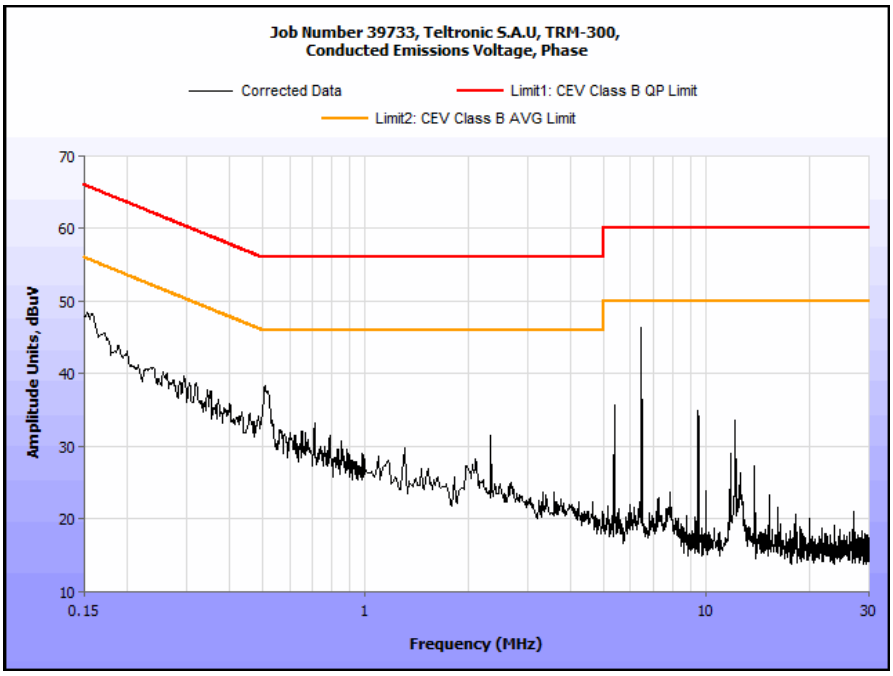
Test Engineer(s): Djed Mouada

Test Date(s): 09/22/13

Conducted Emissions - Voltage, AC Power, Phase Line (120 VAC, 60 Hz)

Frequency (MHz)	Uncorrected Meter Reading (dBµV) QP	Cable Loss (dB)	Corrected Measurement (dBµV) QP	Limit (dBµV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBµV) Avg.	Cable Loss (dB)	Corrected Measurement (dBµV) AVG	Limit (dBµV) AVG	Margin (dB) AVG
0.169	42.29	0	42.29	65.01	-22.72	31.47	0	31.47	55.01	-23.54
0.37	35.29	0	35.29	58.5	-23.21	21.12	0	21.12	48.5	-27.38
0.512	34.65	0	34.65	56	-21.35	26.5	0	26.5	46	-19.5
7.406	49.18	0.17	49.35	60	-10.65	42.61	0.17	42.78	50	-7.22
12.8	21.06	0	21.06	60	-38.94	13.92	0	13.92	50	-36.08
25	18.86	0	18.86	60	-41.14	12.11	0	12.11	50	-37.89

Table 6. Conducted Emissions - Voltage, AC Power, Phase Line (120 VAC, 60 Hz)

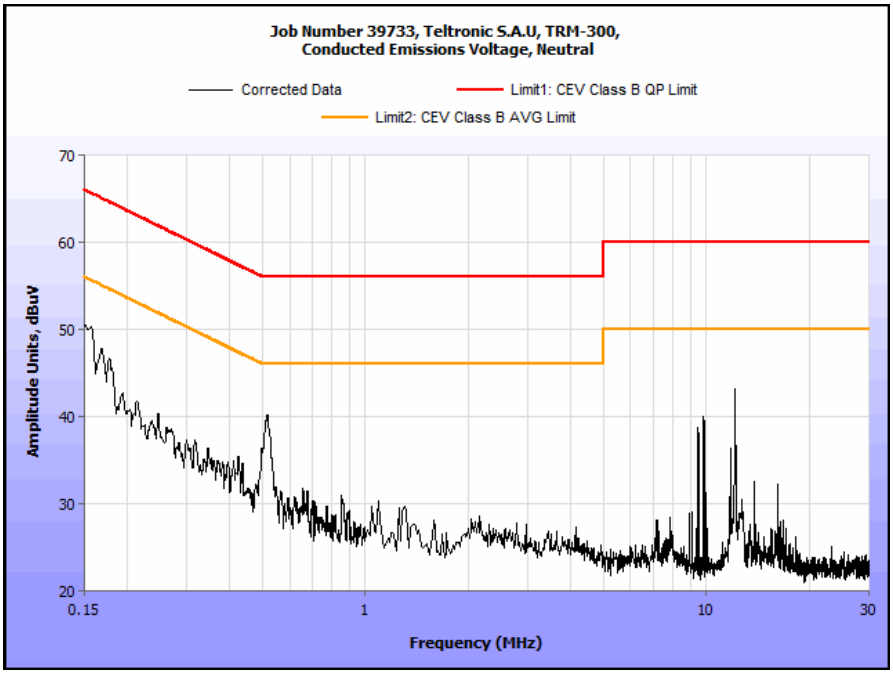


Plot 1. Conducted Emission, Phase Line Plot

Conducted Emissions - Voltage, AC Power, Neutral Line (120 VAC, 60 Hz)

Frequency (MHz)	Uncorrected Meter Reading (dBµV) QP	Cable Loss (dB)	Corrected Measurement (dBµV) QP	Limit (dBµV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBµV) Avg.	Cable Loss (dB)	Corrected Measurement (dBµV) AVG	Limit (dBµV) AVG	Margin (dB) AVG
0.15	39.07	0	39.07	66	-26.93	22.94	0	22.94	56	-33.06
0.512	37.29	0	37.29	56	-18.71	29.45	0	29.45	46	-16.55
1.1	25.57	0	25.57	56	-30.43	18.75	0	18.75	46	-27.25
9.47	36.2	0.17	36.37	60	-23.63	32.54	0.17	32.71	50	-17.29
9.92	31.7	0.17	31.87	60	-28.13	28.13	0.17	28.3	50	-21.7
12.159	43.98	0	43.98	60	-16.02	38.96	0	38.96	50	-11.04

Table 7. Conducted Emissions - Voltage, AC Power, Neutral Line (120 VAC, 60 Hz)



Plot 2. Conducted Emission, Neutral Line Plot

Conducted Emission Limits Test Setup

Photograph 1. Conducted Emissions, Test Setup

3.2. Radiated Emissions Limits

Part §15.109 Radiated Emissions

Test Requirement(s): **15.109 (a)** Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the Class B limits expressed in Table 8.

15.109 (b) The field strength of radiated emissions from a Class A digital device, as determined at a distance of 10 meters, shall not exceed the Class A limits expressed in Table 8.

Frequency (MHz)	Field Strength (dBµV/m)	
	§15.109 (b), Class A Limit (dBµV) @ 10m	§15.109 (a),Class B Limit (dBµV) @ 3m
30 - 88	39.00	40.00
88 - 216	43.50	43.50
216 - 960	46.40	46.00
Above 960	49.50	54.00

Table 8. Radiated Emissions Limits calculated from FCC Part 15, §15.109 (a) (b)

ICES-003, Issue 5 August 2012

Test Requirement(s): **Section 6.2 – Radiated Emissions Limits**

Radiated emissions from an ITE shall be measured from the lowest frequency generated, or used, in the device or 30 MHz, whichever is higher, up to the frequency determined in accordance with Table 9.

Frequency Range of Measurement	
Highest Frequency Generated or Used in Device	Upper Frequency of Radiated Measurement
Below 1.705 MHz	No radiated testing required
1.705 MHz – 108 MHz	1 GHz
108 MHz – 500 MHz	2 GHz
500 MHz – 1 GHz	5 GHz
Above 1 GHz	5th harmonic of the highest frequency or 40 GHz, whichever is lower.

Table 9. Radiated Emissions Limits

At frequencies at or above 30 MHz, measurements may be performed at a distance other than what is specified in this Section. Measurements are not made in the near field except where it can be shown that near field measurements are appropriate due to the characteristics of the device; and it can be demonstrated that the signal levels needed to be measured at the distance employed can be detected by the measurement equipment. Measurements shall not be performed at a distance greater than 30 meters unless it can be demonstrated that measurements at a distance of 30 meters or less are not practical. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse linear distance for field strength measurements).

6.2.1 Radiated Emissions Limits below 1 GHz

Class A: An ITE meeting the conditions for Class A operation defined in Section 2.2 shall comply with the Class A radiated limits set out in Table 10 determined at a distance of 10 meters.

Class A Radiated Limits below 1 GHz	
Frequency (MHz)	Class A Radiated Limit (dBµV/m)
	Quasi-peak
30 to 88	39
88 to 216	43.5
216 to 960	46.4
960 to 1000	49.5

Table 10. Class A Radiated Limits below 1 GHz

Class B: An ITE that does not meet the conditions for Class A operation shall comply with the Class B radiated limits set out in Table 11 determined at a distance of 3 meters.

Class B Radiated Limits below 1 GHz	
Frequency (MHz)	Class B Radiated Limit (dBµV/m)
	Quasi-peak
30 to 88	40
88 to 216	43.5
216 to 960	46
960 to 1000	54

Table 11. Class B Radiated Limits below 1 GHz

6.2.2 Radiated Emissions Limits above 1 GHz

Radiated disturbance measurements above 1 GHz shall be performed over the frequency range determined from Table 9. The appropriate average detector to carry out radiated disturbance measurements above 1 GHz shall be the linear average detector as defined in CISPR 16-1-1.

Class A: An ITE meeting the conditions for Class A equipment shall comply with the Class A radiated limits set out in Table 12 determined at a distance of 10 meters.

Class A Radiated Limits above 1 GHz		
Frequency (MHz)	Class A Radiated Limit (dBµV/m)	
	Linear Average Detector	Peak Detector
>1000	49.5	69.5

Table 12. Class A Radiated Limits above 1 GHz

Class B: An ITE that does not meet the conditions for Class A equipment shall comply with the Class B radiated limits set out in Table 13 determined at a distance of 3 meters.

Class B Radiated Limits above 1 GHz		
Frequency (MHz)	Class B Radiated Limit (dBµV/m)	
	Linear Average Detector	Peak Detector
1000	54	74

Table 13. Class B Radiated Limits above 1 GHz

Test Procedures: The EUT was placed on a non-metallic table, 80 cm above the ground plane inside a semi-anechoic chamber. The method of testing and test conditions of ANSI C63.4 were used. An antenna was located 3 m from the EUT on an adjustable mast. A pre-scan was first performed in order to find prominent radiated emissions. For final emissions measurements at each frequency of interest, the EUT was rotated and the antenna height was varied between 1 m and 4 m in order to maximize the emission. Measurements in both horizontal and vertical polarities were made and the data was recorded. Unless otherwise specified, measurements were made using a quasi-peak detector with a 120 kHz bandwidth.

Test Results: The EUT was compliant with the Class B requirement(s) of this section. Measured emissions were below applicable limits.

Test Engineer(s): Djed Mouada

Test Date(s): 09/20/13

Radiated Emissions Limits Test Results, Class B

Frequency (MHz)	EUT Azimuth (Degrees)	Antenna Polarity (H/V)	Antenna HEIGHT (m)	Uncorrected Amplitude (dBµV)	Antenna Correction Factor (dB) (+)	Cable Loss (dB) (+)	Distance Correction Factor (dB) (-)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
44.1523	360	H	1	5.5	11.34	0.44	0	17.28	40	-22.72
44.1523	111	V	1.1	13.83	11.34	0.44	0	25.61	40	-14.39
49.70942	360	H	1	5.57	8.79	0.48	0	14.84	40	-25.16
49.70942	274	V	1	11.71	8.79	0.48	0	20.98	40	-19.02
95.06212	160	H	1.7	9.15	8.92	0.75	0	18.82	43.5	-24.68
95.06212	156	V	1	9.64	8.92	0.75	0	19.31	43.5	-24.19
128.6195	47	H	1	5.65	13.84	0.91	0	20.40	43.5	-23.10
128.6195	296	V	1	6.37	13.84	0.91	0	21.12	43.5	-22.38
360.01	20	H	1	8.52	15.40	1.46	0	25.38	46	-20.62
360.01	32	V	1	8.94	15.40	1.46	0	25.80	46	-20.20
503.99	332	H	1.03	9.3	18.10	1.88	0	29.28	46	-16.72
503.99	137	V	1.07	10.58	18.10	1.88	0	30.56	46	-15.44

Table 14. Radiated Emissions Limits, Test Results, FCC Limits

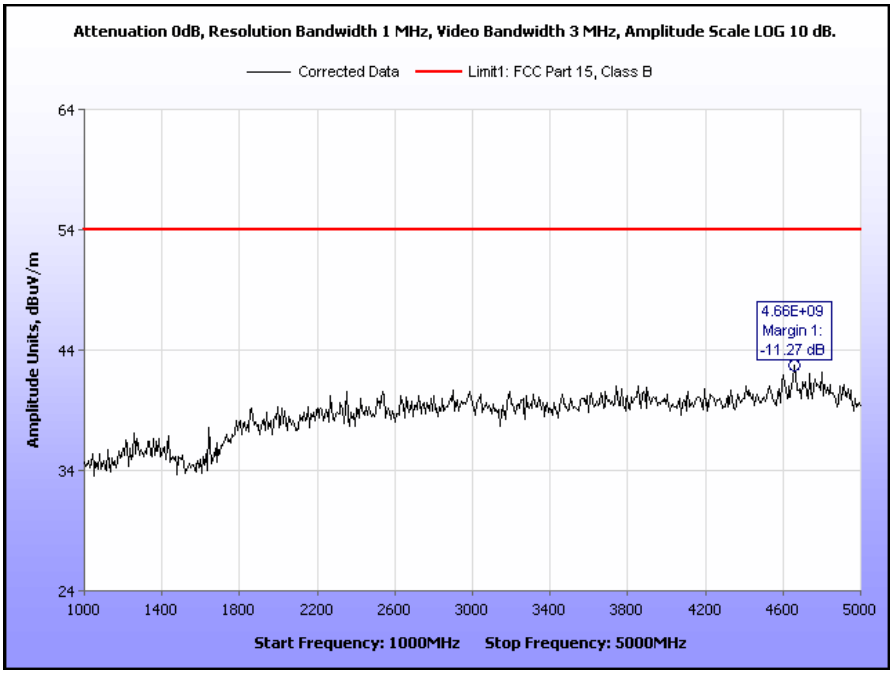
Note: The EUT was tested at 3 m.

Radiated Emissions Limits Test Results, Class B

Frequency (MHz)	EUT Azimuth (Degrees)	Antenna Polarity (H/V)	Antenna HEIGHT (m)	Uncorrected Amplitude (dBµV)	Antenna Correction Factor (dB) (+)	Cable Loss (dB) (+)	Distance Correction Factor (dB) (-)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
44.1523	360	H	1	5.5	11.34	0.44	10.46	6.82	40	-33.18
44.1523	111	V	1.1	13.83	11.34	0.44	10.46	15.15	40	-24.85
49.70942	360	H	1	5.57	8.79	0.48	10.46	4.38	40	-35.62
49.70942	274	V	1	11.71	8.79	0.48	10.46	10.52	40	-29.48
95.06212	160	H	1.7	9.15	8.92	0.75	10.46	8.36	43.5	-35.14
95.06212	156	V	1	9.64	8.92	0.75	10.46	8.85	43.5	-34.65
128.6195	47	H	1	5.65	13.84	0.91	10.46	9.94	43.5	-33.56
128.6195	296	V	1	6.37	13.84	0.91	10.46	10.66	43.5	-32.84
360.01	20	H	1	8.52	15.40	1.46	10.46	14.92	46	-31.08
360.01	32	V	1	8.94	15.40	1.46	10.46	15.34	46	-30.66
503.99	332	H	1.03	9.3	18.10	1.88	10.46	18.82	46	-27.18
503.99	137	V	1.07	10.58	18.10	1.88	10.46	20.10	46	-25.90

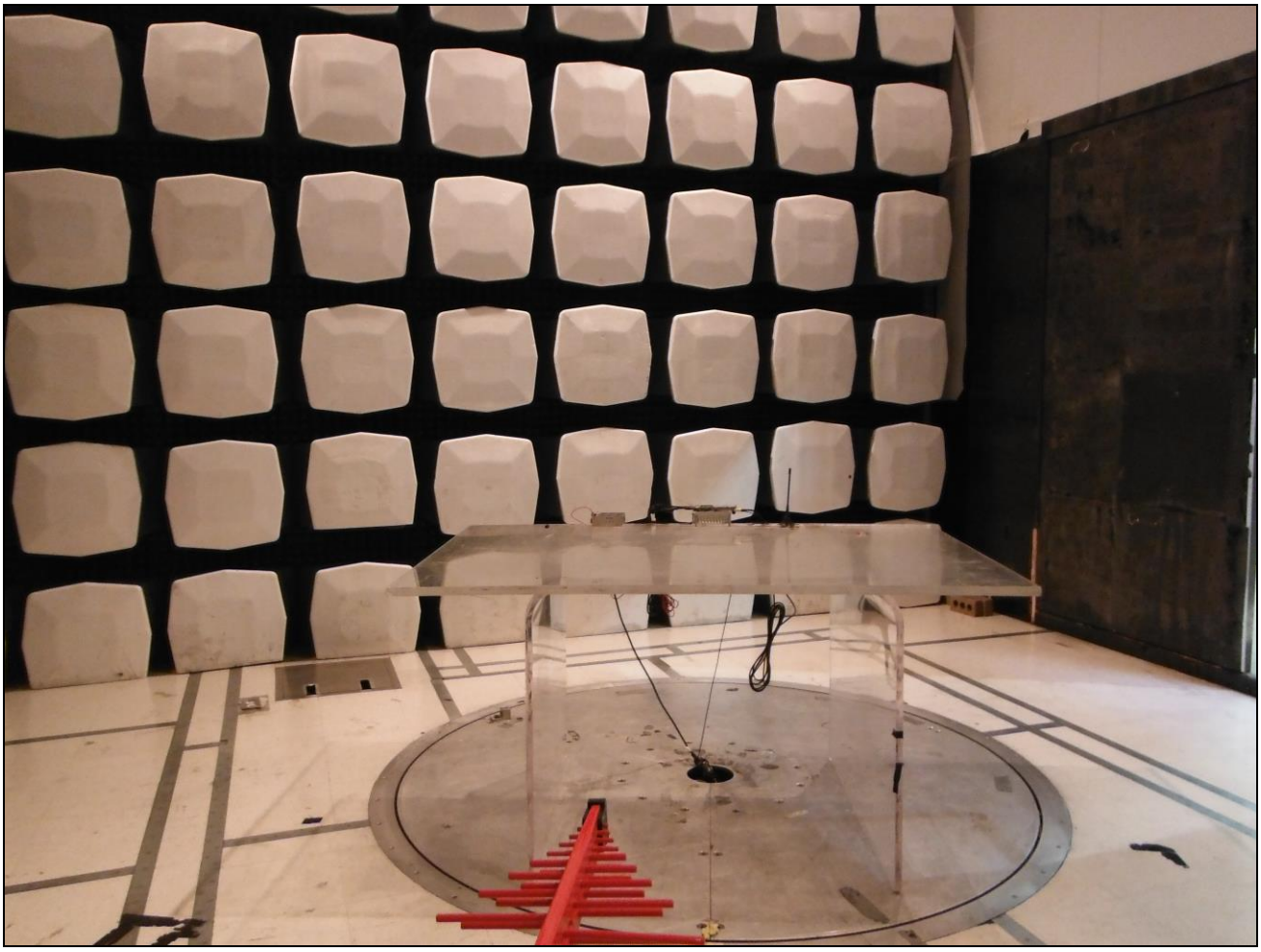
Table 15. Radiated Emissions Limits, Test Results, ICES-003 Limits, 30 MHz – 1 GHz

Note: The EUT was tested at 3 m.



Plot 3. Radiated Emissions, 1 GHz – 5 GHz, FCC/IC Limits

Radiated Emission Limits Test Setup



Photograph 2. Radiated Emission, Test Setup

IV. Electromagnetic Compatibility Criteria for Intentional Radiators

4. Electromagnetic Compatibility RF Power Output Requirements

4.1. RF Output Power

FCC §2.1046, §22.565, §90.205
Test Requirement(s): §2.1046, §22.565 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): Shawn McMillen

Test Date(s): 09/11/13

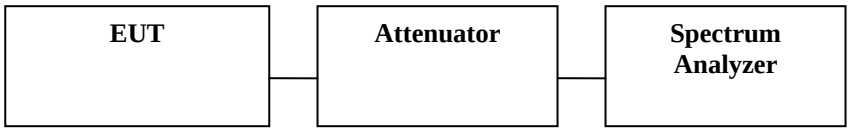
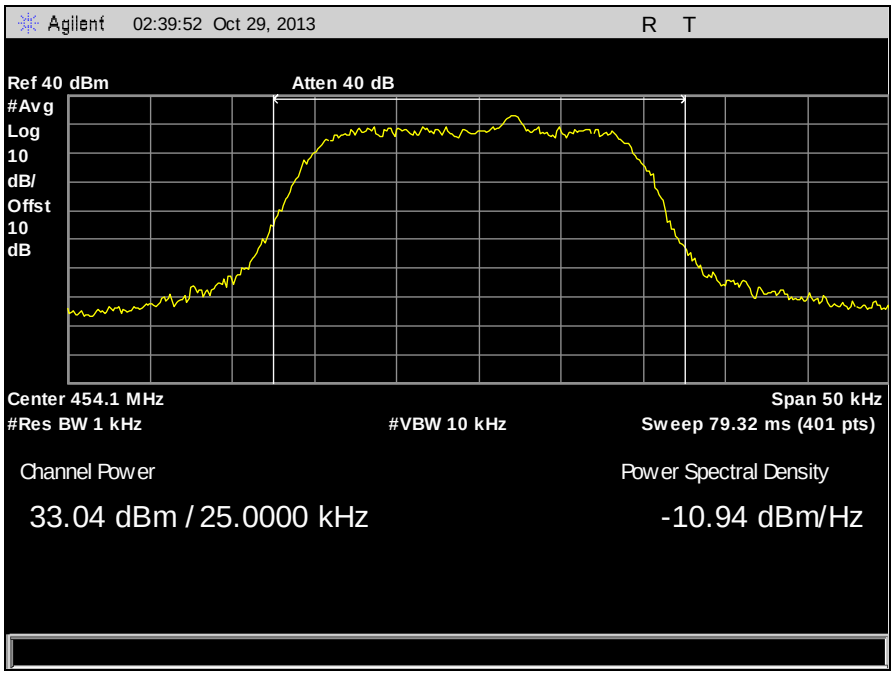


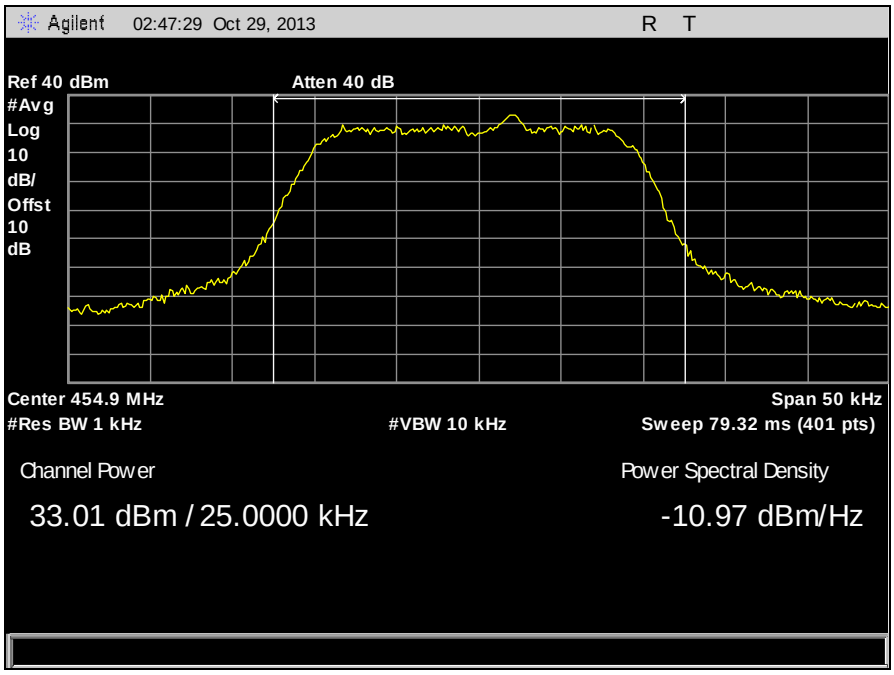
Figure 4. RF Power Output Test Setup

TI D-LMR – Part 22		
Channel	**Frequency (MHz)**	**Power (dBm)**
Low	454.05	33.04
High	454.95	33.01
Low	459.05	33.04
High	459.95	33.04
TETRA – Part 90/RSS-119		
Channel	**Frequency (MHz)**	**Power (dBm)**
Low	450	35.12
Mid	465	35.18
High	470	35.28
TI D-LMR – Part 90/RSS-119		
Channel	**Frequency (MHz)**	**Power (dBm)**
Low	450	33.05
Mid	465	33.07
High	470	33.01
TI D-LMR – Part 90/RSS-119		
Channel	**Frequency (MHz)**	**Power (dBm)**
Low	409.09375	33.03
Mid	416.01875	33.02
High	429.9875	33.06
TETRA – RSS 119		
Low	409.09375	35.48
Mid	416.01875	35.24
High	429.9875	35.24

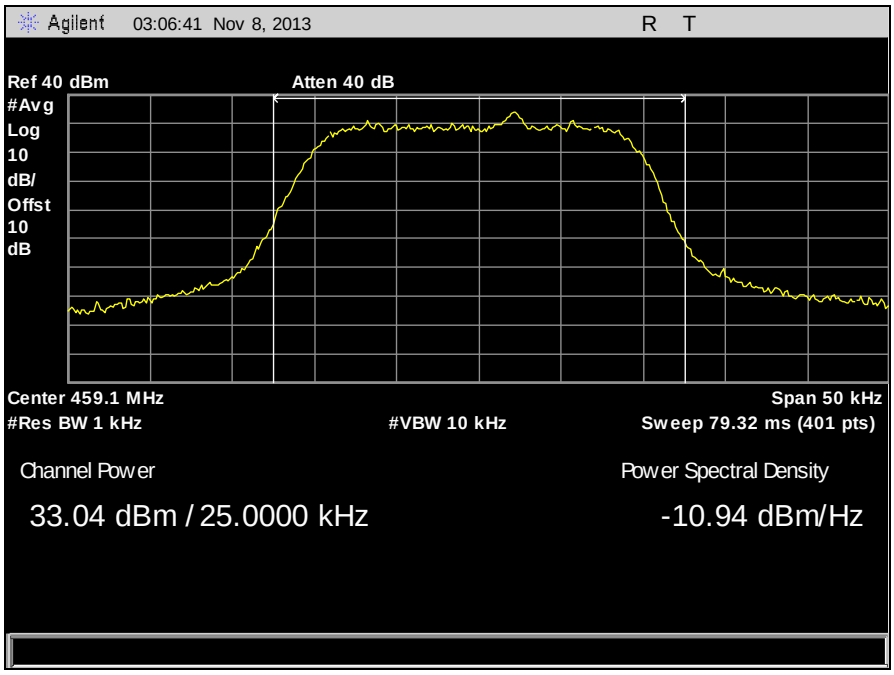
Table 16. RF Output Power, Test Results



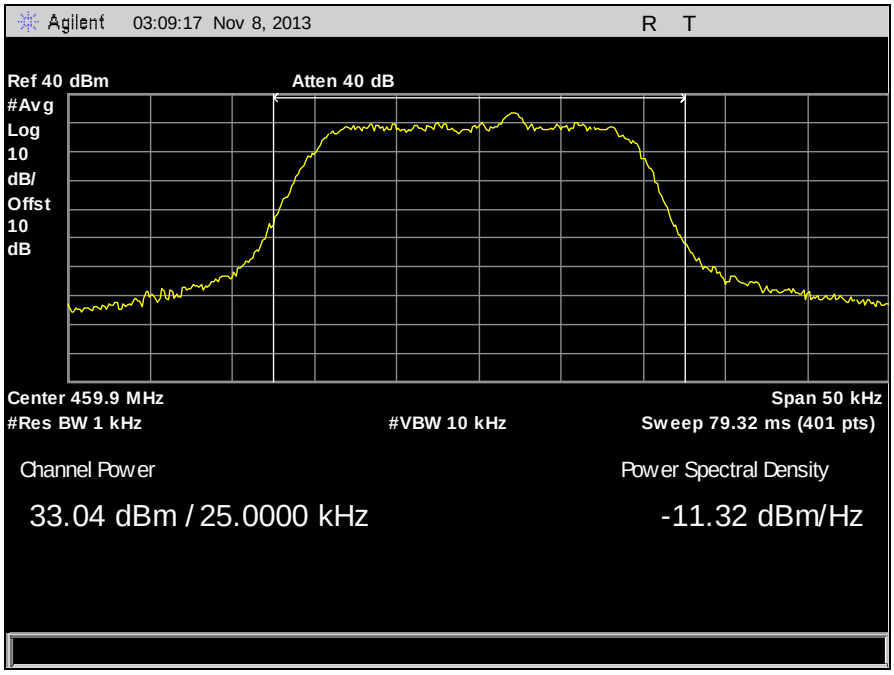
Plot 4. RF Power Output, Part 22, TI D-LMR, 20 kHz, Low Channel, 454.050 MHz, Average



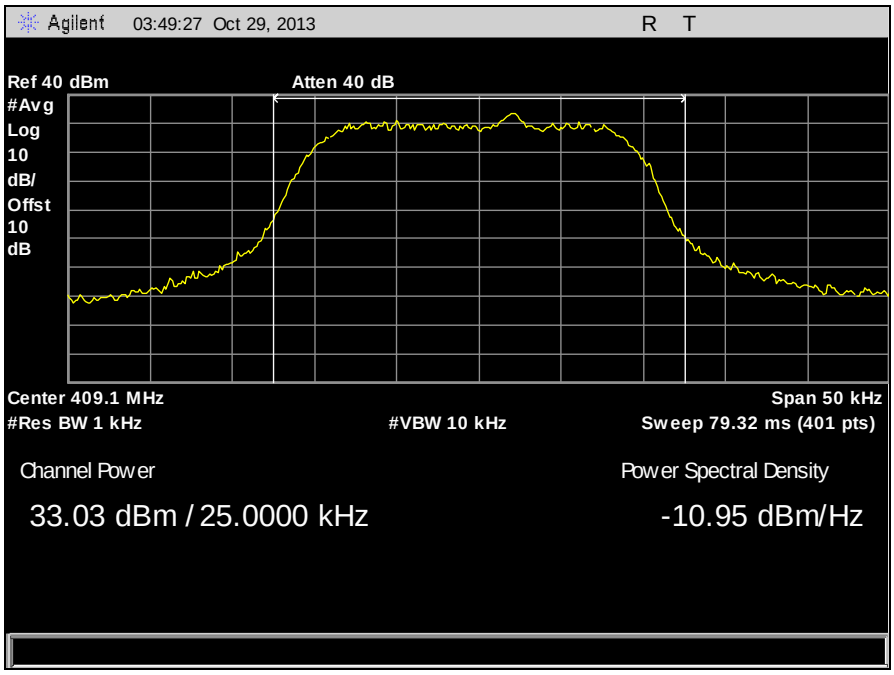
Plot 5. RF Power Output, Part 22, TI D-LMR, 20 kHz, High Channel, 454.950 MHz, Average



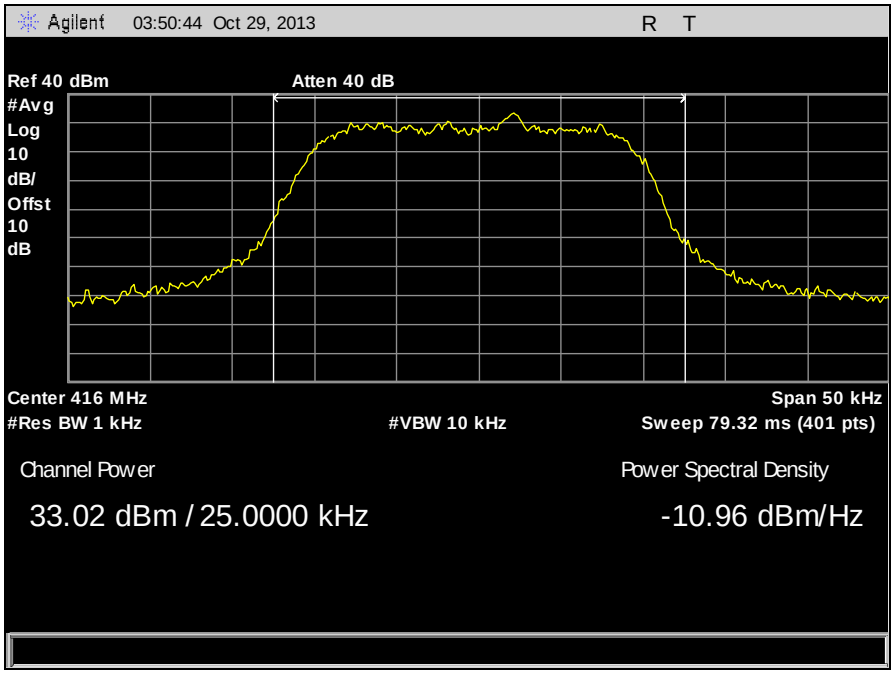
Plot 6. RF Power Output, Part 22, TI D-LMR, 20 kHz, Low Channel, 459.05 MHz, Average



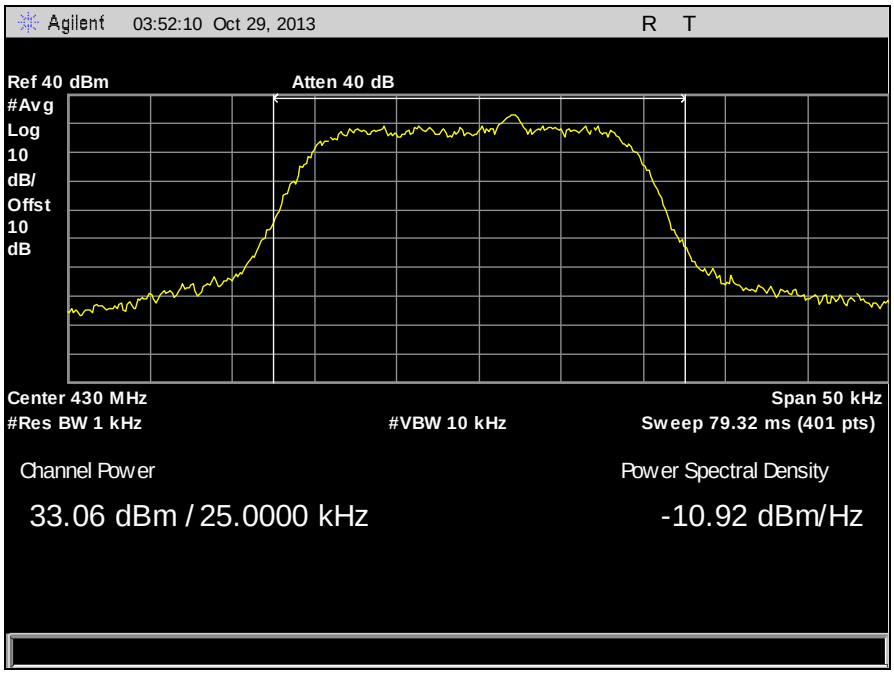
Plot 7. RF Power Output, Part 22, TI D-LMR, 20 kHz, High Channel, 459.95 MHz, Average



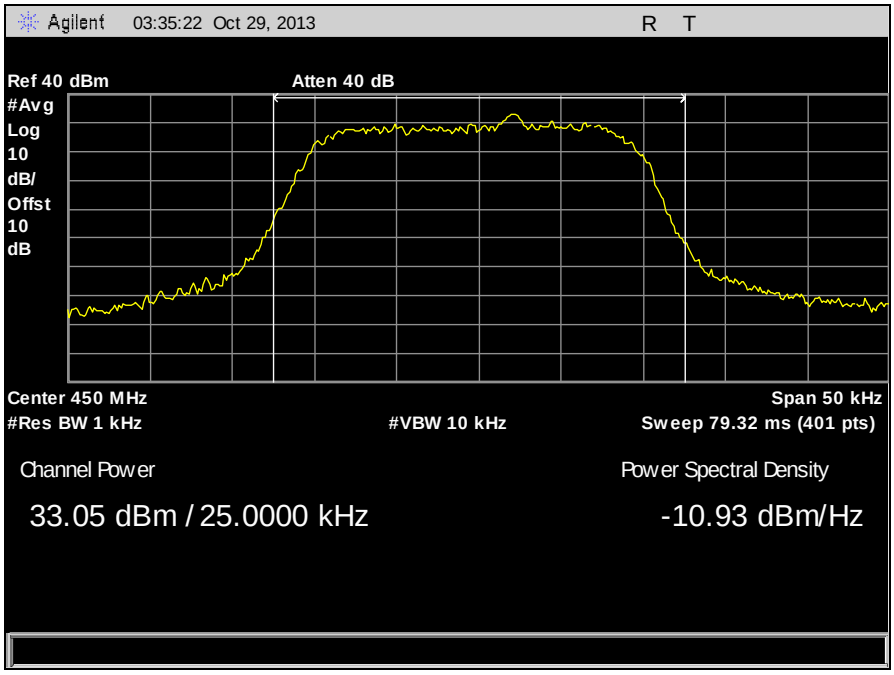
Plot 8. RF Power Output, Part 90, TI D-LMR, 20 kHz, Low Channel, 409.094 MHz, Average



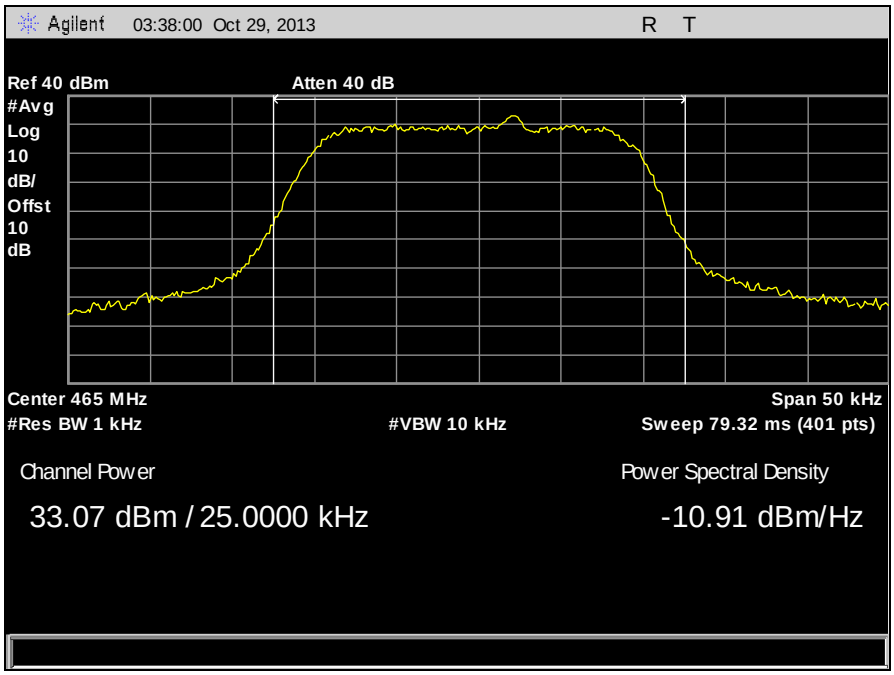
Plot 9. RF Power Output, Part 90, TI D-LMR, 20 kHz, Mid Channel, 416.019 MHz, Average



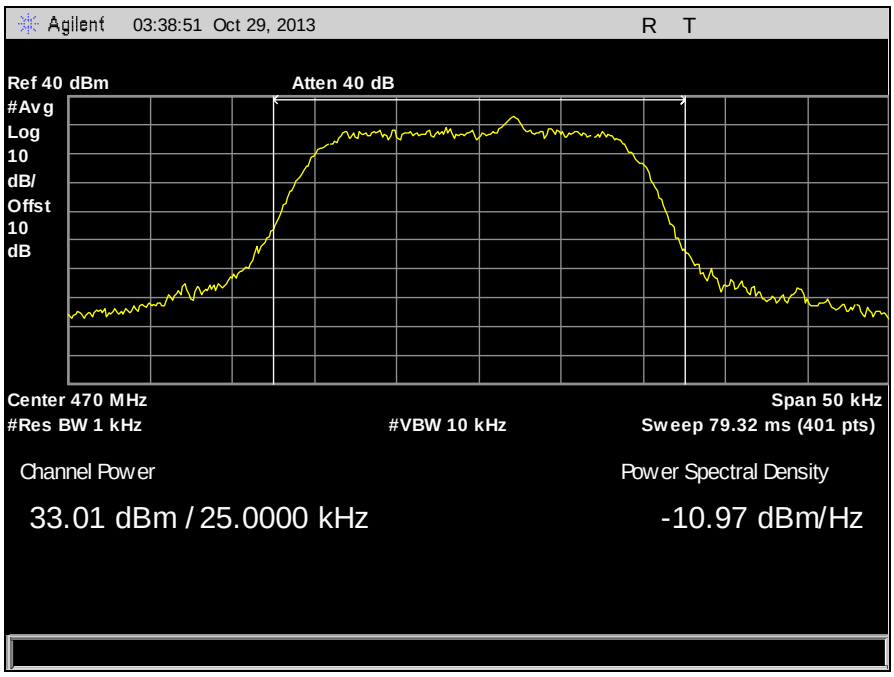
Plot 10. RF Power Output, Part 90, TI D-LMR, 20 kHz, High Channel, 429.9875 MHz, Average



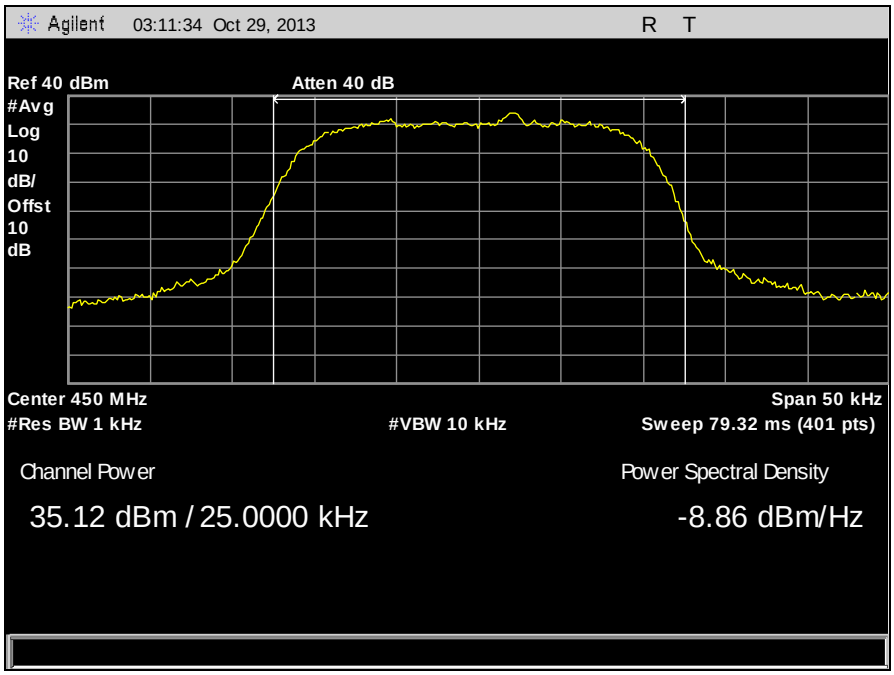
Plot 11. RF Power Output, Part 90, TI D-LMR, 20 kHz, Low Channel, 450 MHz, Average



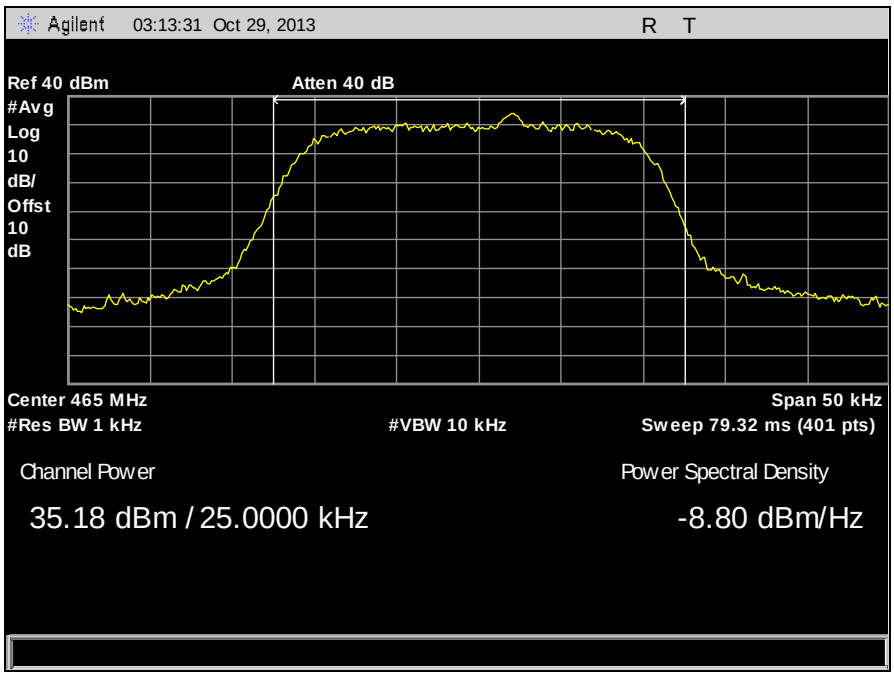
Plot 12. RF Power Output, Part 90, TI D-LMR, 20 kHz, Mid Channel, 465 MHz, Average



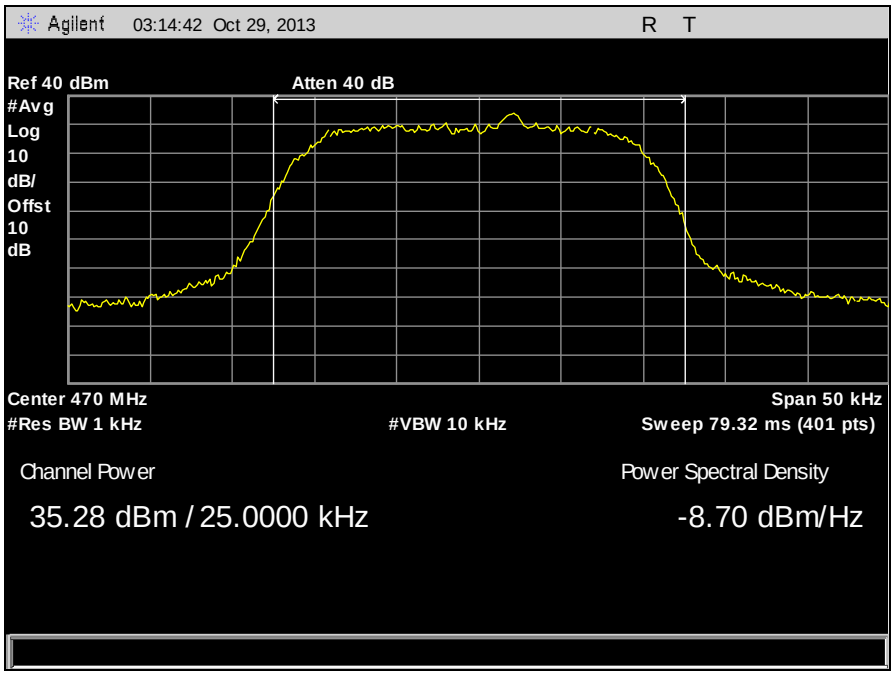
Plot 13. RF Power Output, Part 90, TI D-LMR, 20 kHz, High Channel, 470 MHz, Average



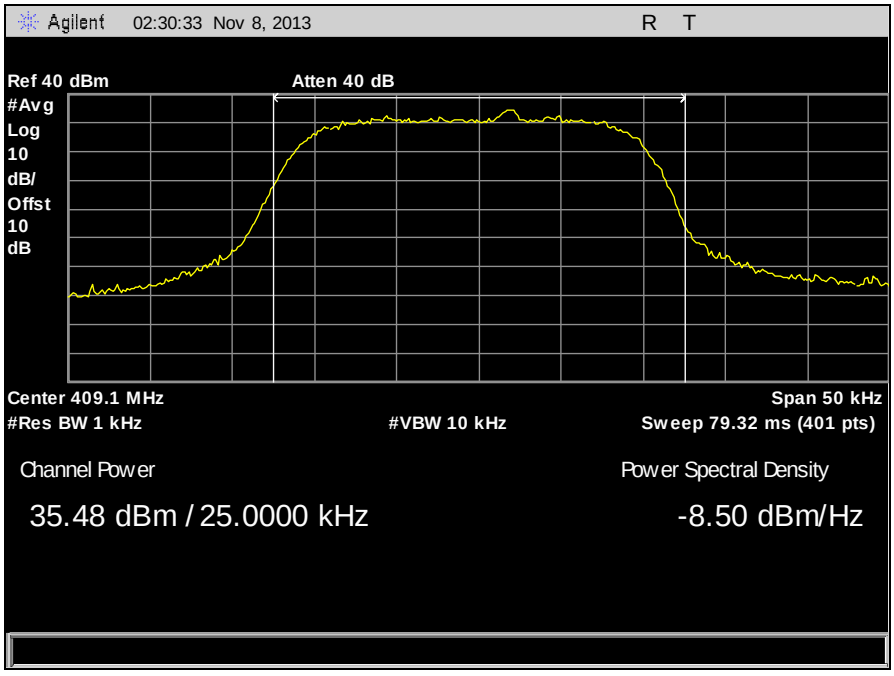
Plot 14. RF Power Output, Part 90, TETRA, 22 kHz, Low Channel, 450 MHz, Average Power



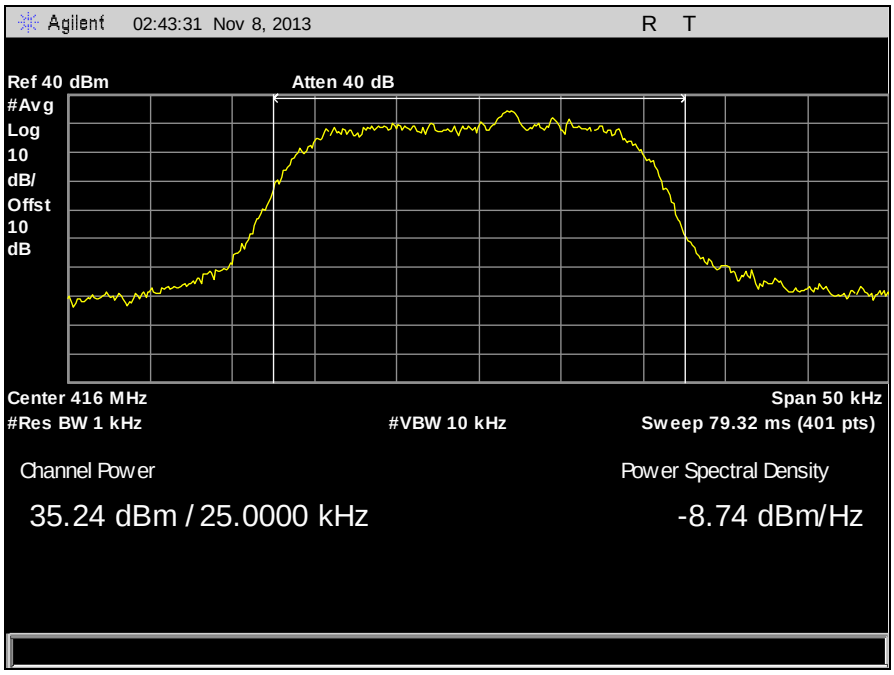
Plot 15. RF Power Output, Part 90, TETRA, 22 kHz, Mid Channel, 465 MHz, Average Power



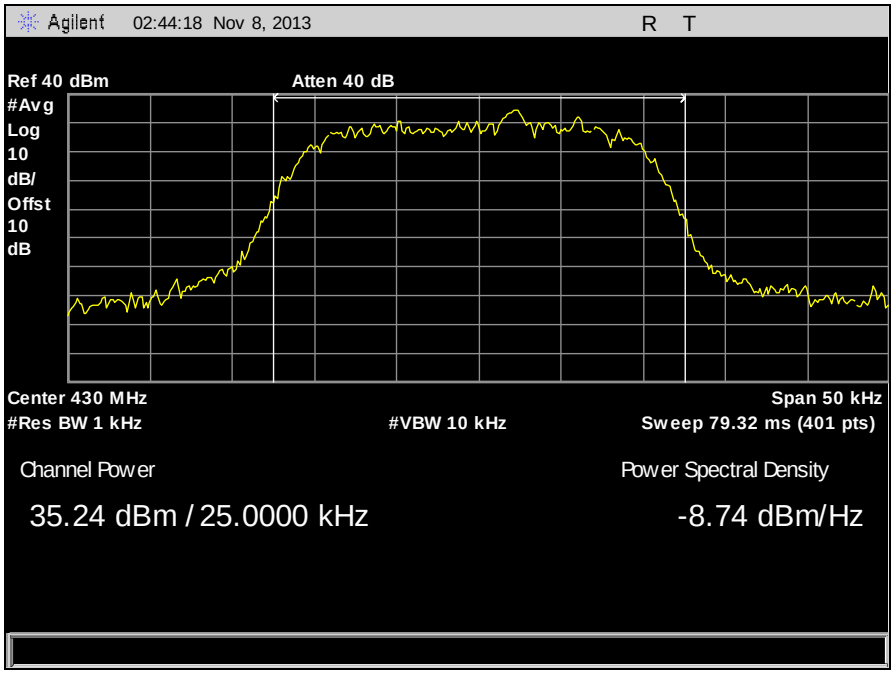
Plot 16. RF Power Output, Part 90, TETRA, 22 kHz, High Channel, 470 MHz, Average Power



Plot 17. RF Power Output, RSS-119, TETRA, 22 kHz, Low Channel, 409.09375 MHz, Average Power



Plot 18. RF Power Output, RSS-119, TETRA, 22 kHz, Mid Channel, 416.01875 MHz, Average Power



Plot 19. RF Power Output, RSS-119, TETRA, 22 kHz, High Channel, 429.9875 MHz, Average Power

4.2. 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 complies with Section §2.1047 and §90.207. Data information provided by Teltronic, S.A.U.

Test Date(s): 02/20/13 – 02/22/13

ANNEX 1: TRM-300 LOW PASS FILTERS

TRANSMITTER LOW PASS FILTER:

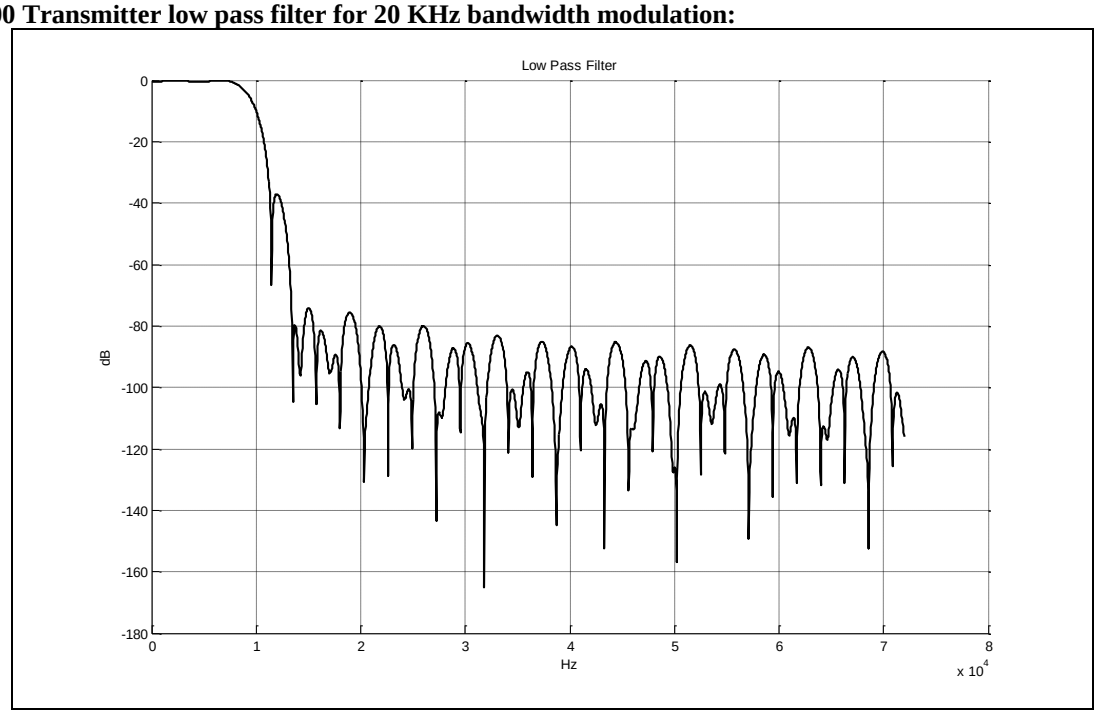
The modulation used is π/4-shifted Differential Quaternary Phase Shift Keying (π/4-DQPSK), with a modulation rate of 18 ksymbols/sec (36 kbits/sec).

A root-raised-cosine filter (RRC) is used as a transmitting and receiving filter in this digital communication system to perform matched filtering.
The combined response of such two filters is that of the raised-cosine filter.
The raised-cosine filter is a filter frequently used for pulse-shaping in digital modulation, known for its ability to minimize intersymbol interference (ISI).

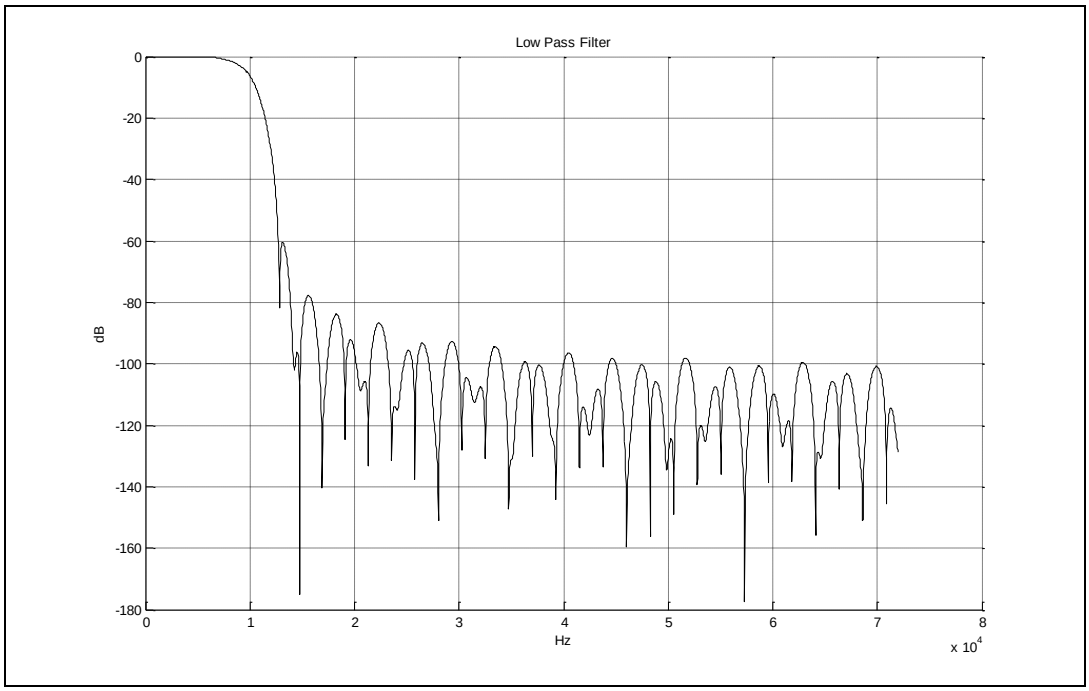
The access scheme is TDMA with 4 physical channels per carrier.

The two following graphs show the transfer function of the aforementioned filter when the authorized modulation bandwidth is 20 KHz and 22 KHz, respectively.

TRM-300 Transmitter low pass filter for 20 KHz bandwidth modulation:



TRM-300 Transmitter low pass filter for 22 KHz bandwidth modulation:



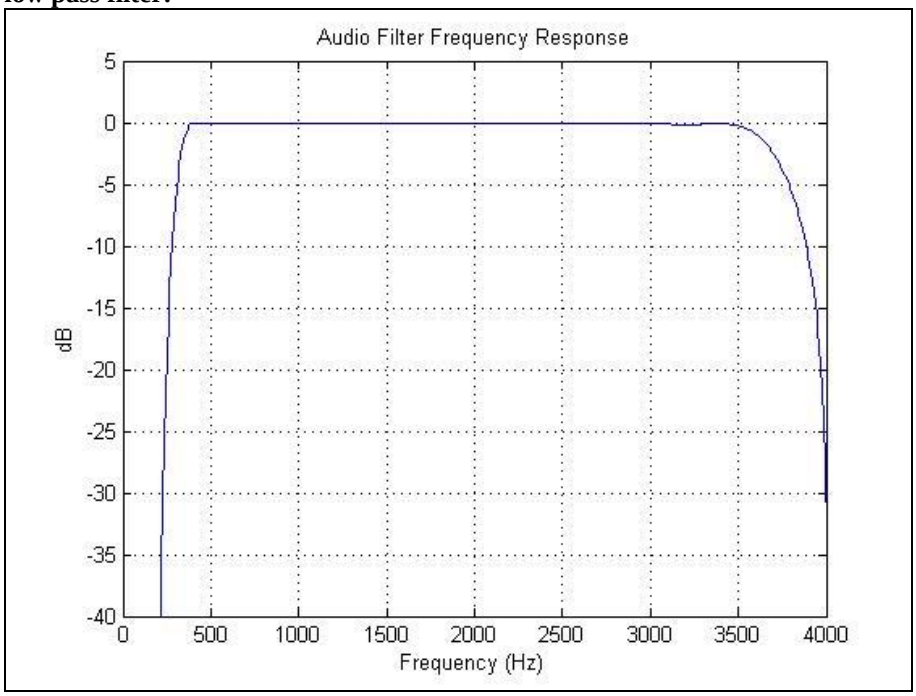
AUDIO LOW PASS FILTER:

The modulation is limited by the data characteristics and its filters.

In the previous section the phase and quadrature branches (I and Q) are filtered with a root-raised-cosine filter (RRC) with a symbol rate of 18 ksymbols/sec. Then, the signal is π/4-DQPSK modulated (see the plots before)

The signal processing is carried out using a digital filter implemented in the OMAP processor. The next picture shows its frequency response.

TRM-300 Audio low pass filter:



4.3. Occupied Bandwidth

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

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

Test Procedures: As required by 47 CFR 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 complies with FCC and IC requirements.

Test Engineer(s): Shawn McMillen

Test Date(s): 09/11/13

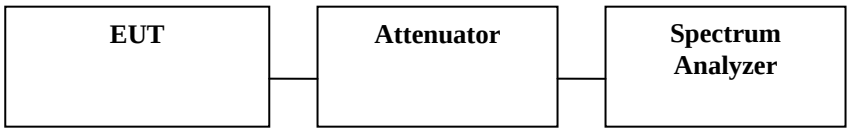
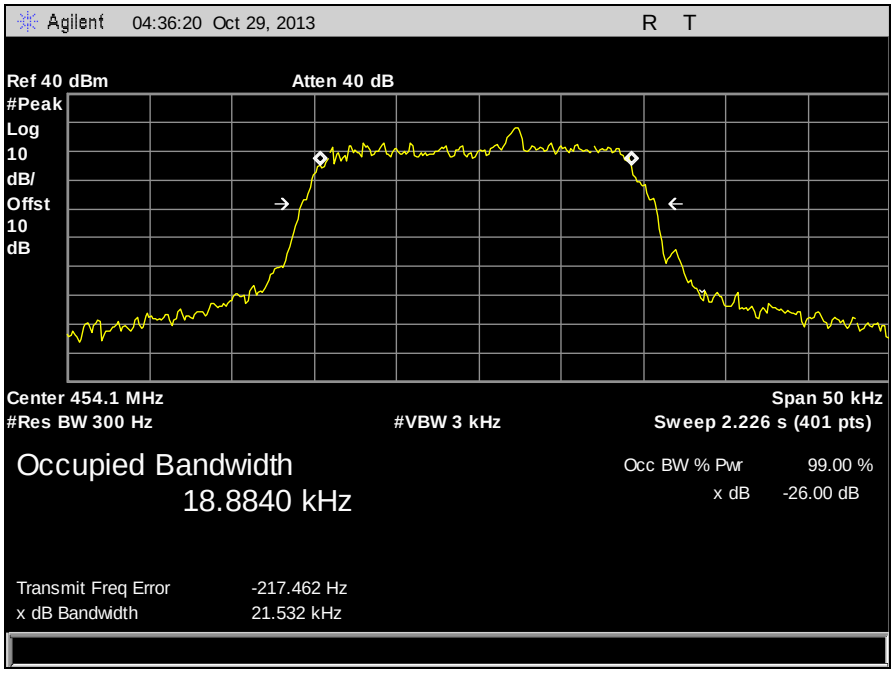


Figure 5. Occupied Bandwidth Test Setup

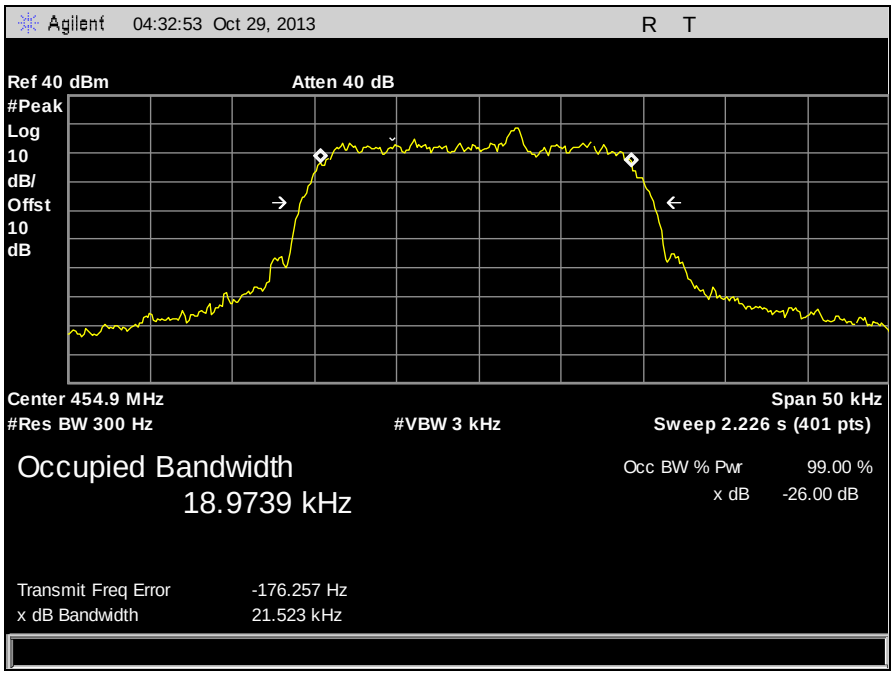
TI D-LMR – Part 22			
Channel	**Frequency (MHz)**	**-26 dB Bandwidth (kHz)**	**99% Occupied Bandwidth (kHz)**
Low	454.050	21.532	19.4957
High	454.95	21.523	19.3502
Low	459.05	21.622	18.9500
High	459.950	21.704	19.3973
TETRA – Part 90/RSS-119			
Channel	**Frequency (MHz)**	**-26 dB Bandwidth (kHz)**	**99% Occupied Bandwidth (kHz)**
Low	450	22.821	20.2826
Mid	465	22.934	19.4548
High	470	23.268	20.4049
TI D-LMR – Part 90/RSS-119			
Low	450	21.465	19.0319
Mid	465	20.944	19.2956
High	470	21.183	19.5305
TI D-LMR – Part 90/RSS-119			
Channel	**Frequency (MHz)**	**-26 dB Bandwidth (kHz)**	**99% Occupied Bandwidth (kHz)**
Low	409.09375	21.303	19.2276
Mid	416.01875	21.597	18.7383
High	429.9875	21.045	19.2593
TETRA – RSS-119			
Low	409.09375	23.314	20.7721
Mid	416.01875	22.716	19.0654
High	429.9875	22.700	20.9720

Table 17. Occupied Bandwidth, Test Results

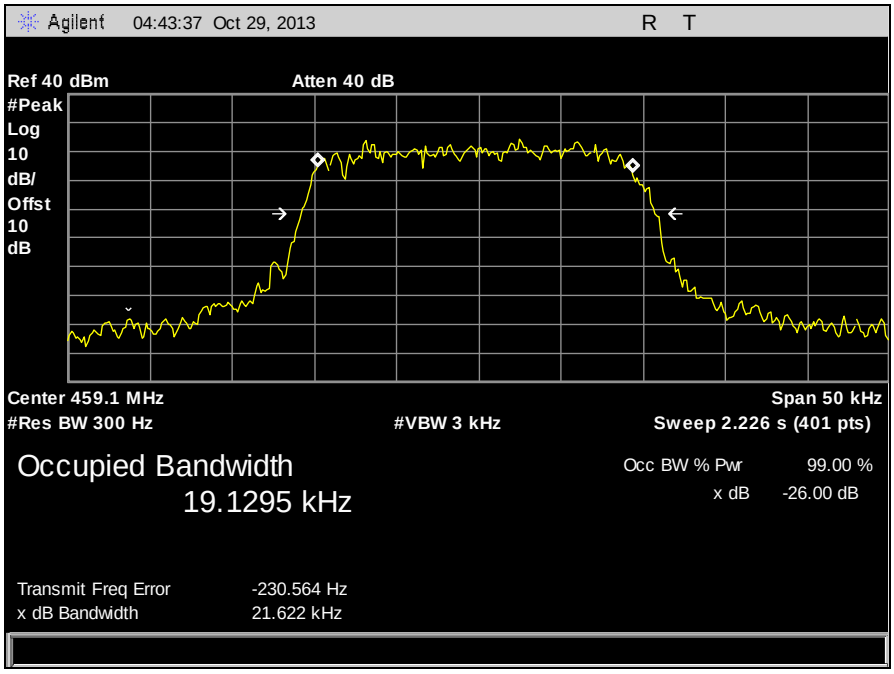
Occupied Bandwidth – FCC Part 22



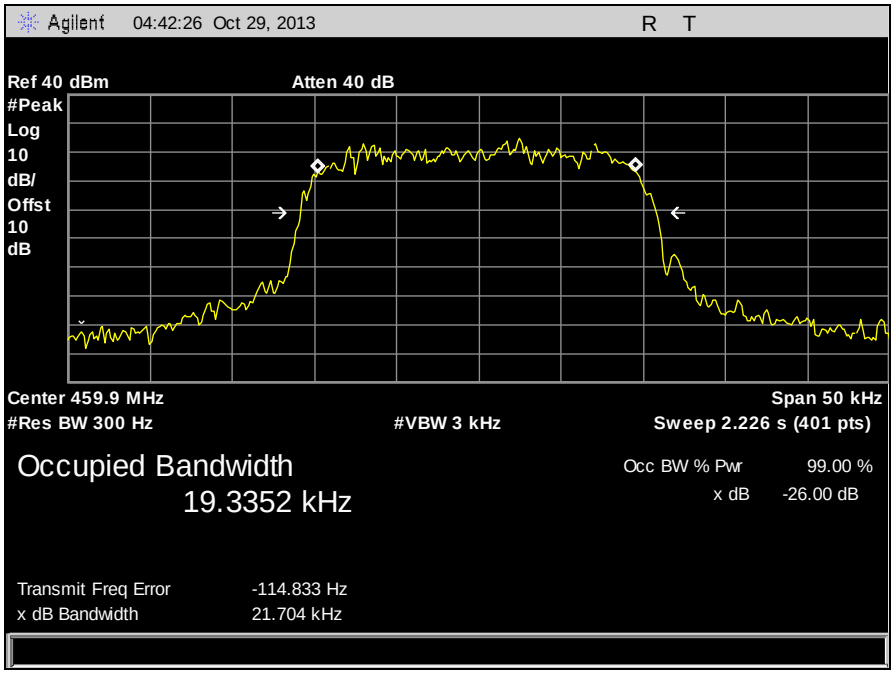
Plot 20. Occupied Bandwidth, Part 22, TI D-LMR, 20 kHz, 454.05 MHz, -26 dB



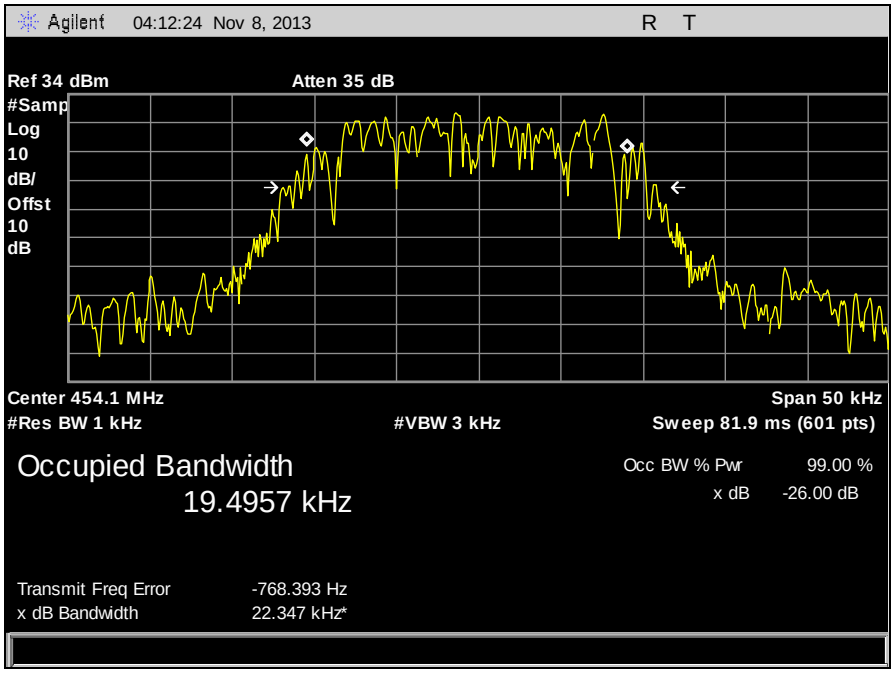
Plot 21. Occupied Bandwidth, Part 22, TI D-LMR, 20 kHz, 454.95 MHz, -26 dB



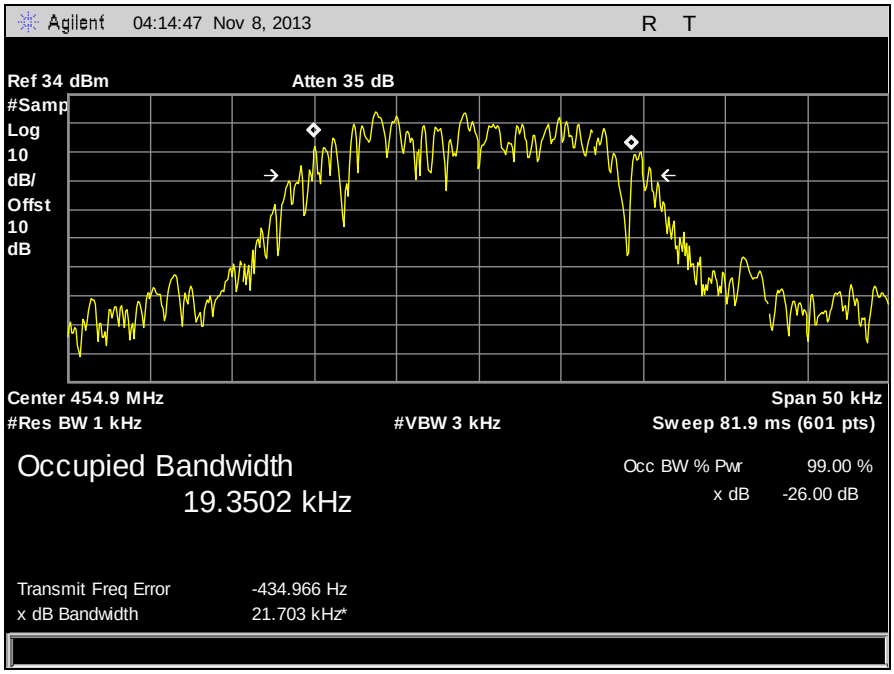
Plot 22. Occupied Bandwidth, Part 22, TI D-LMR, 20 kHz, 459.05 MHz, -26 dB



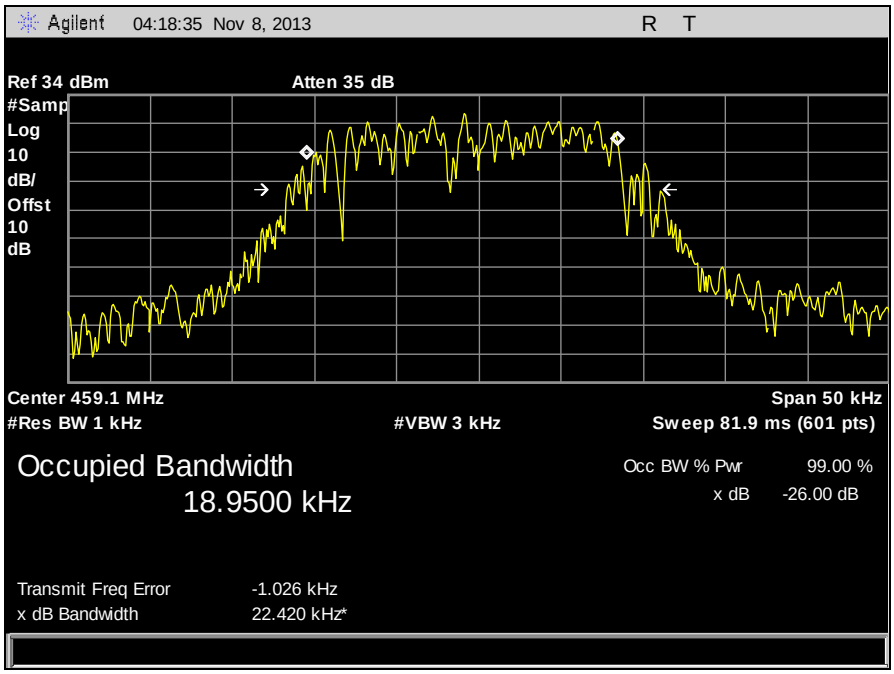
Plot 23. Occupied Bandwidth, Part 22, TI D-LMR, 20 kHz, 459.95 MHz, -26 dB



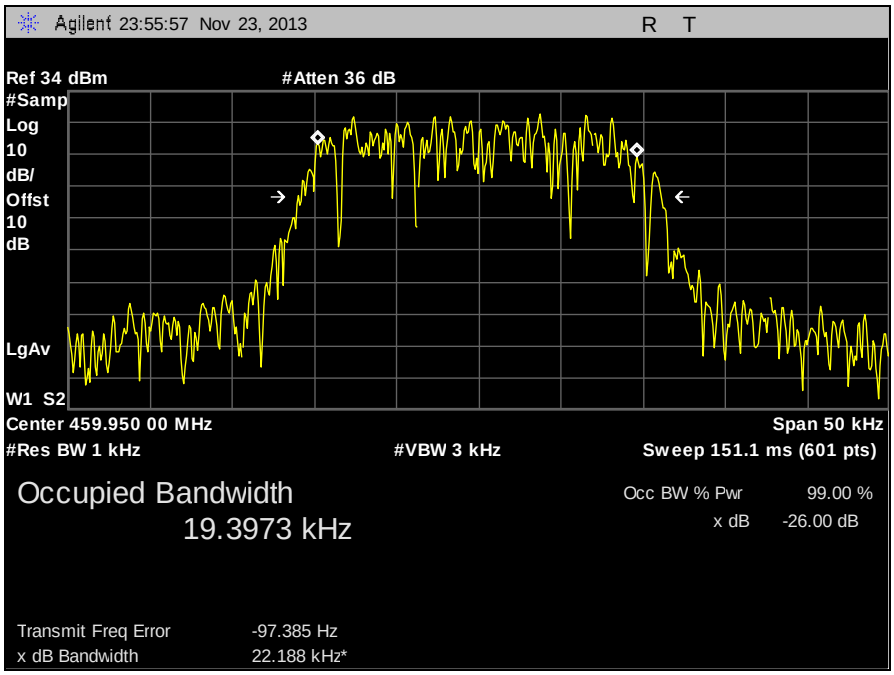
Plot 24. Occupied Bandwidth, Part 22, TI D-LMR, 20 kHz, 454.05 MHz, 99%



Plot 25. Occupied Bandwidth, Part 22, TI D-LMR, 20 kHz, 454.95 MHz, 99%

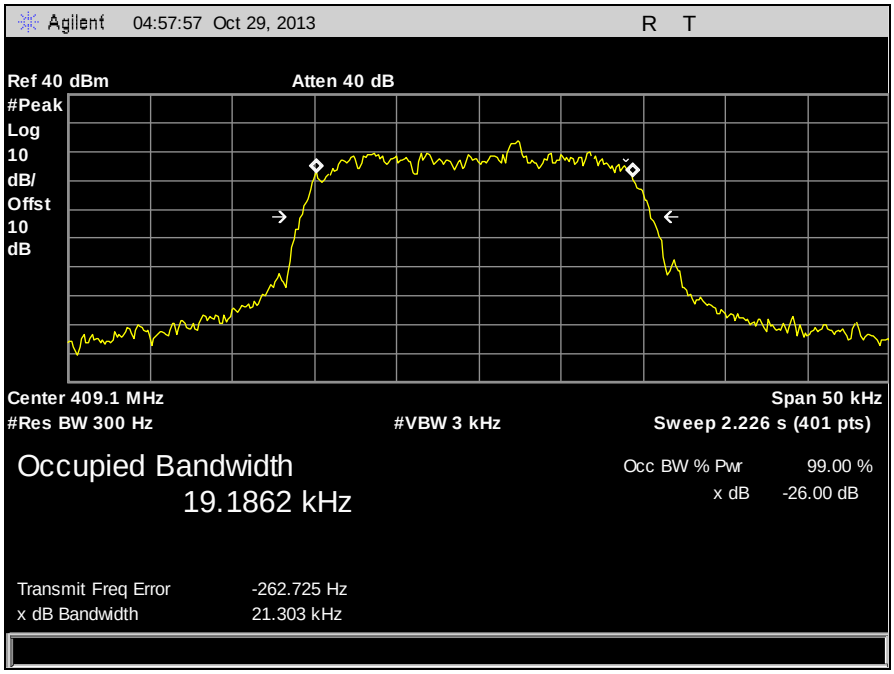


Plot 26. Occupied Bandwidth, Part 22, TI D-LMR, 20 kHz, 459.05 MHz, 99%

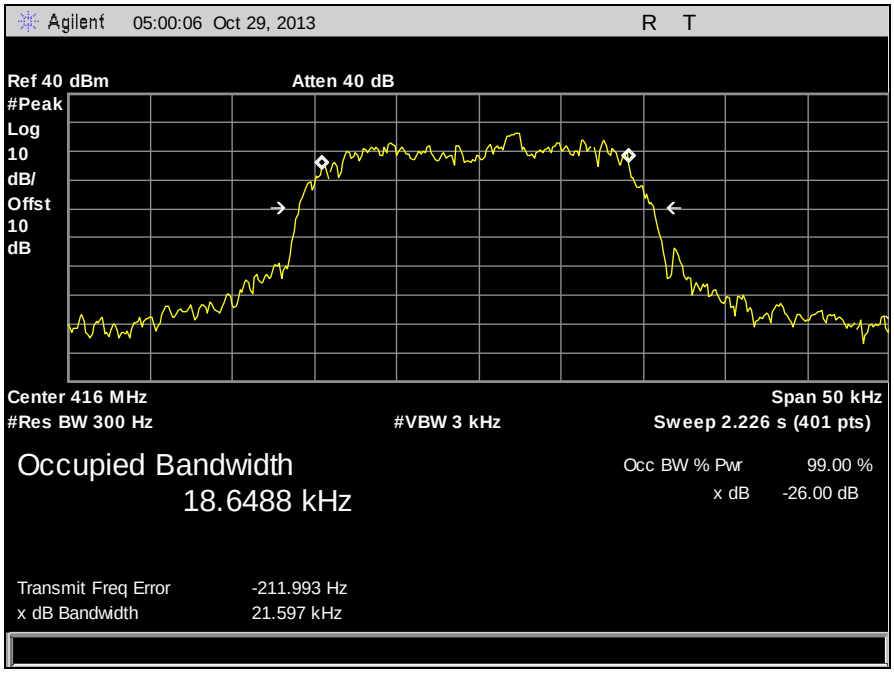


Plot 27. Occupied Bandwidth, Part 22, TI D-LMR, 20 kHz, 459.95 MHz, 99%

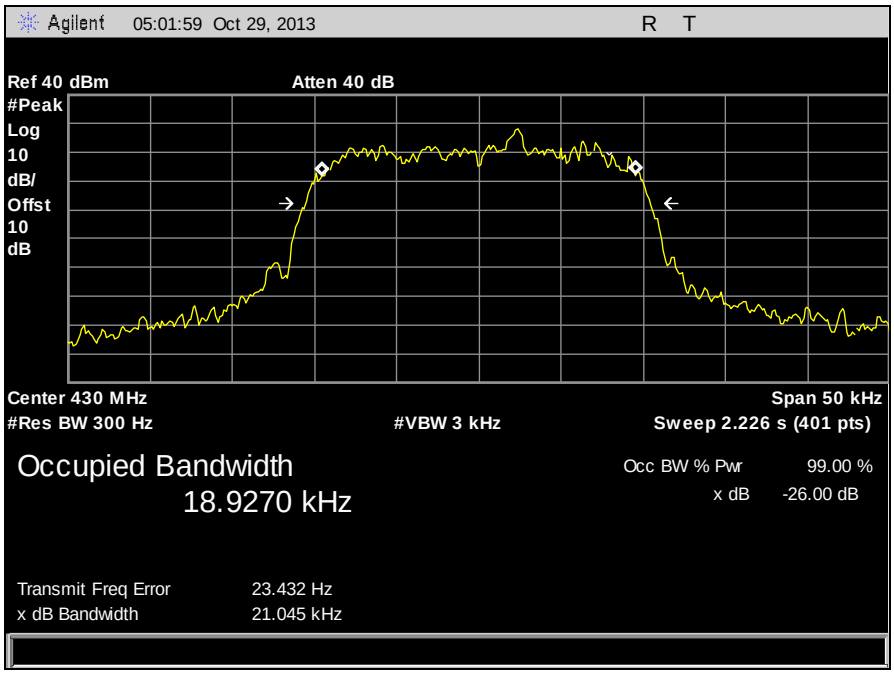
Occupied Bandwidth – FCC Part 90 / IC RSS-119



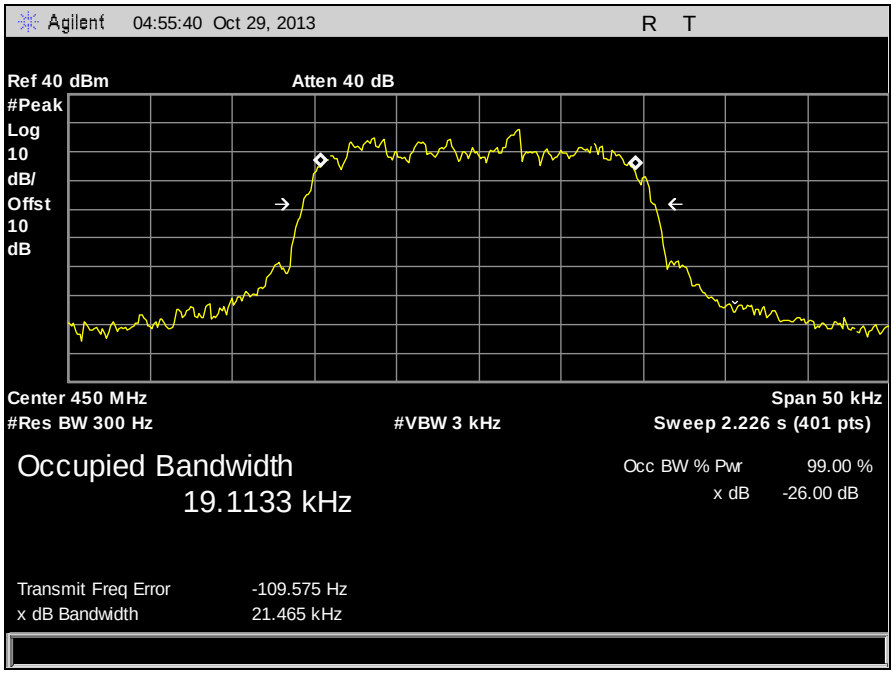
Plot 28. Occupied Bandwidth, Part 90, TI D-LMR, 20 kHz, 409.09375 MHz, -26 dB



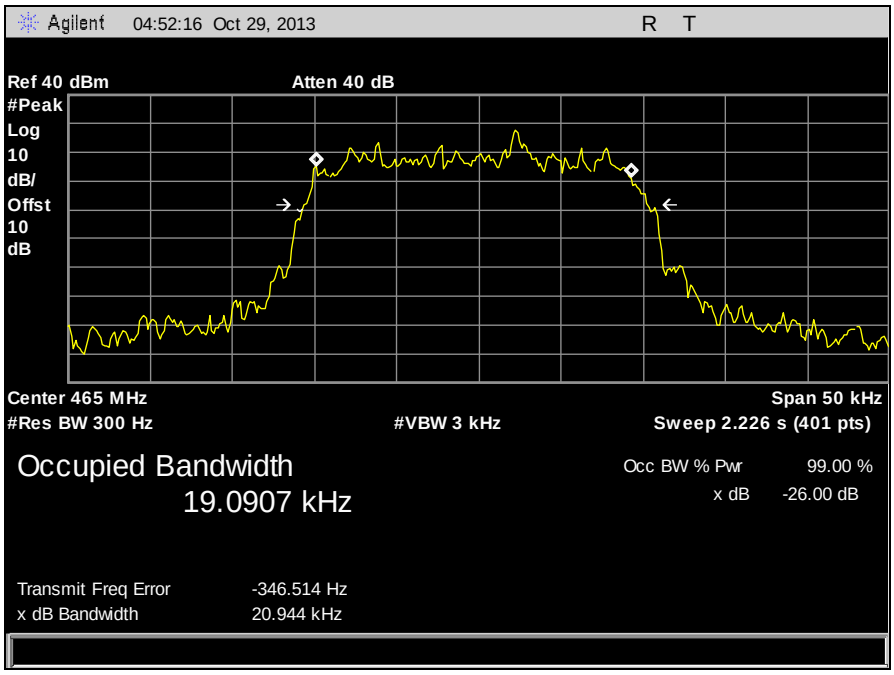
Plot 29. Occupied Bandwidth, Part 90, TI D-LMR, 20 kHz, 416.01875 MHz, -26 dB



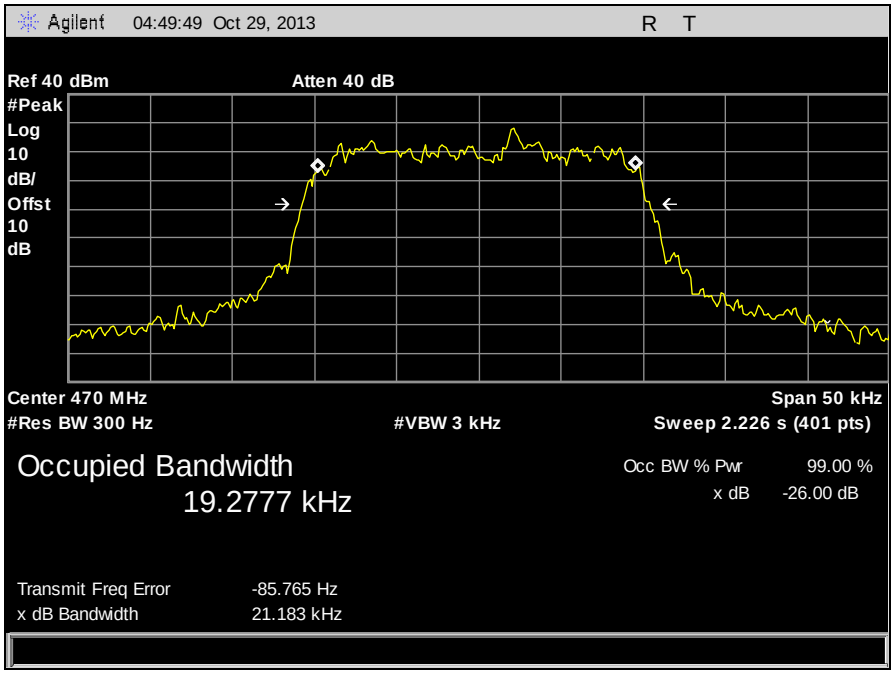
Plot 30. Occupied Bandwidth, Part 90, TI D-LMR, 20 kHz, 429.9875 MHz, -26 dB



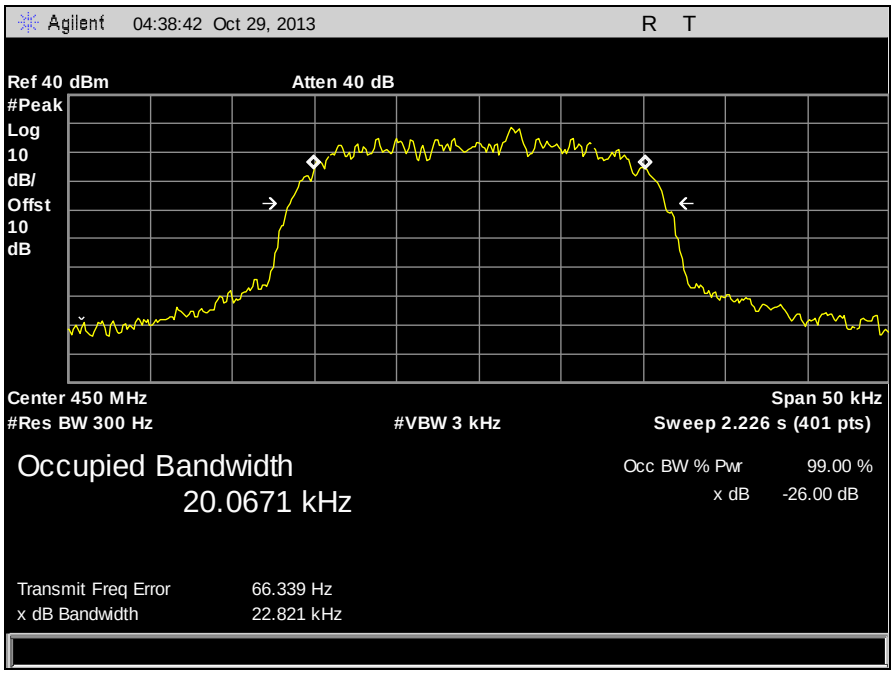
Plot 31. Occupied Bandwidth, Part 90, TI D-LMR, 20 kHz, 450 MHz, -26 dB



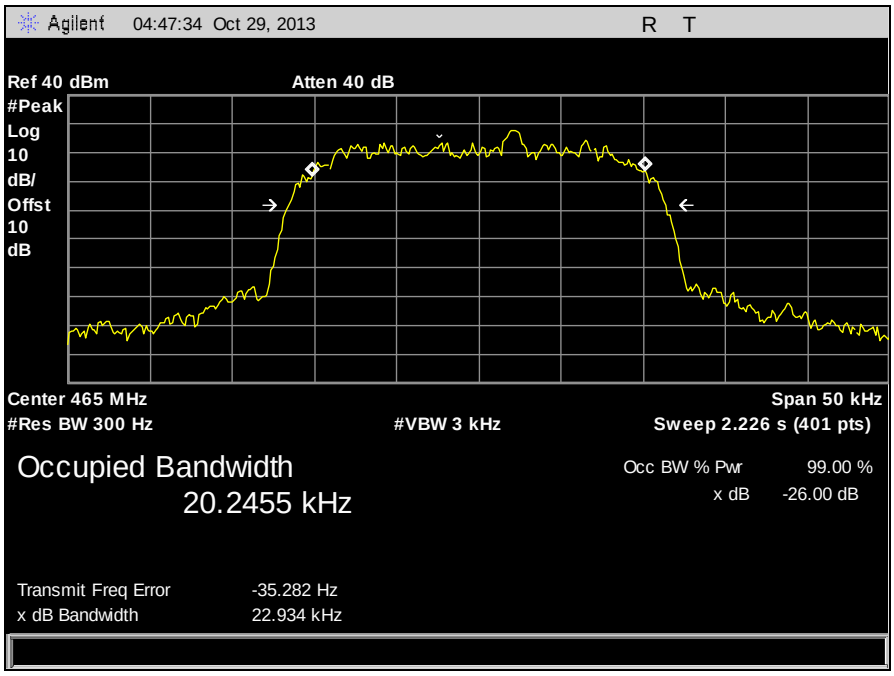
Plot 32. Occupied Bandwidth, Part 90, TI D-LMR, 20 kHz, 465 MHz, -26 dB



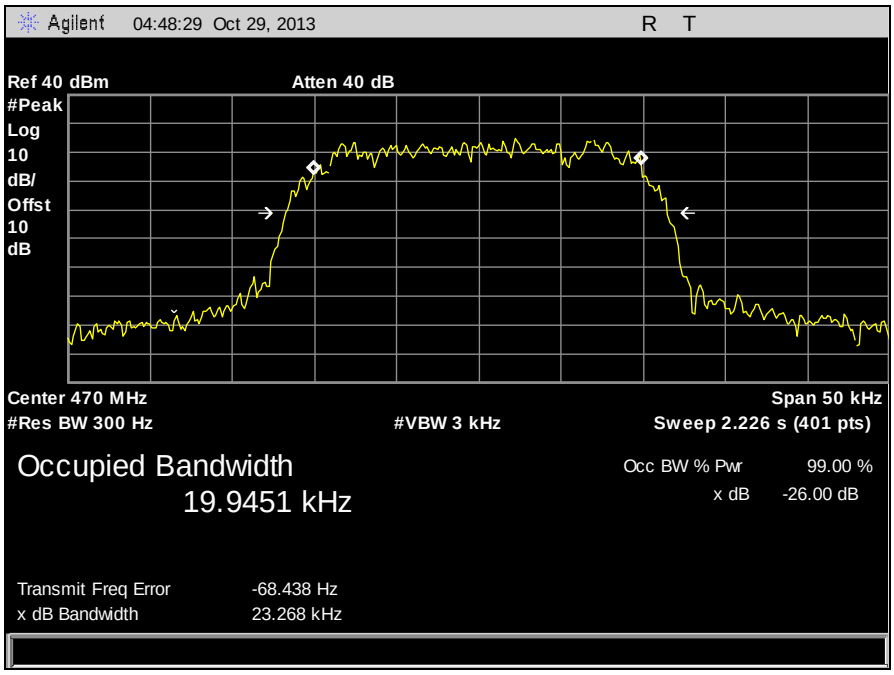
Plot 33. Occupied Bandwidth, Part 90, TI D-LMR, 20 kHz, 470 MHz, -26 dB



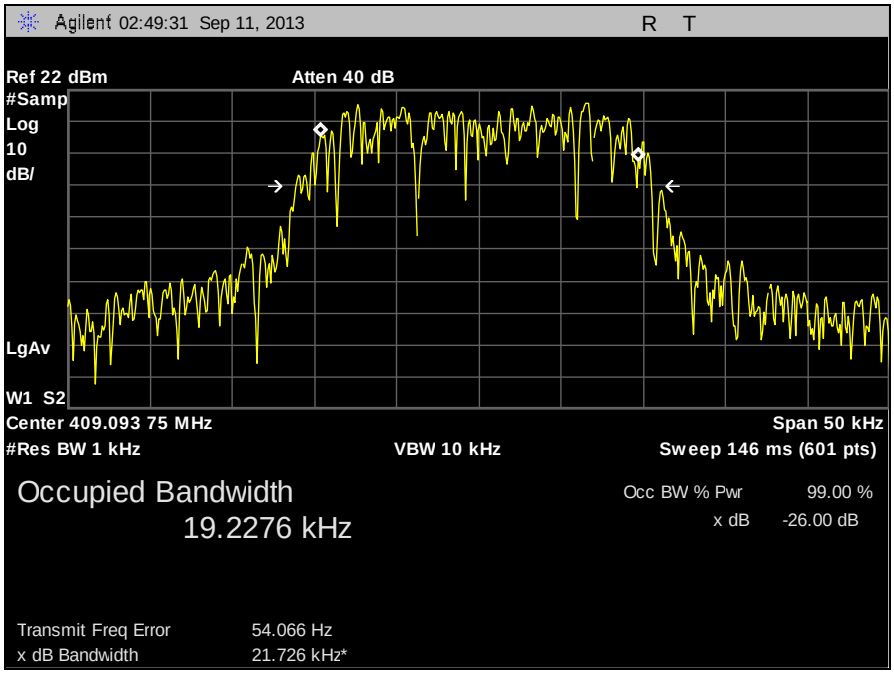
Plot 34. Occupied Bandwidth, Part 90, TETRA, 22 kHz, 450 MHz, -26 dB



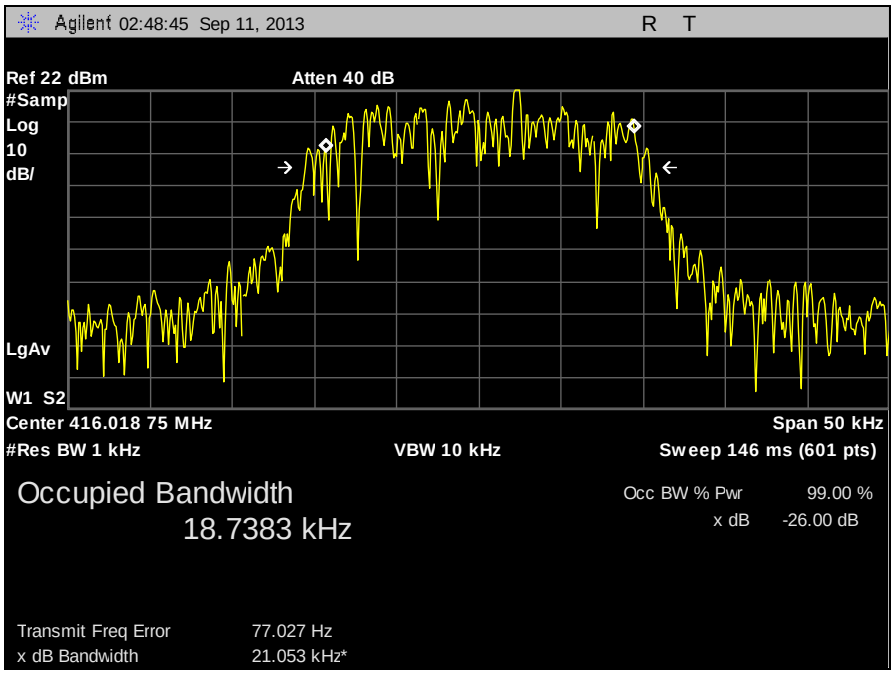
Plot 35. Occupied Bandwidth, Part 90, TETRA, 22 kHz, 465 MHz, -26 dB



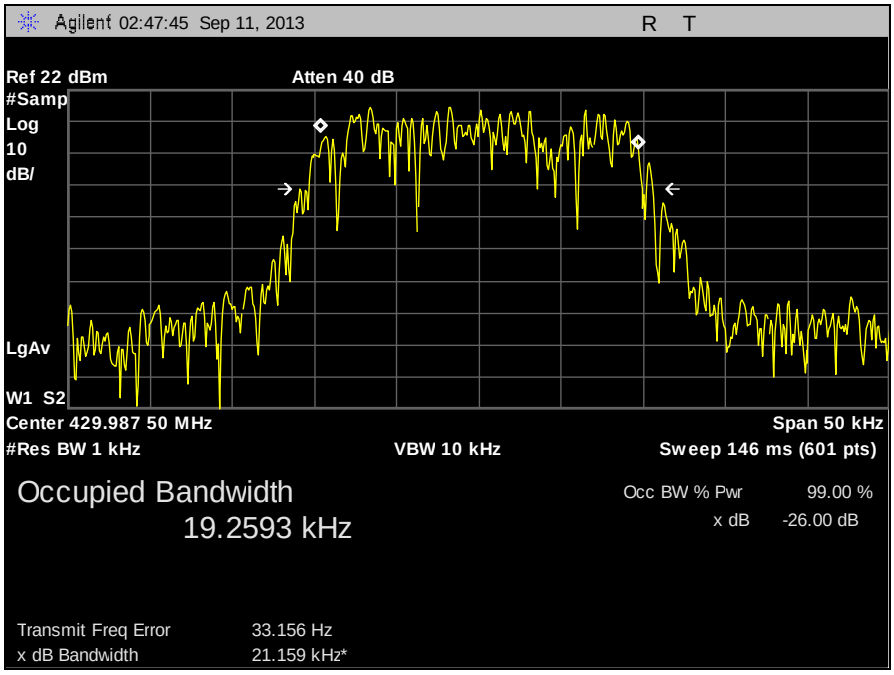
Plot 36. Occupied Bandwidth, Part 90, TETRA, 22 kHz, 470 MHz, -26 dB



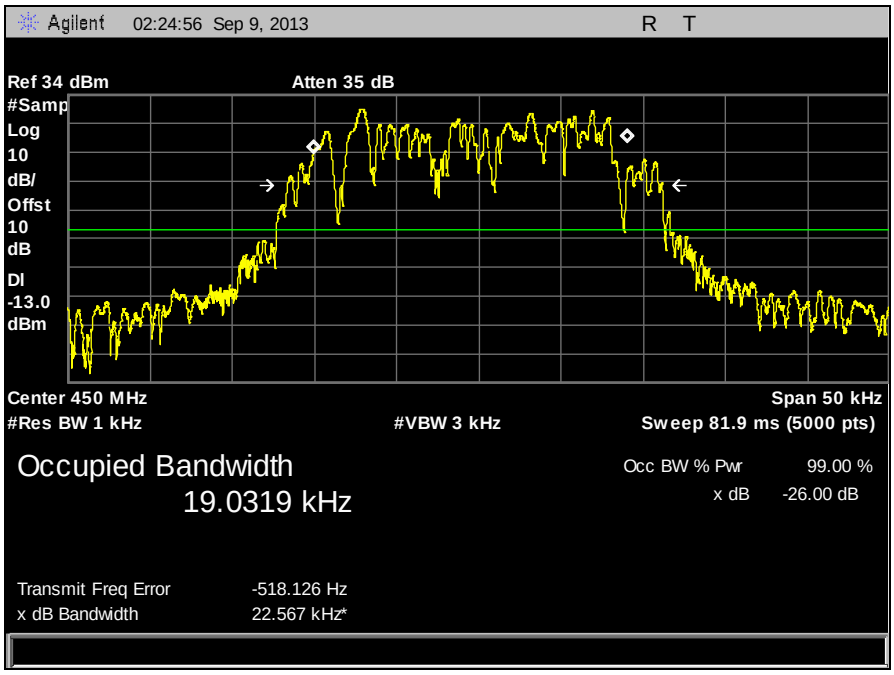
Plot 37. 99% Bandwidth, TI D-LMR, 20 kHz, Low Channel, 409.09375 MHz



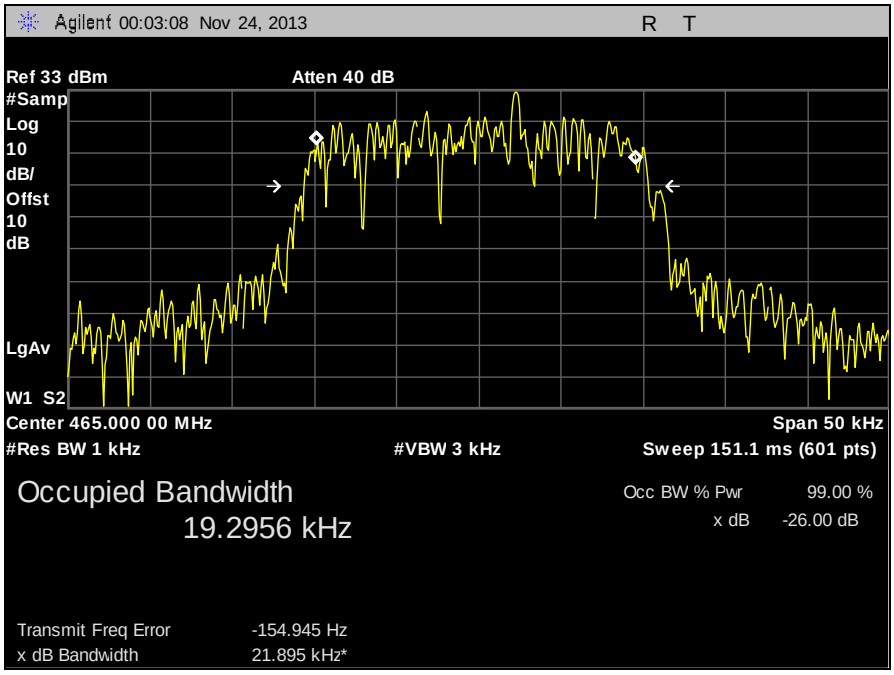
Plot 38. 99% Bandwidth, TI D-LMR, 20 kHz, Mid Channel, 416.01875 MHz



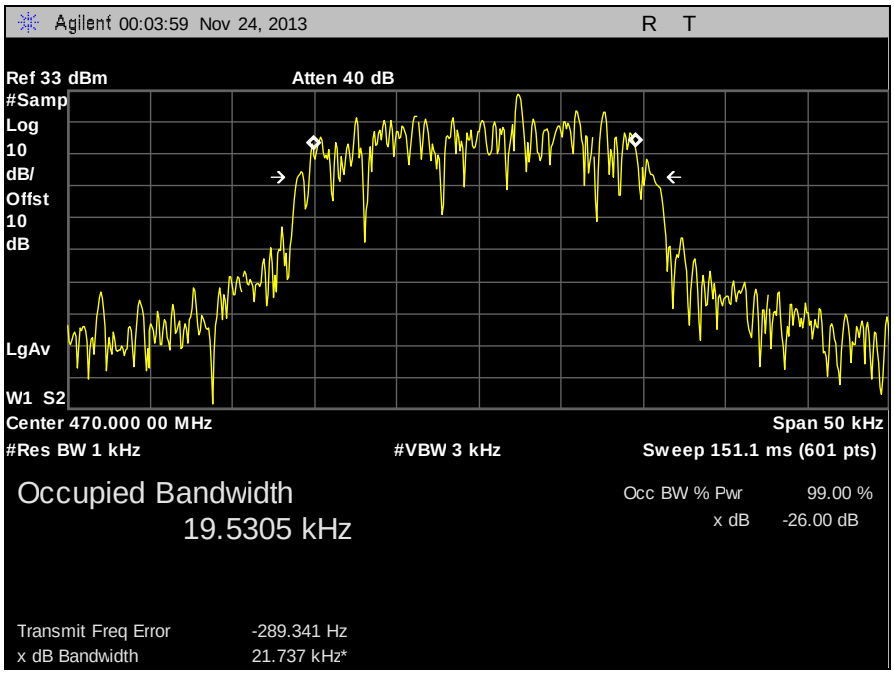
Plot 39. 99% Bandwidth, TI D-LMR, 20 kHz, High Channel, 429.9875 MHz



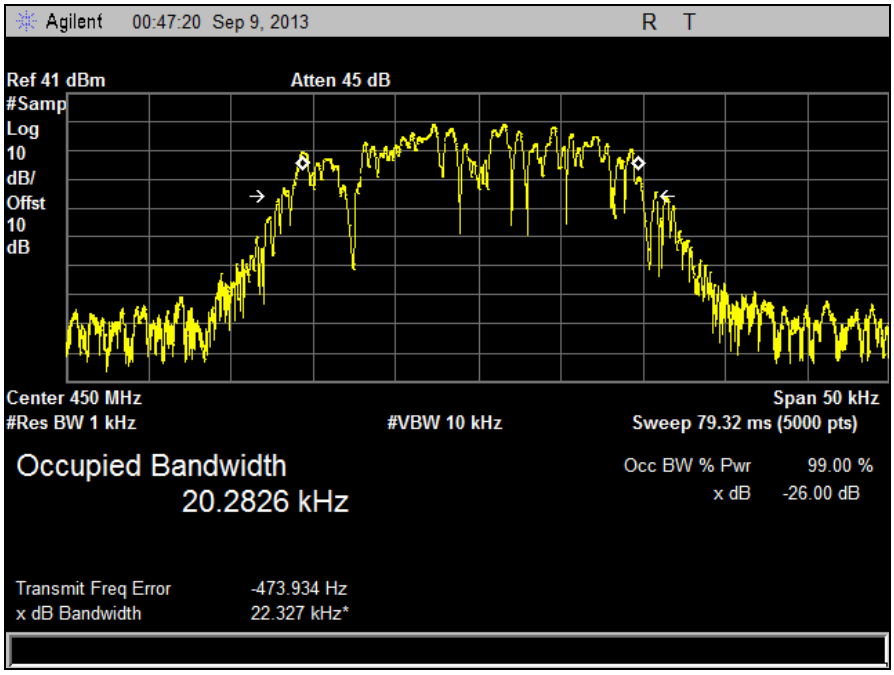
Plot 40. 99% Bandwidth, TI D-LMR, 20 kHz, Low Channel, 450 MHz



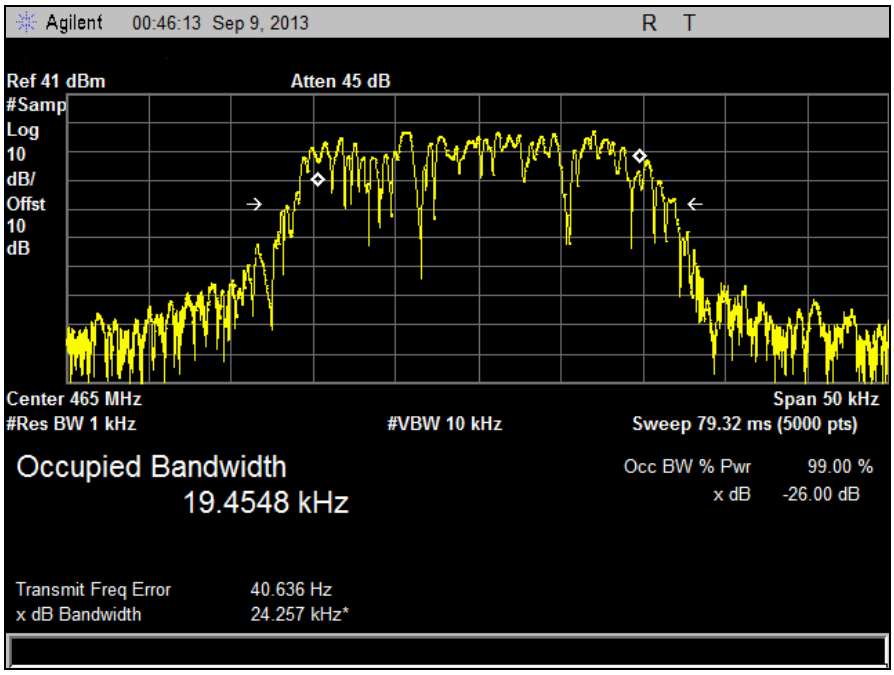
Plot 41. 99% Bandwidth, TI D-LMR, 20 kHz, Mid Channel, 465 MHz



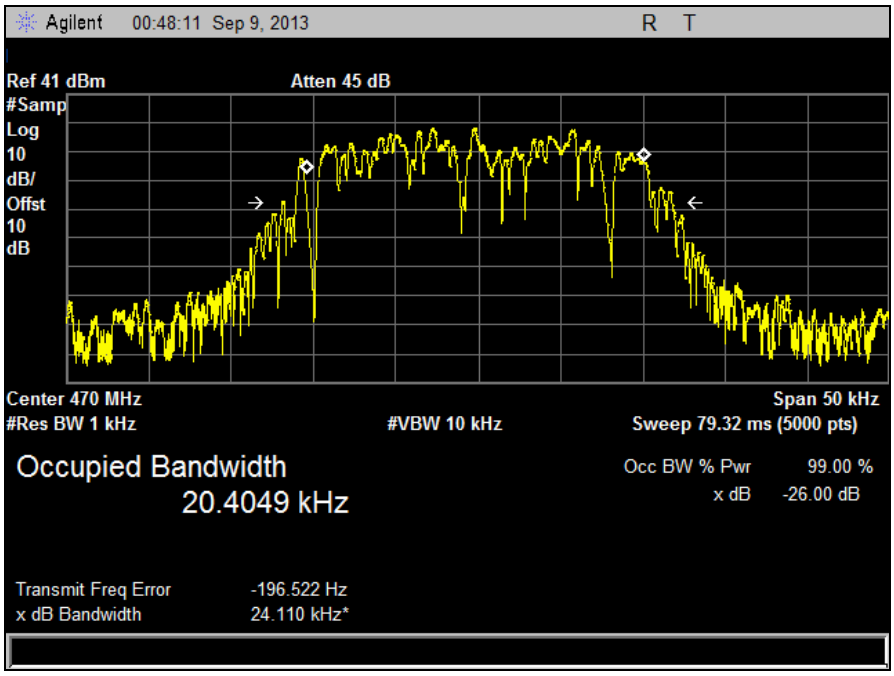
Plot 42. 99% Bandwidth, TI D-LMR, 20 kHz, High Channel, 470 MHz



Plot 43. 99% Bandwidth, TETRA, 22 kHz, Low Channel, 450 MHz

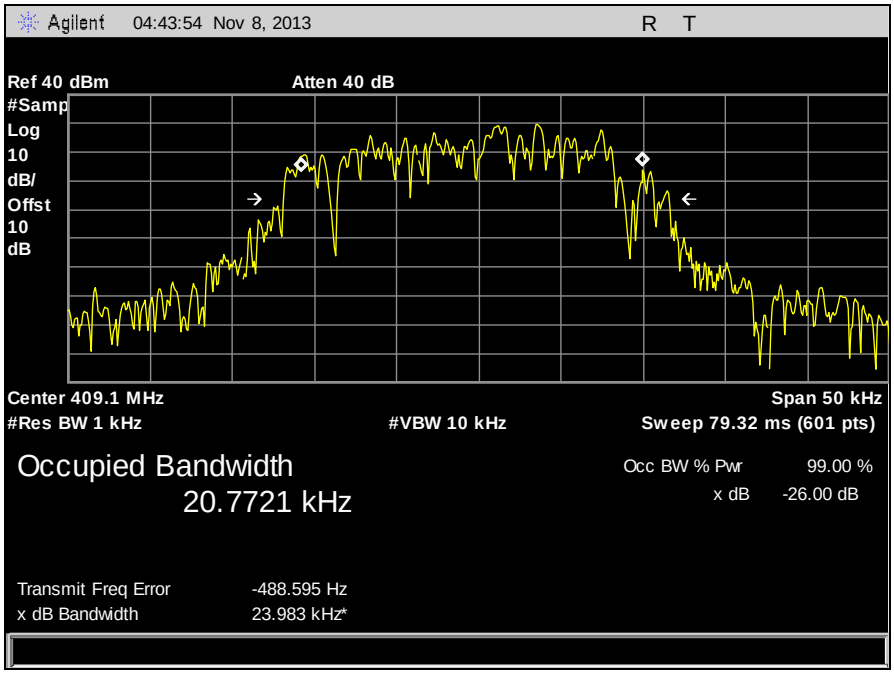


Plot 44. 99% Bandwidth, TETRA, 22 kHz, Mid Channel, 465 MHz

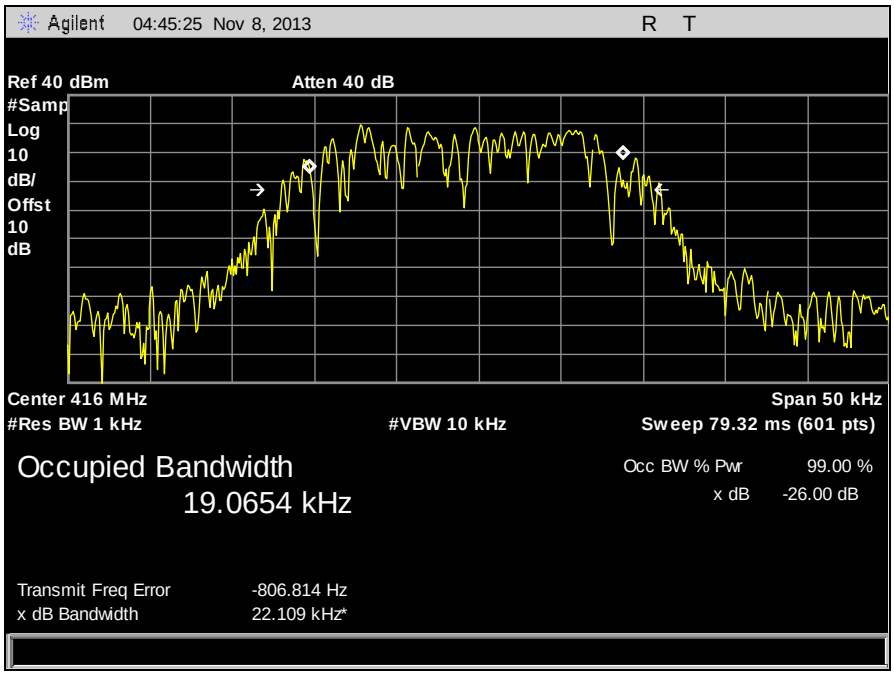


Plot 45. 99% Bandwidth, TETRA, 22 kHz, High Channel, 470 MHz

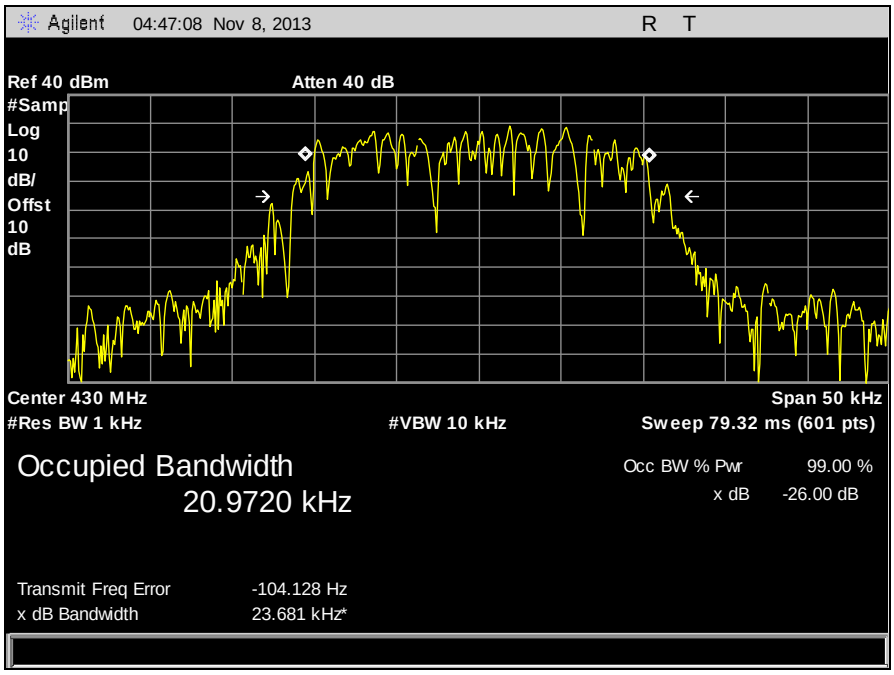
Occupied Bandwidth –IC RSS-119



Plot 46. 99% Bandwidth, TETRA, 22 kHz, Low Channel, 409.09375 MHz



Plot 47. 99% Bandwidth, TETRA, 22 kHz, mid Channel, 416.01875 MHz



Plot 48. 99% Bandwidth, TETRA, 22 kHz, High Channel, 429.9875 MHz

4.4. Emission Mask

FCC §90.210

Test Requirement(s): **§90.210 (Emissions Mask)**
EUT has an audio low pass filter. Therefore, the mask that applies to TRM-300 409-470 MHz, TI D-LMR modulation is Mask B. For TETRA, the ACP measurement according to §90.221 (R&O 12-114) applies.

IC RSS-119, Issue 11, June 2011

Test Requirement(s): 5.5.7 Voice input to an FM transmitter may use the spectrum mask with audio filter if it is equipped with suitable filters to be used for the audio signal only and not for other purposes. Other modulations must comply with the masks *without audio filter*.
TI D-LMR (authorized bandwidth 20 kHz), Mask C applies
TETRA (authorized bandwidth 22 kHz), Mask Y applies

Test Procedures: A laptop was connected to the EUT to control the RF output frequency channel. The EUT was connected to a spectrum analyzer. The measured power was set relative to zero dB reference. The RBW of the spectrum analyzer was set to at least 1% of the channel bandwidth.

Test Results: Equipment complies with these requirements.

The following pages show measurements of Emission Mask plots:

Test Engineer(s): Shawn McMillen

Test Date(s): 10/01/13

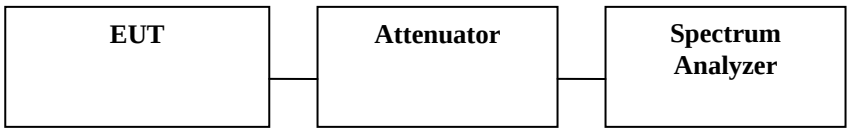
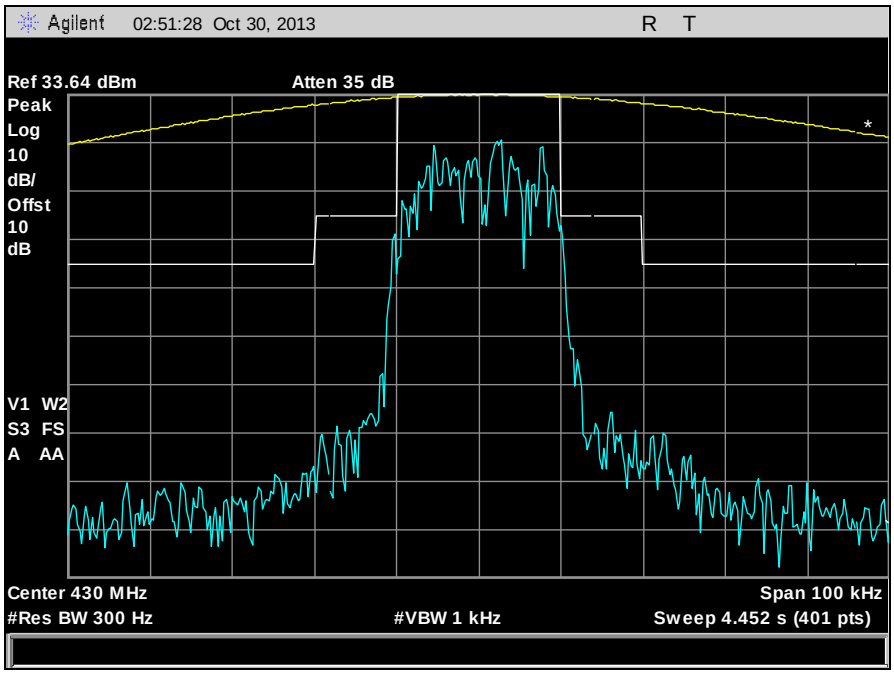


Figure 6. Emission Mask Test Setup

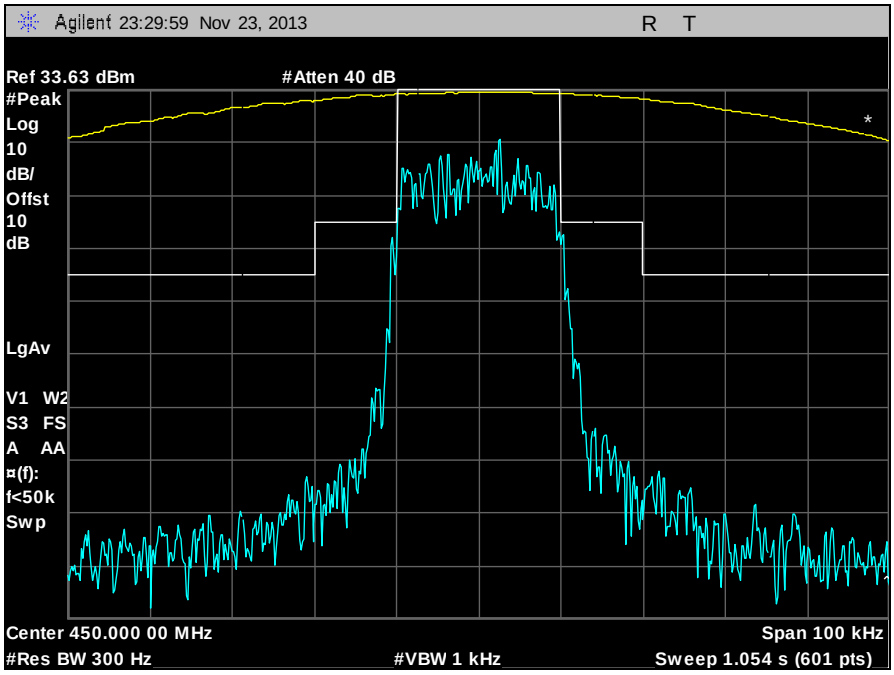
§90.210, Mask B, TI D-LMR

Plot 49. Emission Mask, TI D-LMR, 20 kHz, Low Channel, 409.094 MHz, Mask B

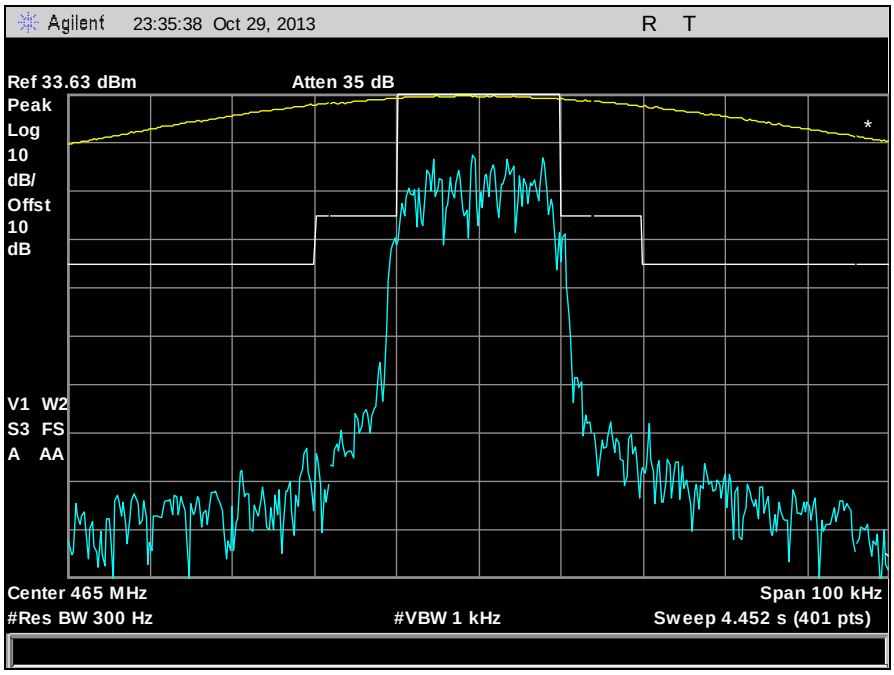
Plot 50. Emission Mask, TI D-LMR, 20 kHz, Mid Channel, 416.019 MHz, Mask B



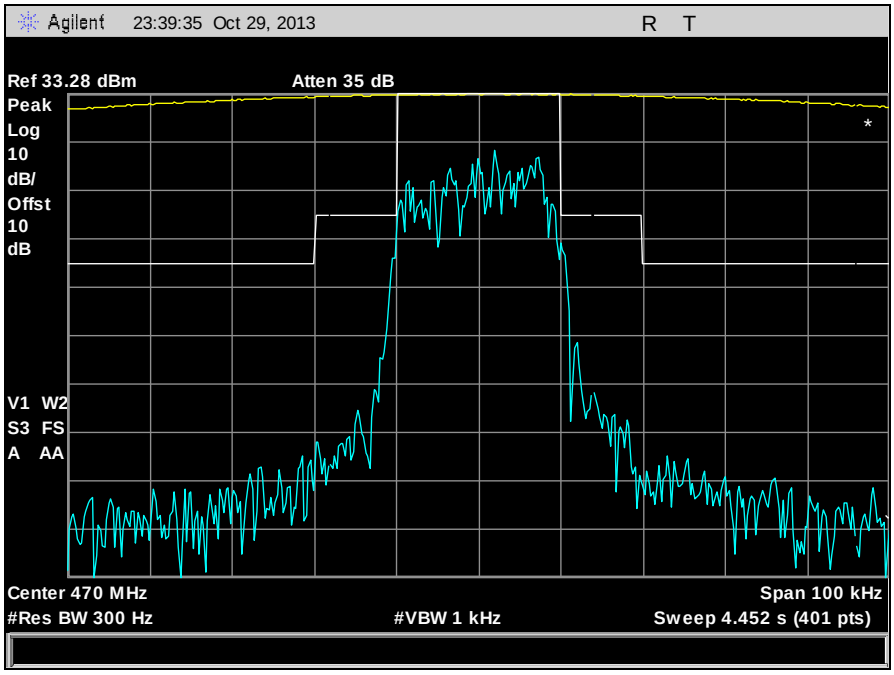
Plot 51. Emission Mask, TI D-LMR, 20 kHz, High Channel, 429.988 MHz, Mask B



Plot 52. Emission Mask, TI D-LMR, 20 kHz, Low Channel, 450 MHz, Mask B

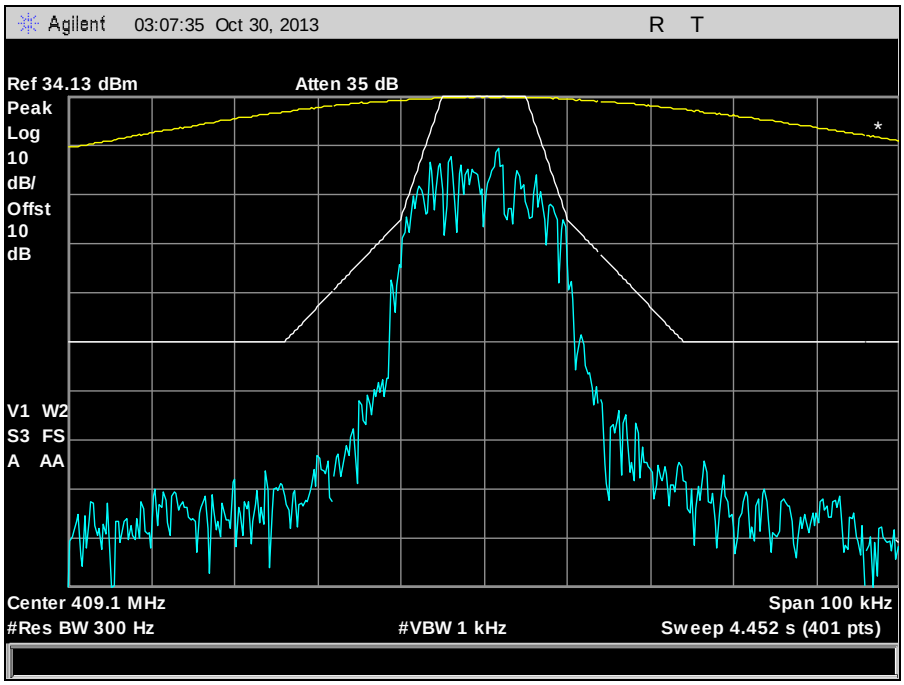


Plot 53. Emission Mask, TI D-LMR, 20 kHz, Mid Channel, 465 MHz, Mask B



Plot 54. Emission Mask, TI D-LMR, 20 kHz, High Channel, 470 MHz, Mask B

IC RSS-119, Mask C, TI D-LMR



Plot 55. Emission Mask, TI D-LMR, 20 kHz, Low Channel, 409.09375 MHz, Mask C

Plot 56. Emission Mask, TI D-LMR, 20 kHz, Mid Channel, 416.019 MHz, Mask C

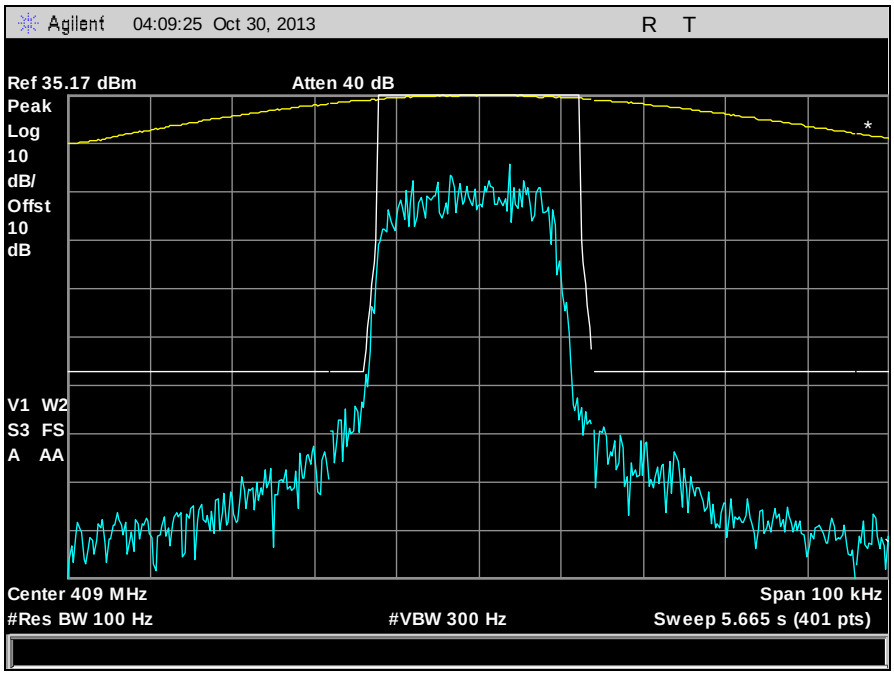
Plot 57. Emission Mask, TI D-LMR, 20 kHz, High Channel, 429.9875 MHz, Mask C

Plot 58. Emission Mask, TI D-LMR, 20 kHz, Low Channel, 450 MHz, Mask C

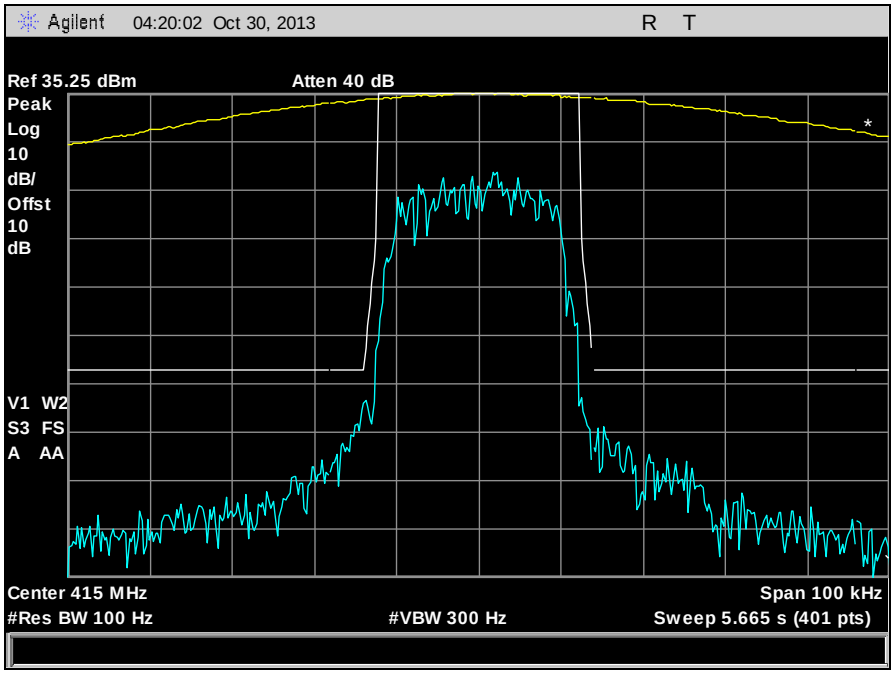
Plot 59. Emission Mask, TI D-LMR, 20 kHz, Mid Channel, 465 MHz, Mask C

Plot 60. Emission Mask, TI D-LMR, 20 kHz, High Channel, 470 MHz, Mask C

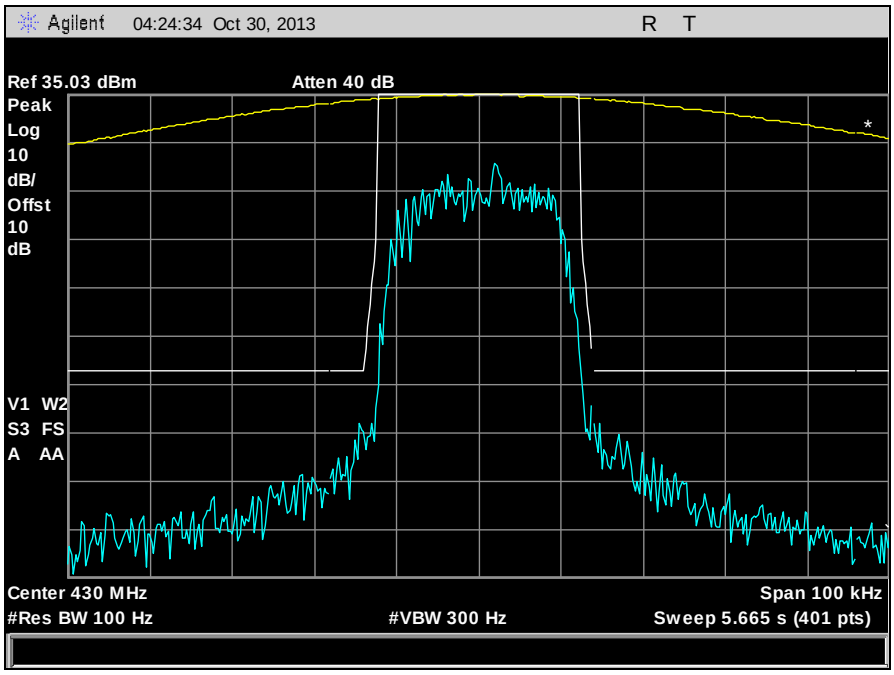
IC RSS-119, Mask Y, TETRA



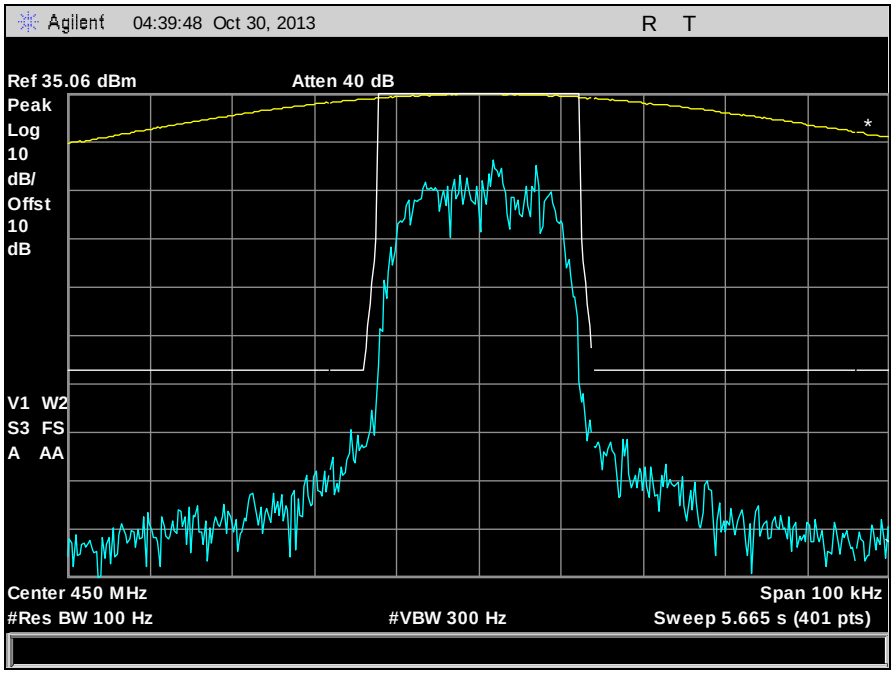
Plot 61. Emission Mask, TETRA, 22 kHz, Low Channel, 409.09375 MHz, Mask Y



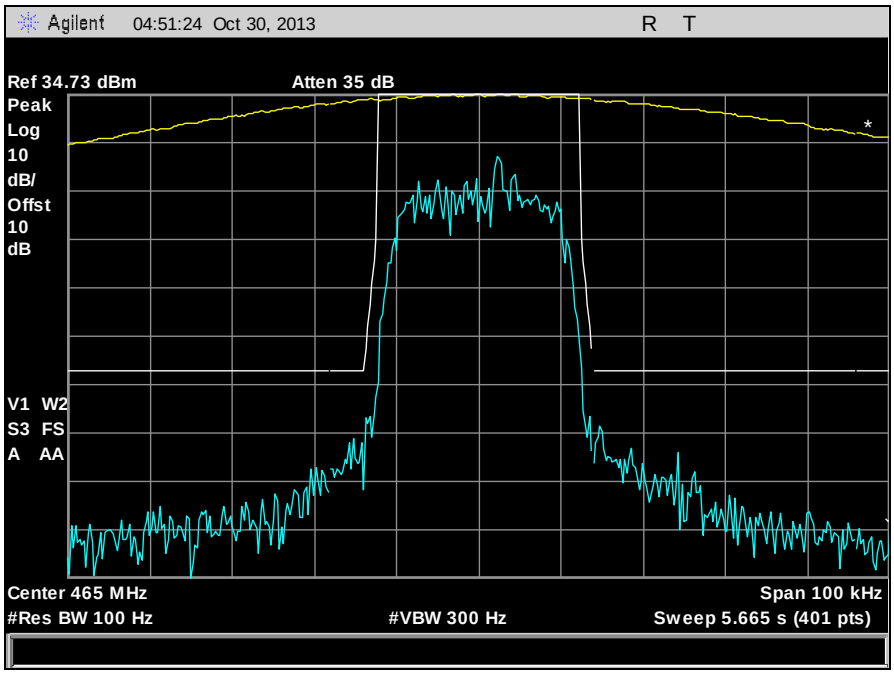
Plot 62. Emission Mask, TETRA, 22 kHz, Mid Channel, 415.019 MHz, Mask Y



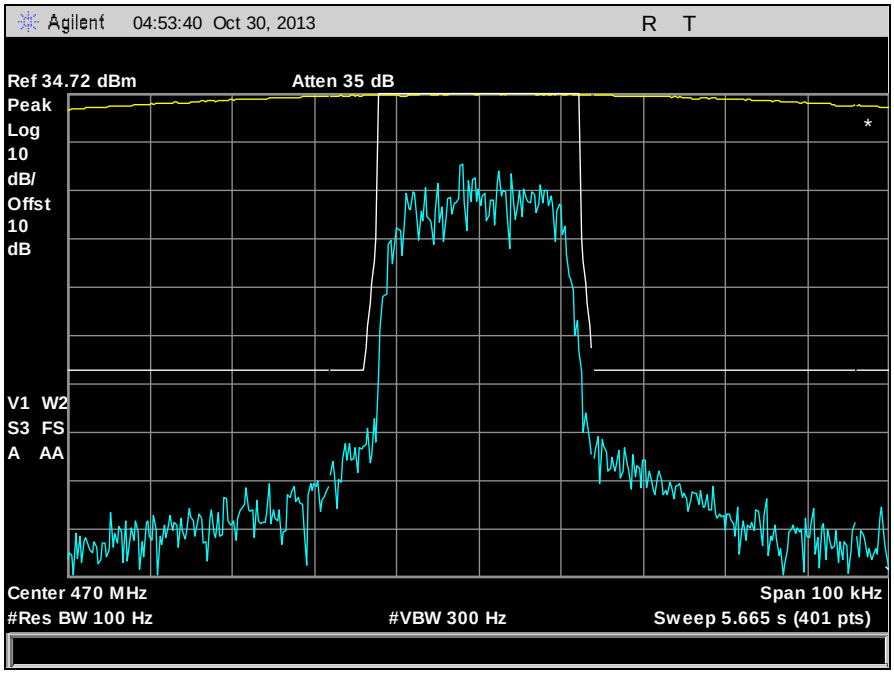
Plot 63. Emission Mask, TETRA, 22 kHz, High Channel, 429.988 MHz, Mask Y



Plot 64. Emission Mask, TETRA, 22 kHz, Low Channel, 450 MHz, Mask Y



Plot 65. Emission Mask, TETRA, 22 kHz, Mid Channel, 465 MHz, Mask Y



Plot 66. Emission Mask, TETRA, 22 kHz, High Channel, 470 MHz, Mask Y

4.5. Spurious Emissions at Antenna Terminals

FCC §2.1051, §22.359, §90.210

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.

§22.359 Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log (P) dB.

§90.210 (b) *Emission Mask B.* For transmitters that are equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:
(1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.
(2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.
(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

§90.221(d) On any frequency removed from the assigned frequency by more than 75 kHz, the attenuation of any emission must be at least 43 + 10 log (Pwatts) dB.

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.

5.8.2 Emission Mask C for Transmitters not Equipped with an Audio Low-pass Filter

The power of any emission shall be attenuated below the transmitter output power P (dBW) as specified in Table 5.

Table 5 – Emission Mask C

Displacement Frequency, f_d (kHz)	**Minimum Attenuation (dB)**	**Resolution Bandwidth (Hz)**
$5 < f_d \leq 10$	$83 \log_{10}(f_d/5)$	300
$10 < f_d \leq 50$	whichever is the lesser attenuation: 50 or $29 \log_{10}(f_d^2/11)$	300
$f_d > 50$	$43 + 10 \log_{10}(p)$	Specified in Section 4.2.1

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: $30 + 16.67(f_d\text{-}12.375)$ 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, §22.359, and §90.210 and RSS-119.

Test Engineer(s): Shawn McMillen

Test Date(s): 09/11/13

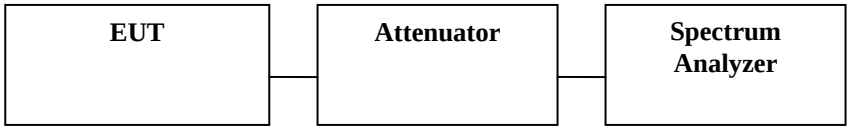
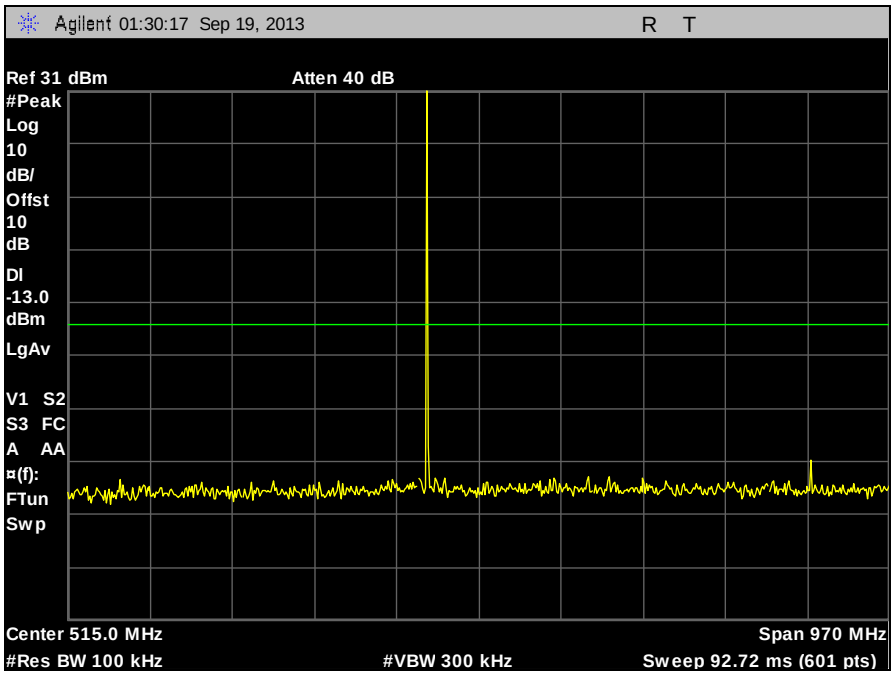
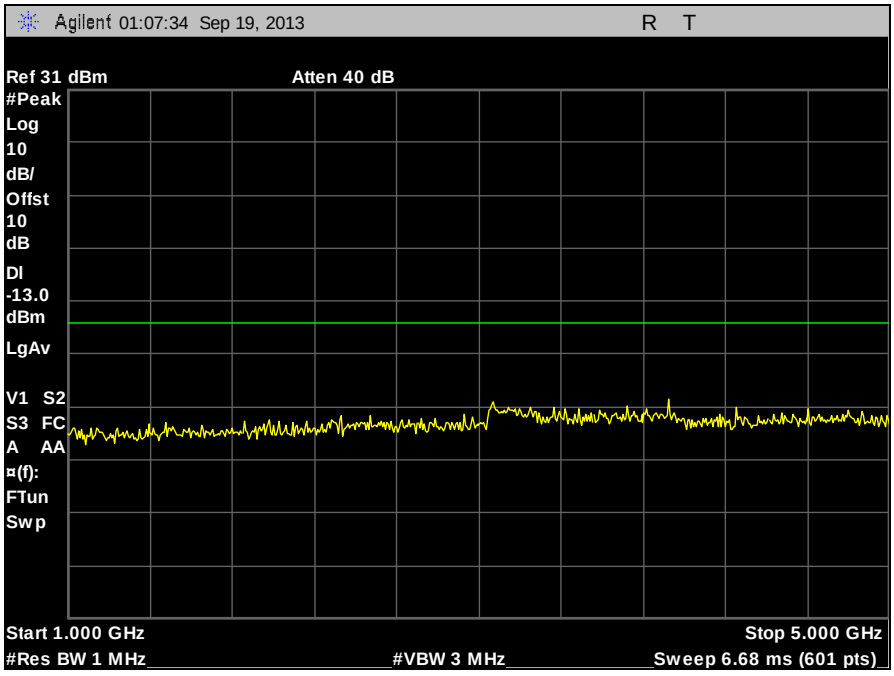


Figure 7. Spurious Emissions at Antenna Terminals Test Setup

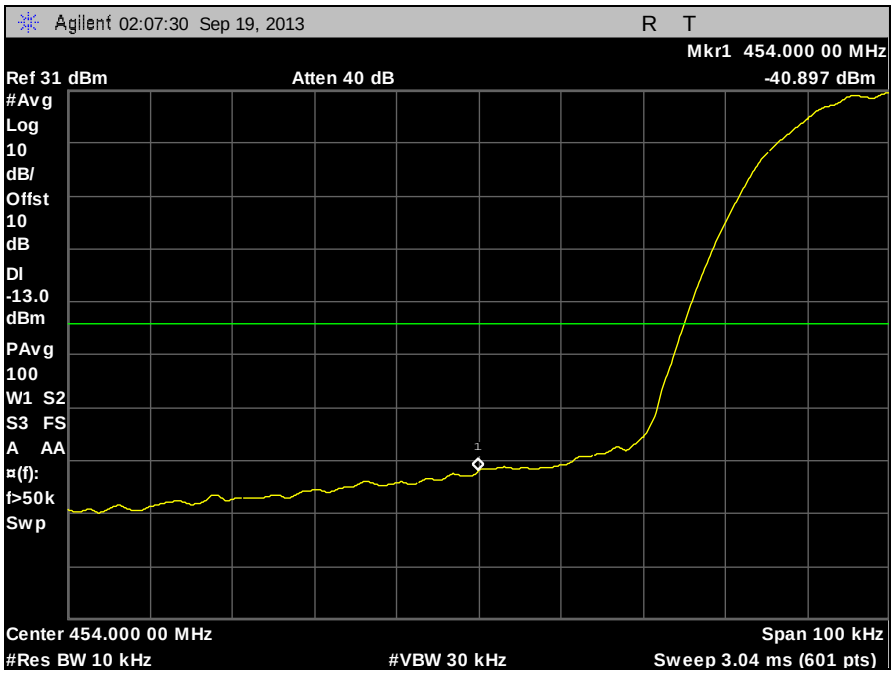
FCC Part 22



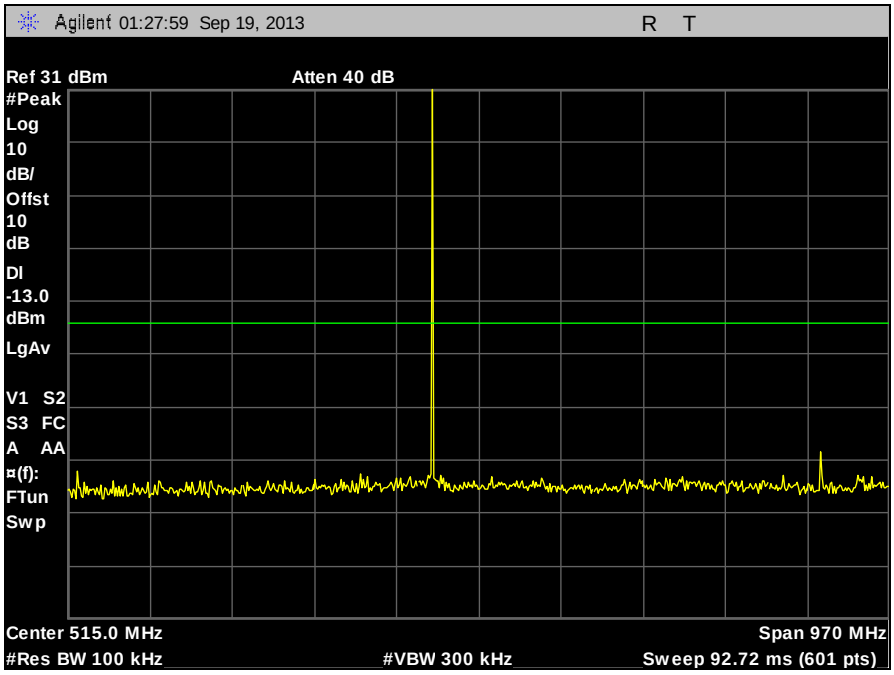
Plot 67. Conducted Spurious Emissions, Part 22, TI D-LMR, 20 kHz, Low Channel, 454.050 MHz, 30 MHz – 1 GHz



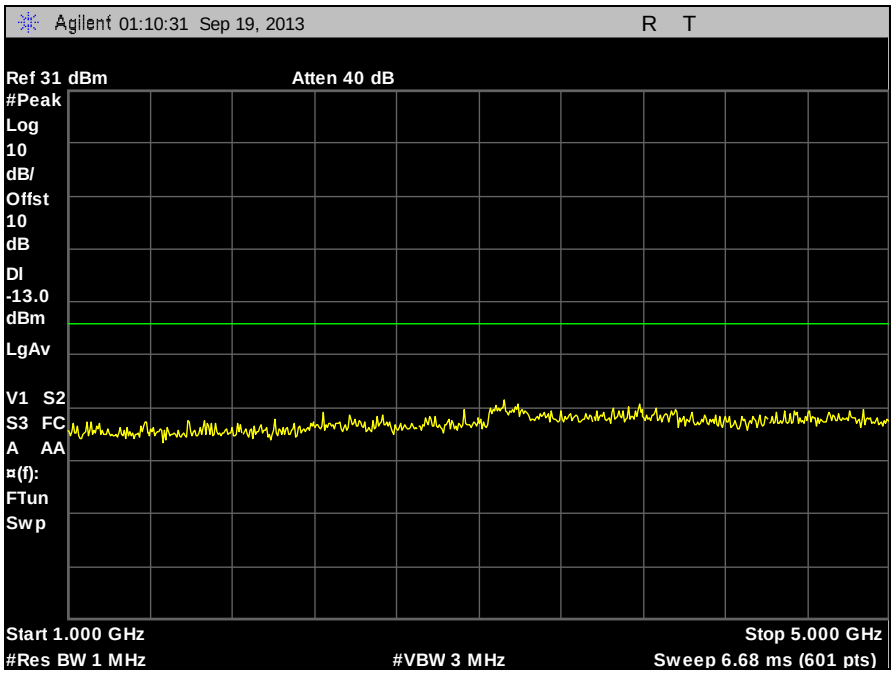
Plot 68. Conducted Spurious Emissions, Part 22, TI D-LMR, 20 kHz, Low Channel, 454.050 MHz, 1 GHz – 5 GHz



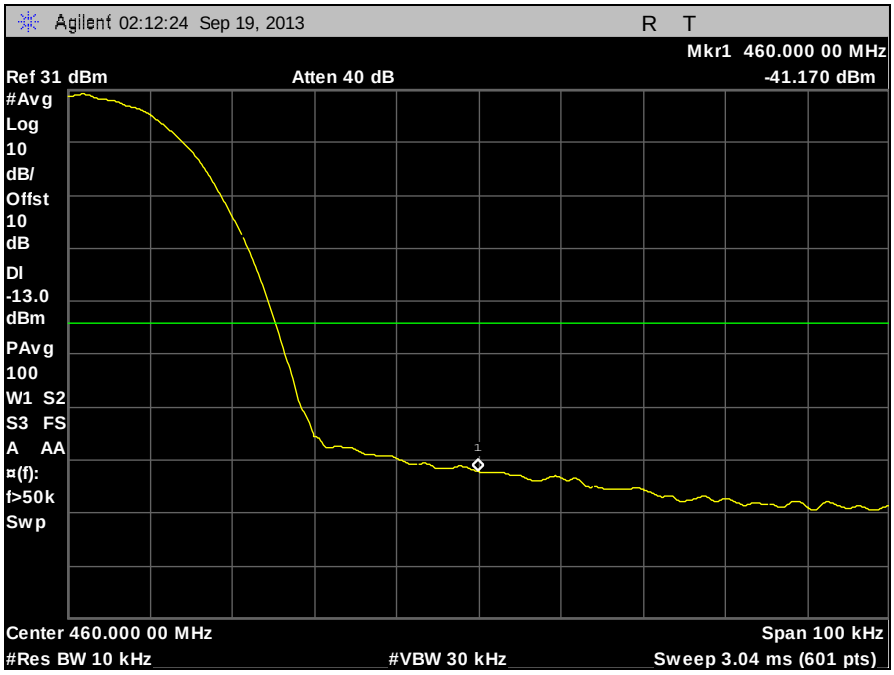
Plot 69. Conducted Spurious Emissions, Part 22, TI D-LMR, 20 kHz, Low Channel, 454.050 MHz, Band Edge



Plot 70. Conducted Spurious Emissions, Part 22, TI D-LMR, 20 kHz, High Channel, 459.950 MHz, 30 MHz – 1 GHz

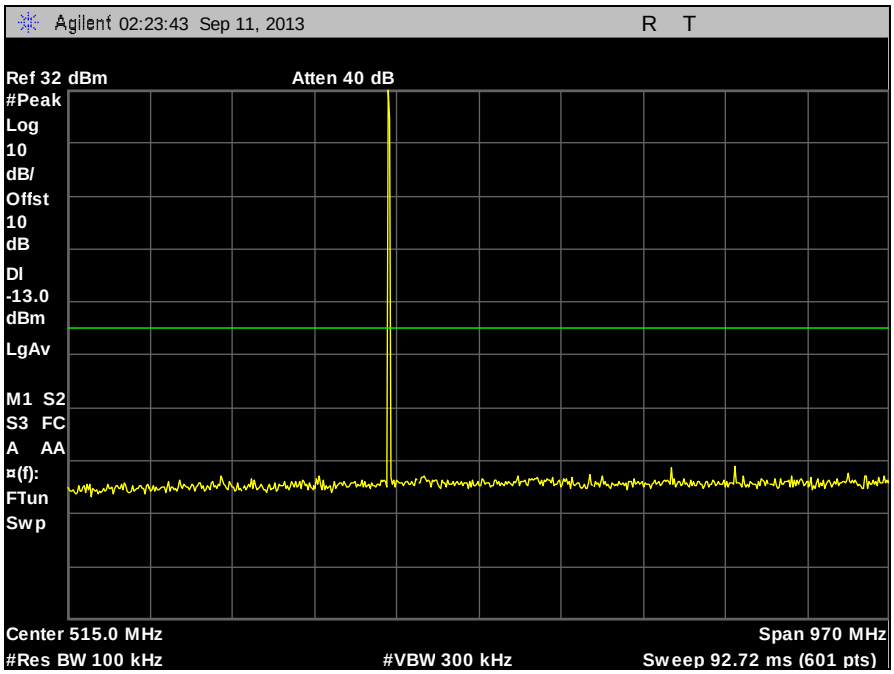


Plot 71. Conducted Spurious Emissions, Part 22, TI D-LMR, 20 kHz, High Channel, 459.950 MHz, 1 GHz – 5 GHz

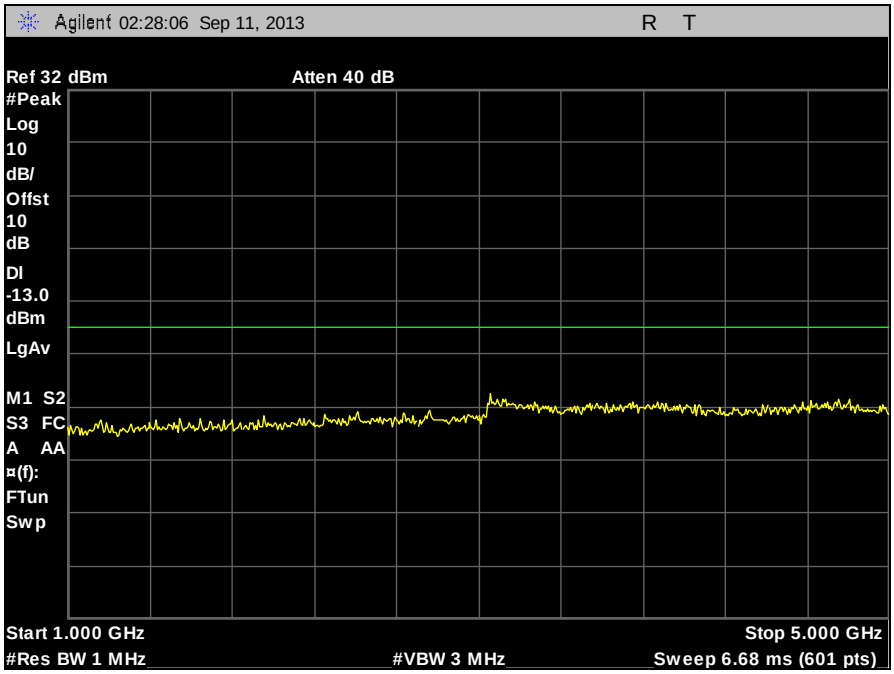


Plot 72. Conducted Spurious Emissions, Part 22, TI D-LMR, 20 kHz, High Channel, 459.950 MHz, Band Edge

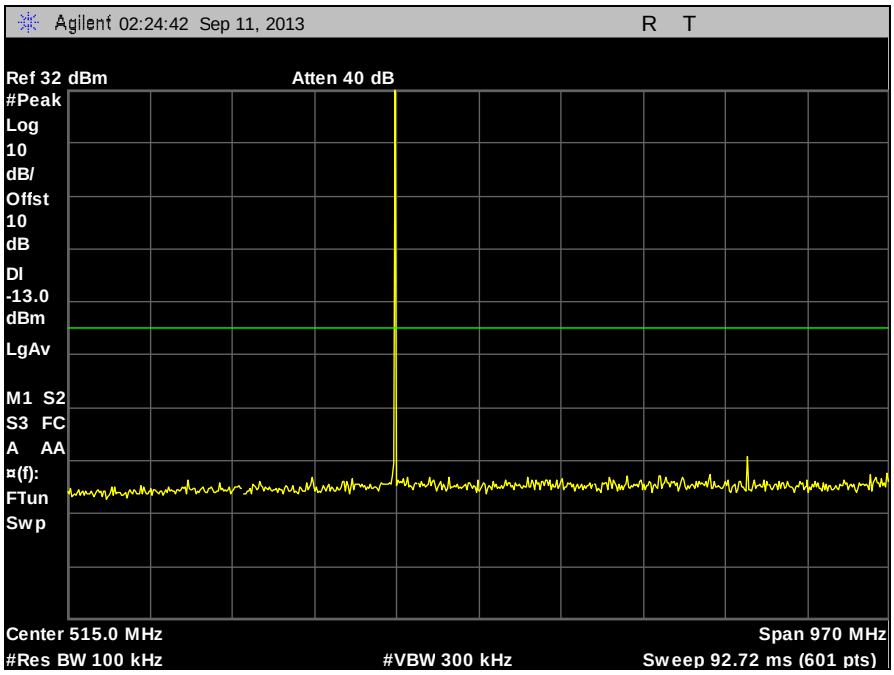
FCC Part 90 and IC RSS-119 – TI D-LMR



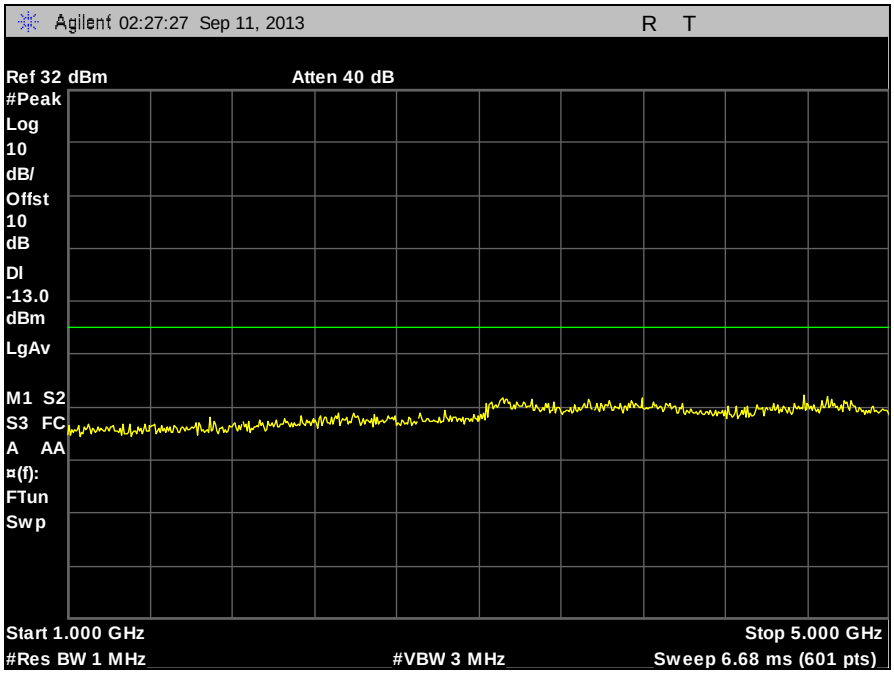
Plot 73. Conducted Spurious Emissions, Part 90, TI D-LMR, 20 kHz, Low Channel, 409.09375 MHz, 30 MHz – 1 GHz



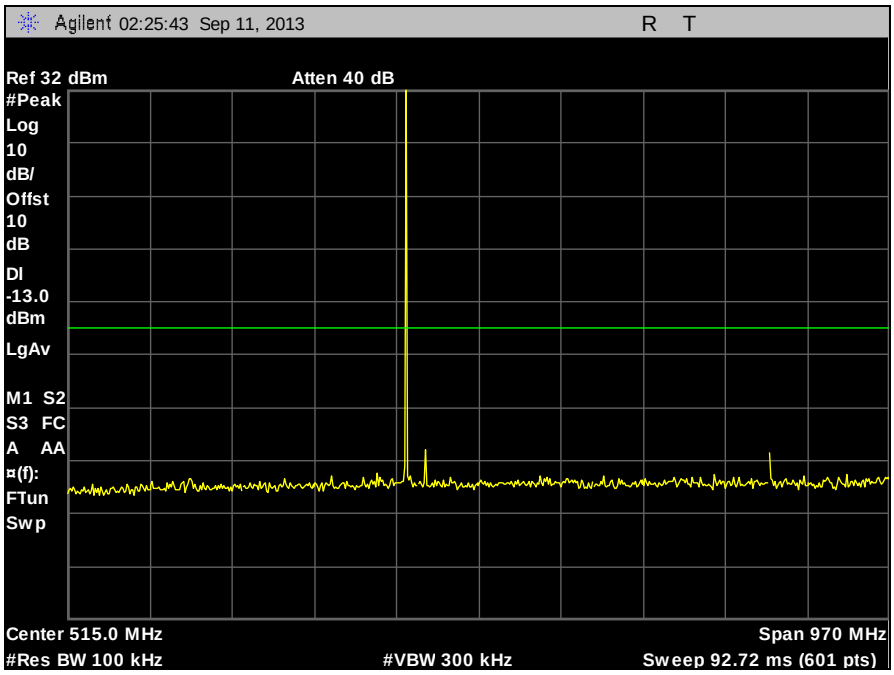
Plot 74. Conducted Spurious Emissions, Part 90, TI D-LMR, 20 kHz, Low Channel, 409.09375 MHz, 1 GHz – 5 GHz



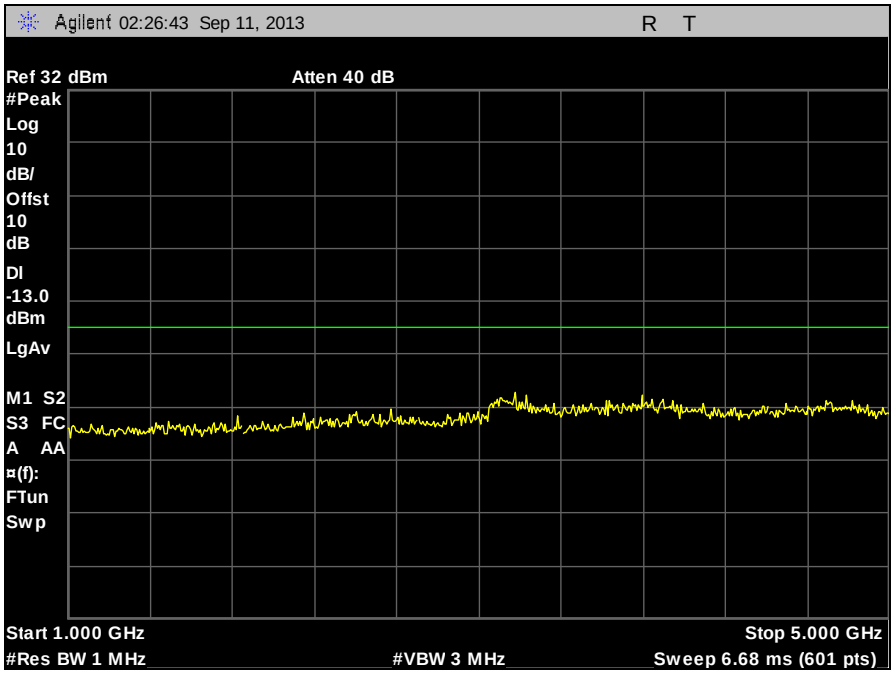
Plot 75. Conducted Spurious Emissions, Part, 90, TI D-LMR, 20 kHz, Mid Channel, 415.01875 MHz, 30 MHz – 1 GHz



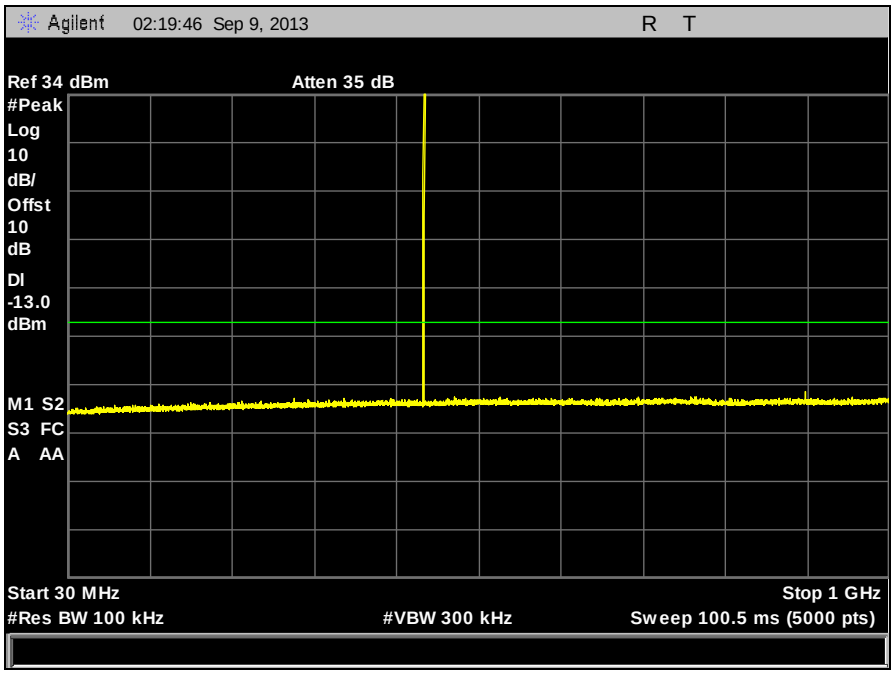
Plot 76. Conducted Spurious Emissions, Part 90, TI D-LMR, 20 kHz, Mid Channel, 415.01875 MHz, 1 GHz – 5 GHz



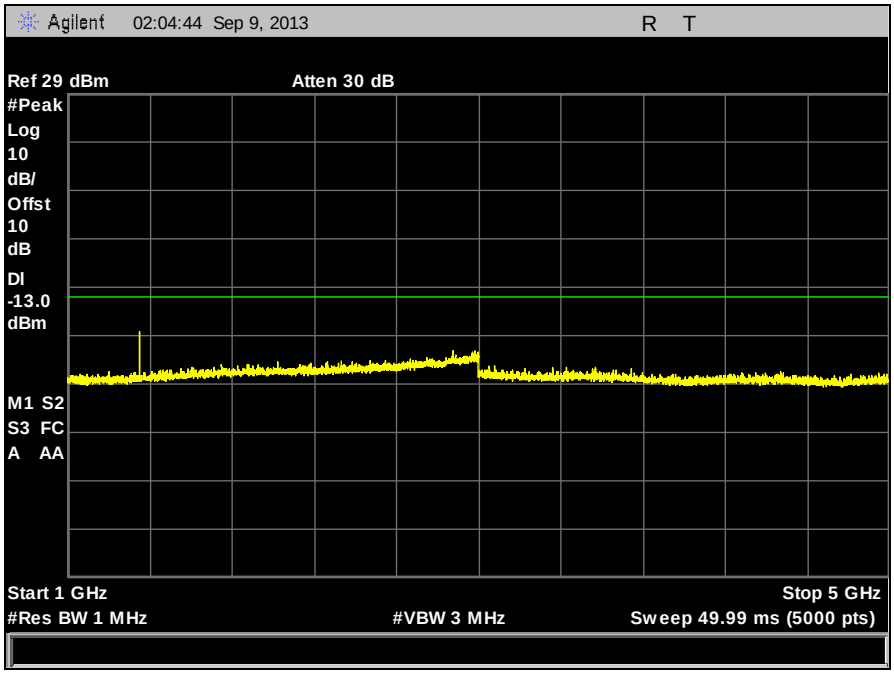
Plot 77. Conducted Spurious Emissions, Part 90, TI D-LMR, 20 kHz, High Channel, 429.9875 MHz, 30 MHz – 1 GHz



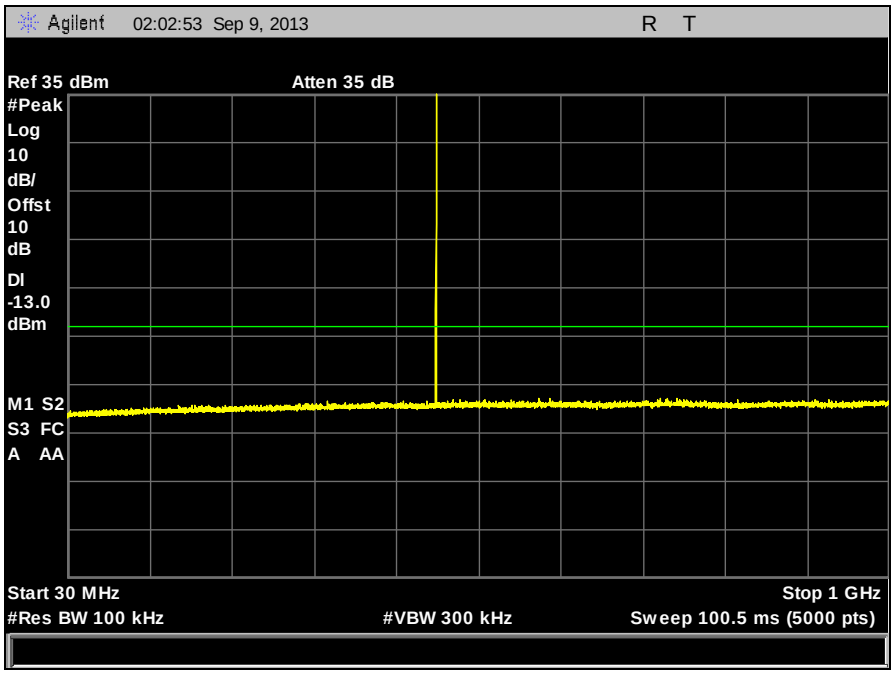
Plot 78. Conducted Spurious Emissions, Part 90, TI D-LMR, 20 kHz, High Channel, 429.9875 MHz, 1 GHz – 5 GHz



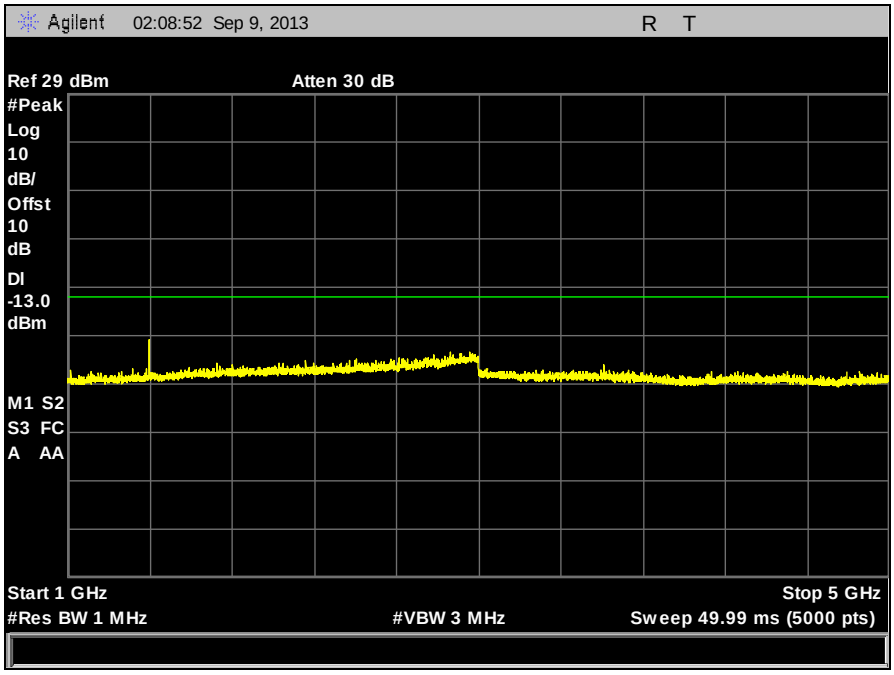
Plot 79. Conducted Spurious Emissions, Part 90, TI D-LMR, 20 kHz, Low Channel, 450 MHz, 30 MHz – 1 GHz



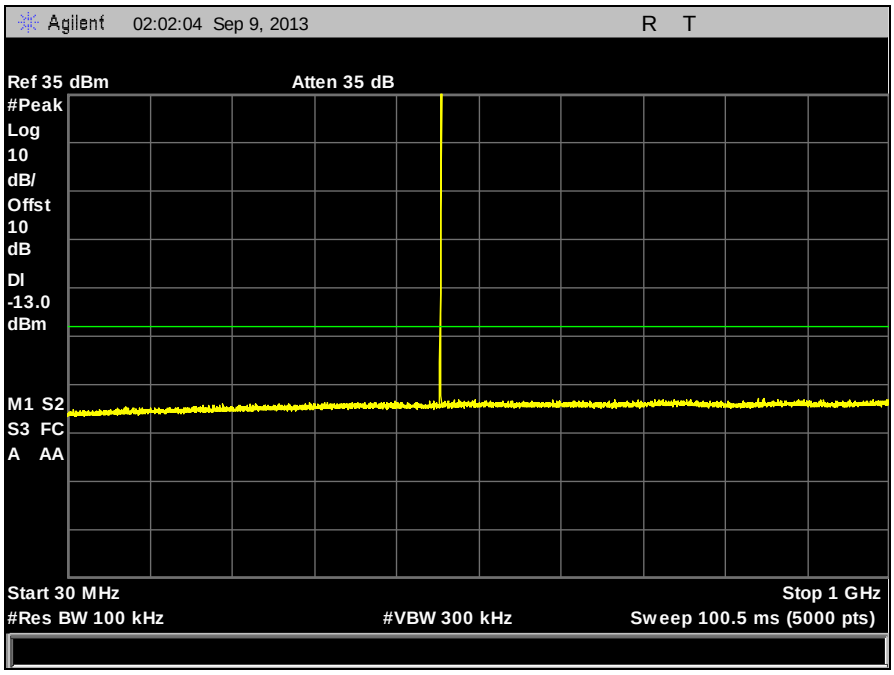
Plot 80. Conducted Spurious Emissions, Part 90, TI D-LMR, 20 kHz, Low Channel, 450 MHz, 1 GHz – 5 GHz



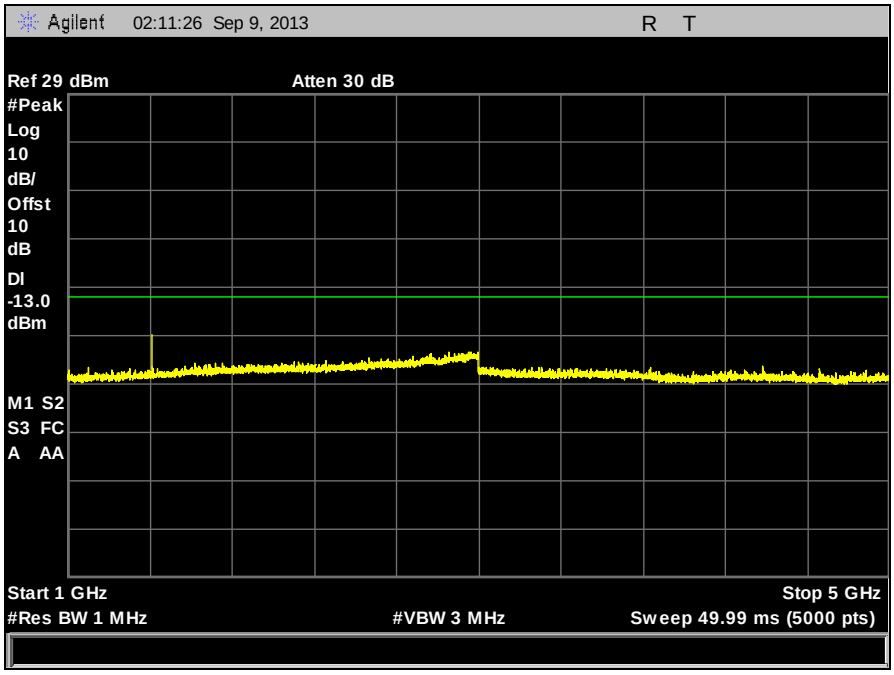
Plot 81. Conducted Spurious Emissions, Part 90, TI D-LMR, 20 kHz, Mid Channel, 465 MHz, 30 MHz – 1 GHz



Plot 82. Conducted Spurious Emissions, Part 90, TI D-LMR, 20 kHz, Mid Channel, 465 MHz, 1 GHz – 5 GHz

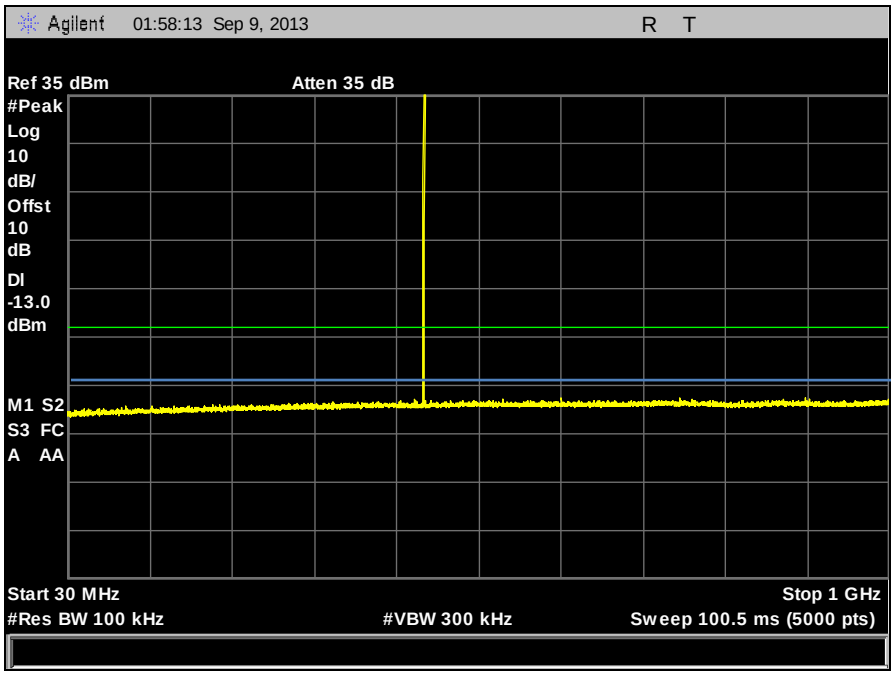


Plot 83. Conducted Spurious Emissions, Part 90, TI D-LMR, 20 kHz, High Channel, 470 MHz, 30 MHz – 1 GHz

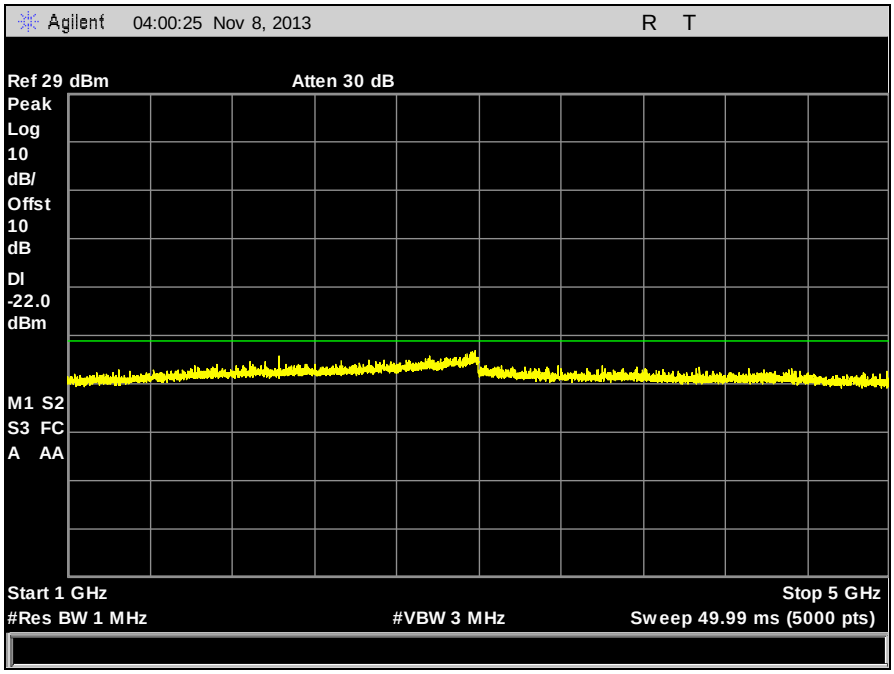


Plot 84. Conducted Spurious Emissions, Part 90, TI D-LMR, 20 kHz, High Channel, 470 MHz, 1 GHz – 5 GHz

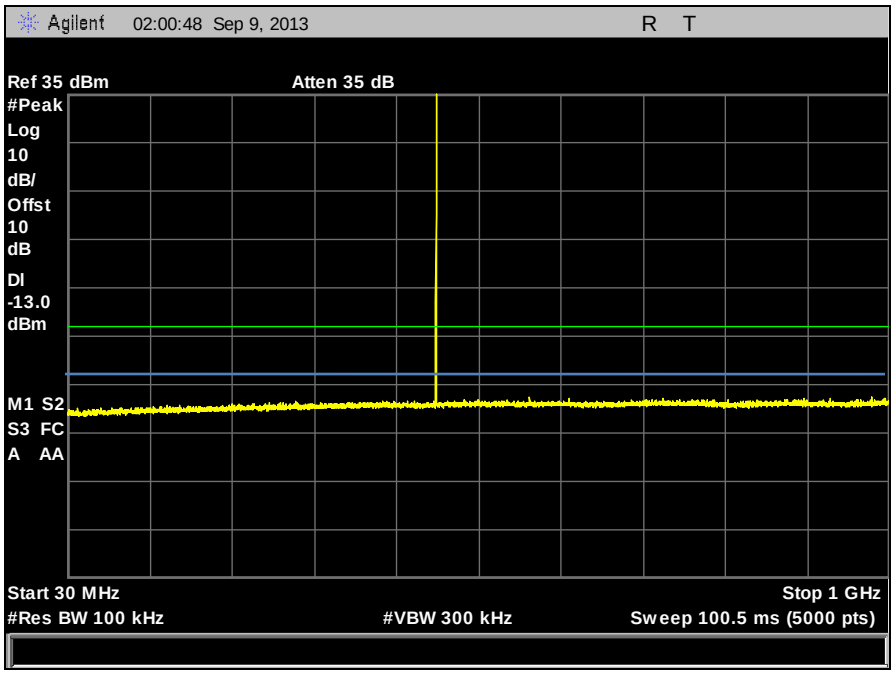
FCC Part 90 and IC RSS-119 – TETRA



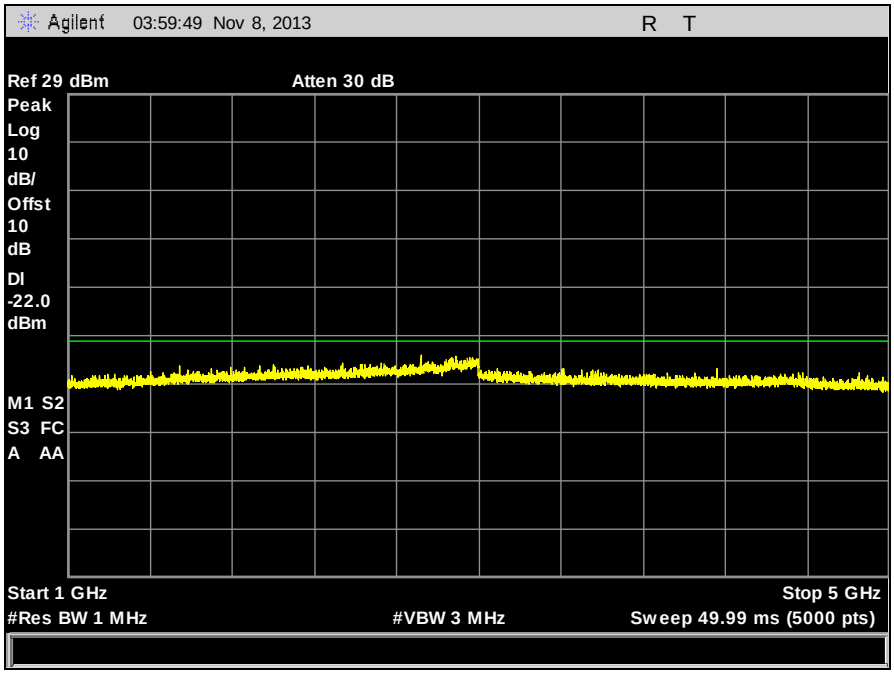
Plot 85. Conducted Spurious Emissions, Part 90, TETRA, 22 kHz, Low Channel, 450 MHz, 30 MHz – 1 GHz



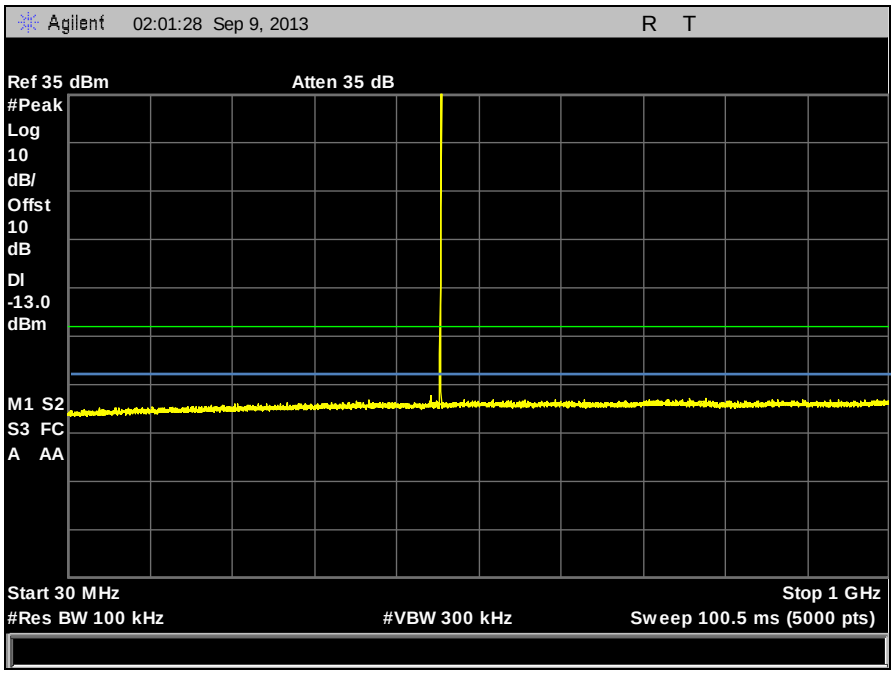
Plot 86. Conducted Spurious Emissions, Part 90, TETRA, 22 kHz, Low Channel, 450 MHz, 1 GHz – 5 GHz



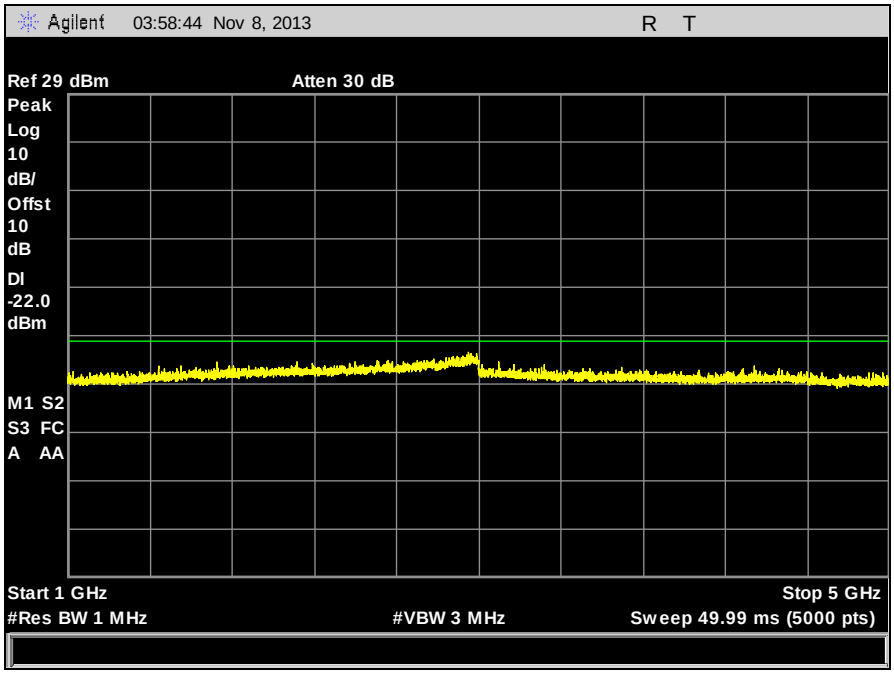
Plot 87. Conducted Spurious Emissions, Part 90, TETRA, 22 kHz, Mid Channel, 465 MHz, 30 MHz – 1 GHz



Plot 88. Conducted Spurious Emissions, Part 90, TETRA, 22 kHz, Mid Channel, 465 MHz, 1 GHz – 5 GHz

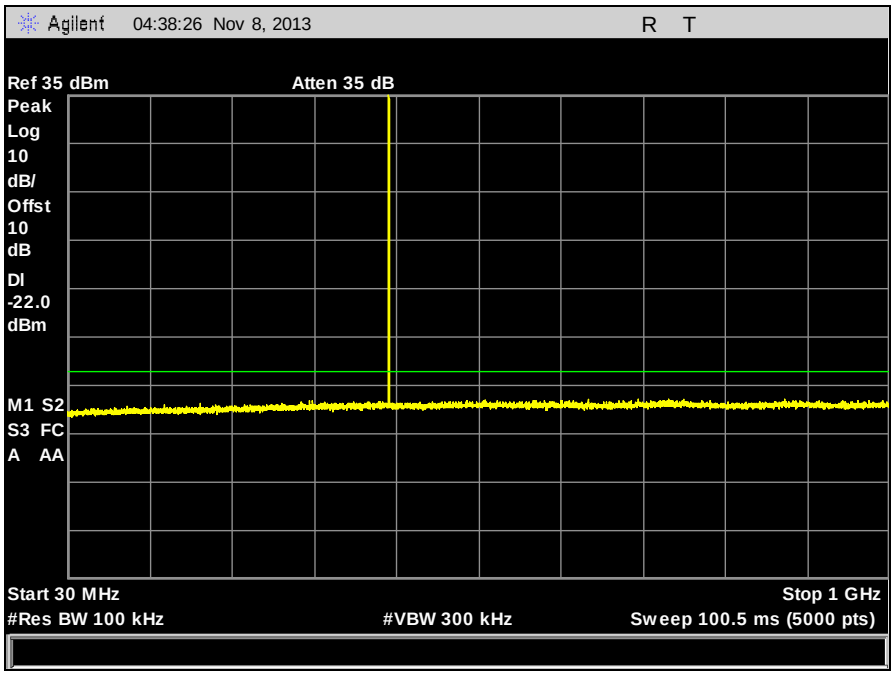


Plot 89. Conducted Spurious Emissions, Part 90, TETRA, 22 kHz, High Channel, 470 MHz, 30 MHz – 1 GHz

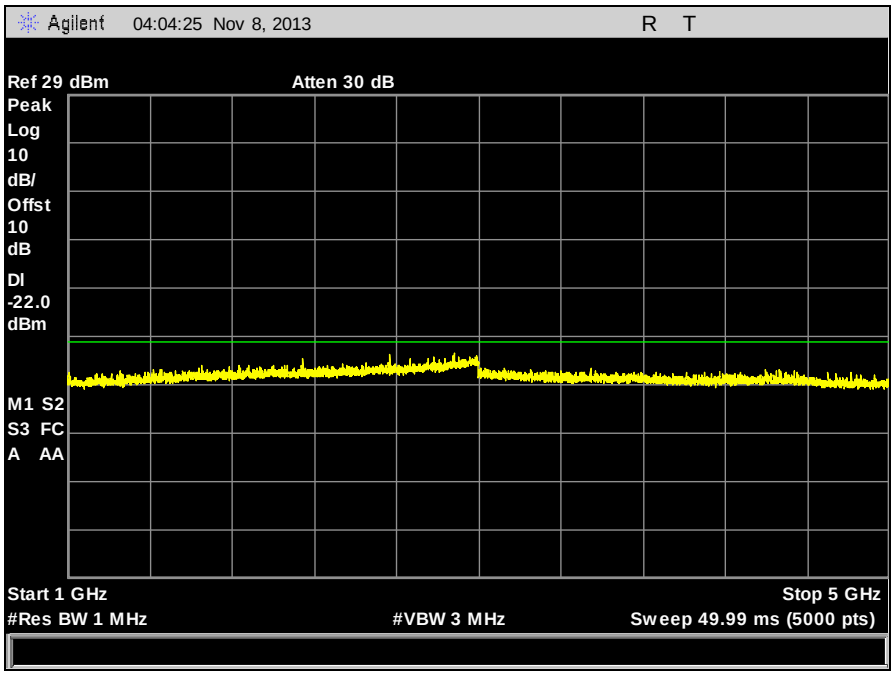


Plot 90. Conducted Spurious Emissions, Part 90, TETRA, 22 kHz, High Channel, 470 MHz, 1 GHz – 5 GHz

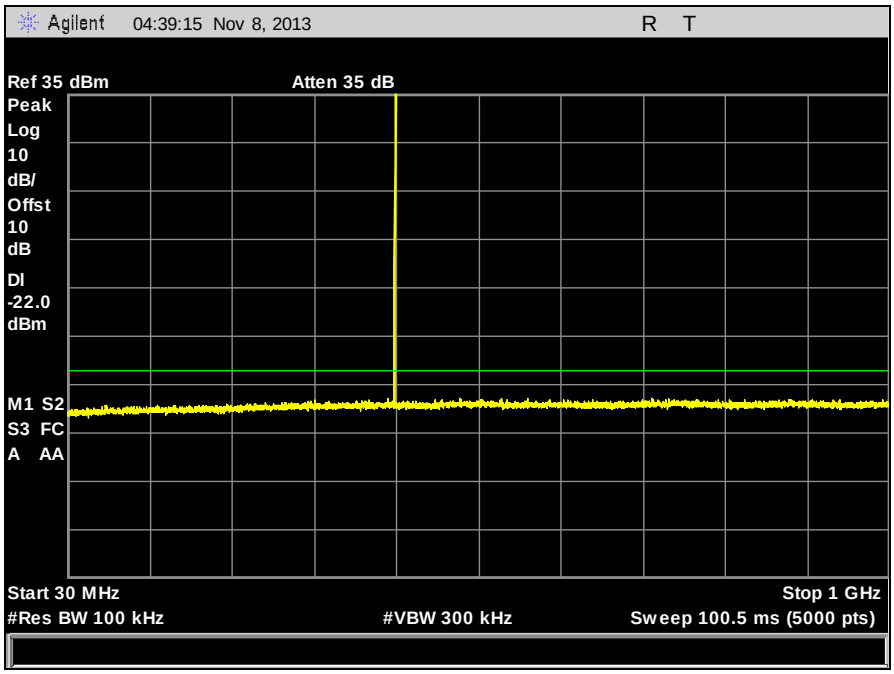
IC RSS-119 – TETRA



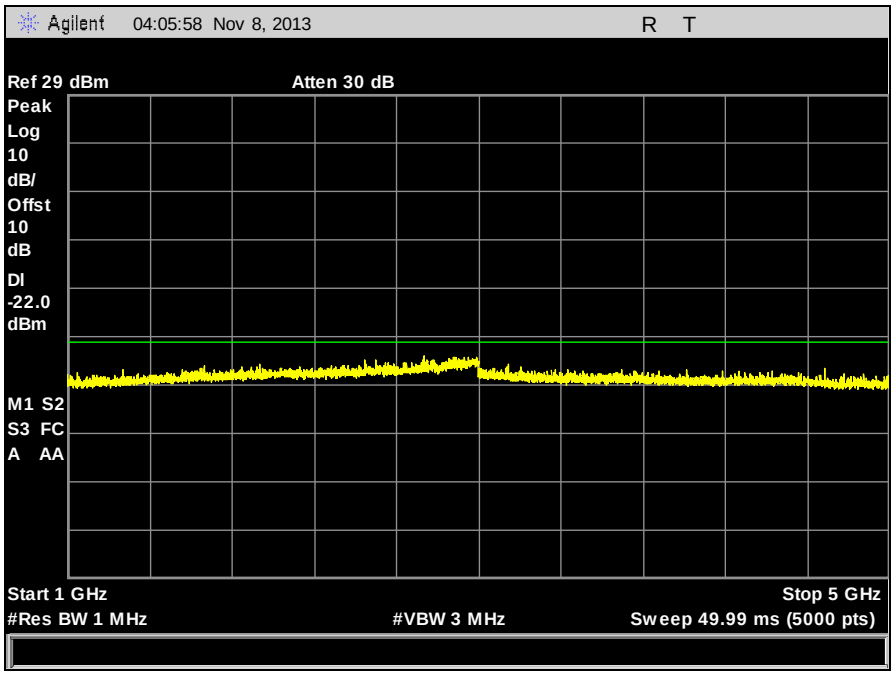
Plot 91. Conducted Spurious Emissions, RSS-119, TETRA, 22 kHz, Low Channel, 409.09375 MHz, 30 MHz – 1 GHz



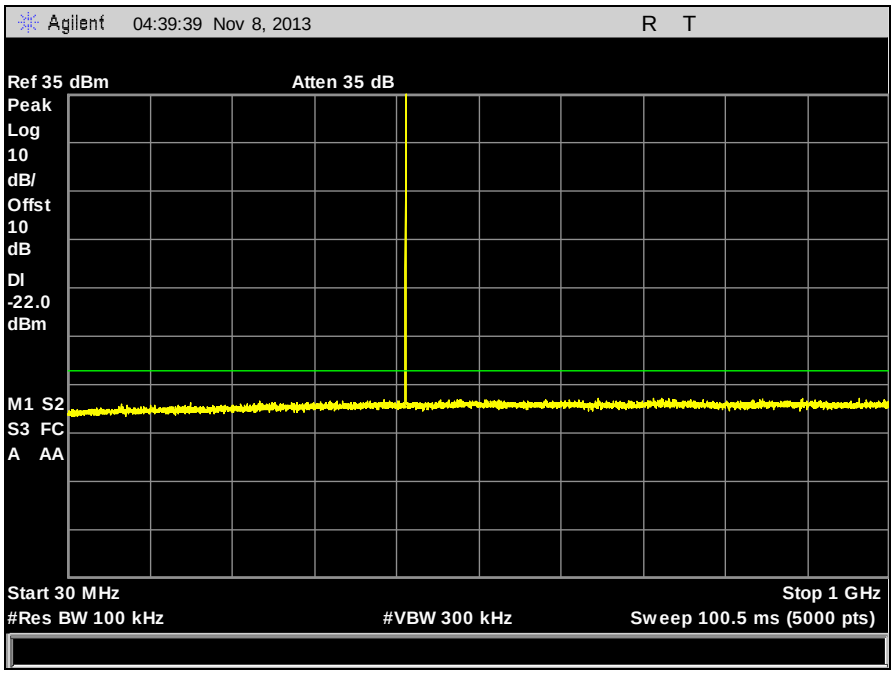
Plot 92. Conducted Spurious Emissions, RSS-119, TETRA, 22 kHz, Low Channel, 409.09375 MHz, 1 GHz – 5 GHz



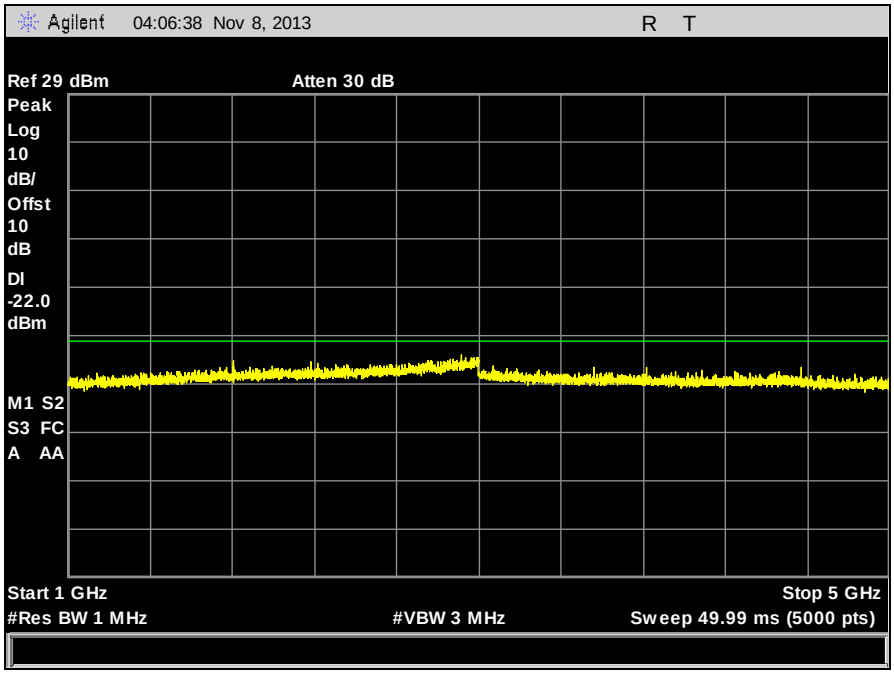
Plot 93. Conducted Spurious Emissions, RSS-119, TETRA, 22 kHz, Mid Channel, 416.01875 MHz, 30 MHz – 1 GHz



Plot 94. Conducted Spurious Emissions, RSS-119, TETRA, 22 kHz, Mid Channel, 416.01875 MHz, 1 GHz – 5 GHz



Plot 95. Conducted Spurious Emissions, RSS-119, TETRA, 22 kHz, High Channel, 429.9875 MHz, 30 MHz – 1 GHz



Plot 96. Conducted Spurious Emissions, RSS-119, TETRA, 22 kHz, High Channel, 429.9875 MHz, 1 GHz – 5 GHz

4.6. Adjacent Channel Power

FCC §90.221

Test Requirement(s): **§90.221 Adjacent channel power limits.**

(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.

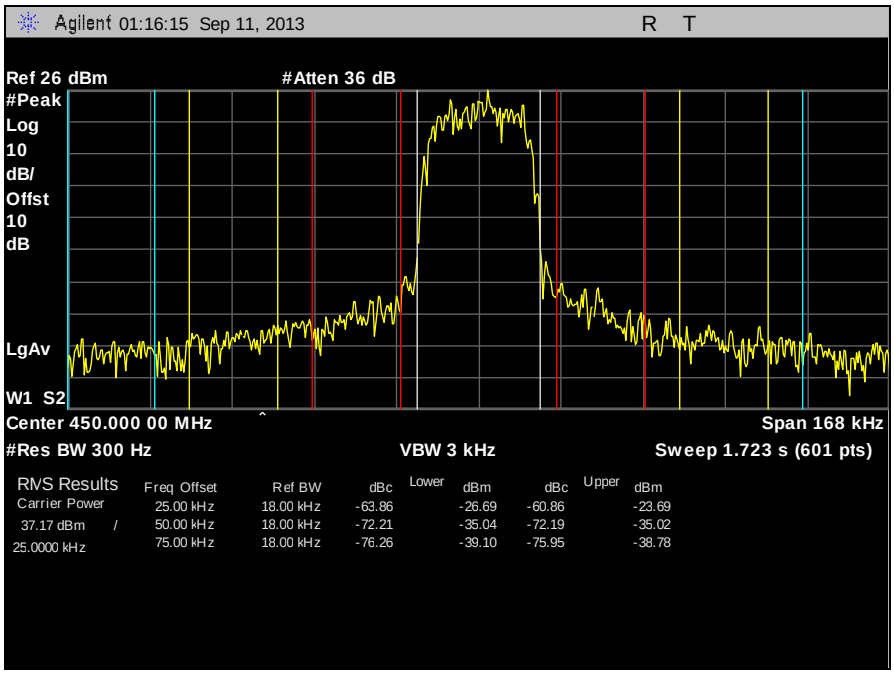
Test Procedures: As required by 47 CFR *adjacent power measurements* were made at the RF output terminals using a Spectrum Analyzer.

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

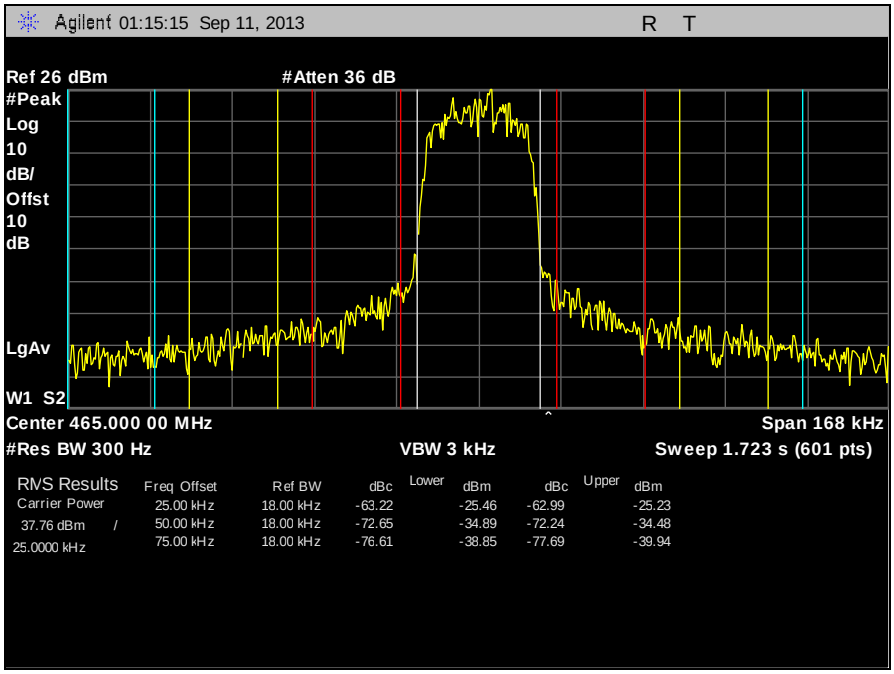
Test Results: Equipment complies with Section §90.221.

Test Engineer(s): Shawn McMillen

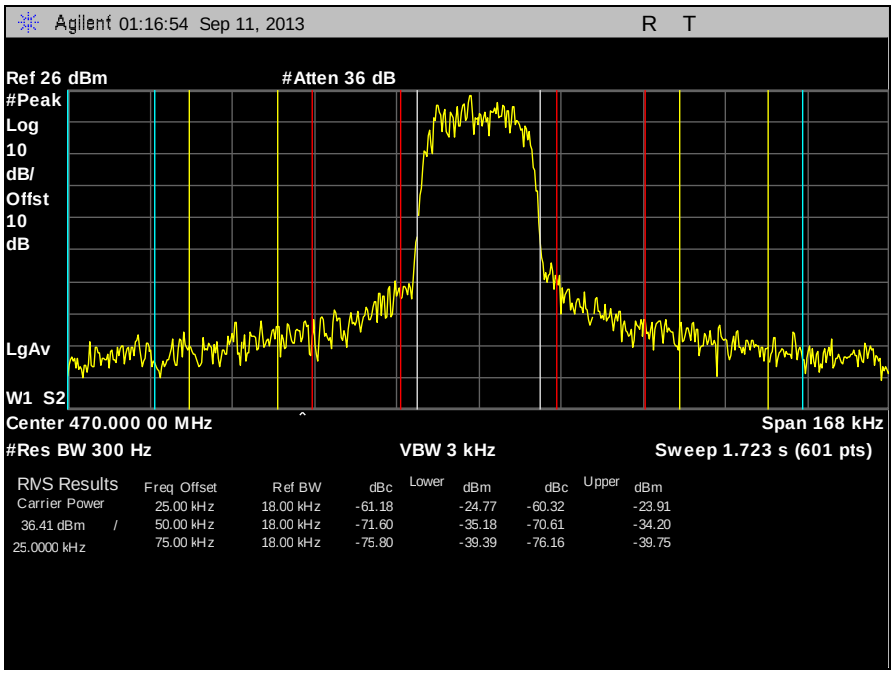
Test Date(s): 10/04/13



Plot 97. Adjacent Channel Power, TETRA, 22 kHz, Low Channel, 450 MHz



Plot 98. Adjacent Channel Power, TETRA, 22 kHz, Mid Channel, 465 MHz



Plot 99. Adjacent Channel Power, TETRA, 22 kHz, High Channel, 470 MHz

4.7. Frequency Stability

FCC §2.1055, §22.355, §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 Procedures: As required by 47 CFR 2.1055, *Frequency Stability measurements* were made at the RF output terminals using a direct connect to a Spectrum Analyzer.

The EUT was placed in the Environmental Chamber with the support equipment on the outside. The EUT was set to transmit at its mid channel using a CW carrier. The frequency drift was investigated for every 10°C increment until the unit was stabilized. Measurements were made using the frequency counter function of the spectrum analyzer for the frequency ranges requiring a limit of 5ppm.

For frequency ranges requiring a limit of 1ppm, the EUT was connected to a Digital Mobile Test Set. A call was set up and the Frequency Error was given in Hz.

Operational voltage for the EUT is 7.4 VDC when operated from a DC source and 120 VAC when supplied from the mains by using the AC/DC adapter D028202PT. Reference temperature was set at 20°C. In either case, the voltage was varied by ±15% of nominal.

Test Results: Equipment complies with Section §2.1055, §22.355, and §90.213 and RSS-119.

Test Engineer(s): Len Knight

Test Date(s): 09/11/13 – 09/18/13

409 - 430 MHz Range					
Test Frequency (MHz)	**Temperature (deg. C)**	**Voltage (VDC)**	**Frequency Error (Hz)**	**Frequency Error (ppm)**	**IC Limit (ppm)**
416.025	50	7.4	9	0.0216	1
416.025	40	7.4	7.2	0.0173	1
416.025	30	7.4	-8	-0.0192	1
416.025	20	7.4	9.8	0.0236	1
416.025	20	6.3	-10.9	-0.0262	1
416.025	20	8.5	-8.5	-0.0204	1
416.025	10	7.4	-10.4	-0.0250	1
416.025	0	7.4	-11.3	-0.0272	1
416.025	-10	7.4	-17.3	-0.0416	1
416.025	-20	7.4	-15.6	-0.0375	1
416.025	-30	7.4	-14.3	-0.0344	1
Test Frequency (MHz)	**Temperature (deg. C)**	**Voltage (VAC)**	**Frequency Error (Hz)**	**Frequency Error (ppm)**	**IC Limit (ppm)**
416.025	20	120	-17.1	-0.0411	1
416.025	20	102	-8.2	-0.0197	1
416.025	20	138	8.5	0.0204	1

Table 18. Frequency Stability, TETRA, 22 kHz, 409 – 430 MHz

450 - 470 MHz Range						
Test Frequency (MHz)	**Temperature (deg. C)**	**Voltage (VAC)**	**Frequency Error (Hz)**	**Frequency Error (ppm)**	**IC Limit (ppm)**	**FCC Limit (ppm)**
460.025	50	120	13.1	0.0285	1	5
460.025	40	120	15.8	0.0343	1	5
460.025	30	120	14.2	0.0309	1	5
460.025	20	120	15.5	0.0337	1	5
460.025	20	102	10.4	0.0226	1	5
460.025	20	138	11.3	0.0246	1	5
460.025	10	120	9.8	0.0213	1	5
460.025	0	120	8.9	0.0193	1	5
460.025	-10	120	-10.1	-0.0220	1	5
460.025	-20	120	-4.6	-0.0100	1	5
460.025	-30	120	-13.7	-0.0298	1	5
Test Frequency (MHz)	**Temperature (deg. C)**	**Voltage (VDC)**	**Frequency Error (Hz)**	**Frequency Error (ppm)**	**IC Limit (ppm)**	**FCC Limit (ppm)**
460.025	20	7.4	11.7	0.0254	1	5
460.025	20	6.3	4.7	0.0102	1	5
460.025	20	8.5	9.6	0.0209	1	5

Table 19. Frequency Stability, TETRA, 22 kHz, 450 – 470 MHz

409 - 430 MHz Range						
Test Frequency (MHz)	**Temperature (deg. C)**	**Voltage (VDC)**	**Frequency Error (Hz)**	**Frequency Error (ppm)**	**IC Limit (ppm)**	**FCC Limit (ppm)**
416.01875	50	7.4	-43.881	-0.1055	5	5
416.01875	40	7.4	-35.604	-0.0856	5	5
416.01875	30	7.4	0.022	0.0001	5	5
416.01875	20	7.4	REF	REF	5	5
416.01875	20	6.3	28.976	0.0697	5	5
416.01875	20	8.5	38.509	0.0926	5	5
416.01875	10	7.4	-32.62	-0.0784	5	5
416.01875	0	7.4	-12	-0.0288	5	5
416.01875	-10	7.4	16.669	0.0401	5	5
416.01875	-20	7.4	33.116	0.0796	5	5
416.01875	-30	7.4	-7.224	-0.0174	5	5
Test Frequency (MHz)	**Temperature (deg. C)**	**Voltage (VAC)**	**Frequency Error (Hz)**	**Frequency Error (ppm)**	**IC Limit (ppm)**	**FCC Limit (ppm)**
416.01875	20	120	REF	REF	5	5
416.01875	20	102	-17.122	-0.0412	5	5
416.01875	20	138	-0.014	0.0000	5	5

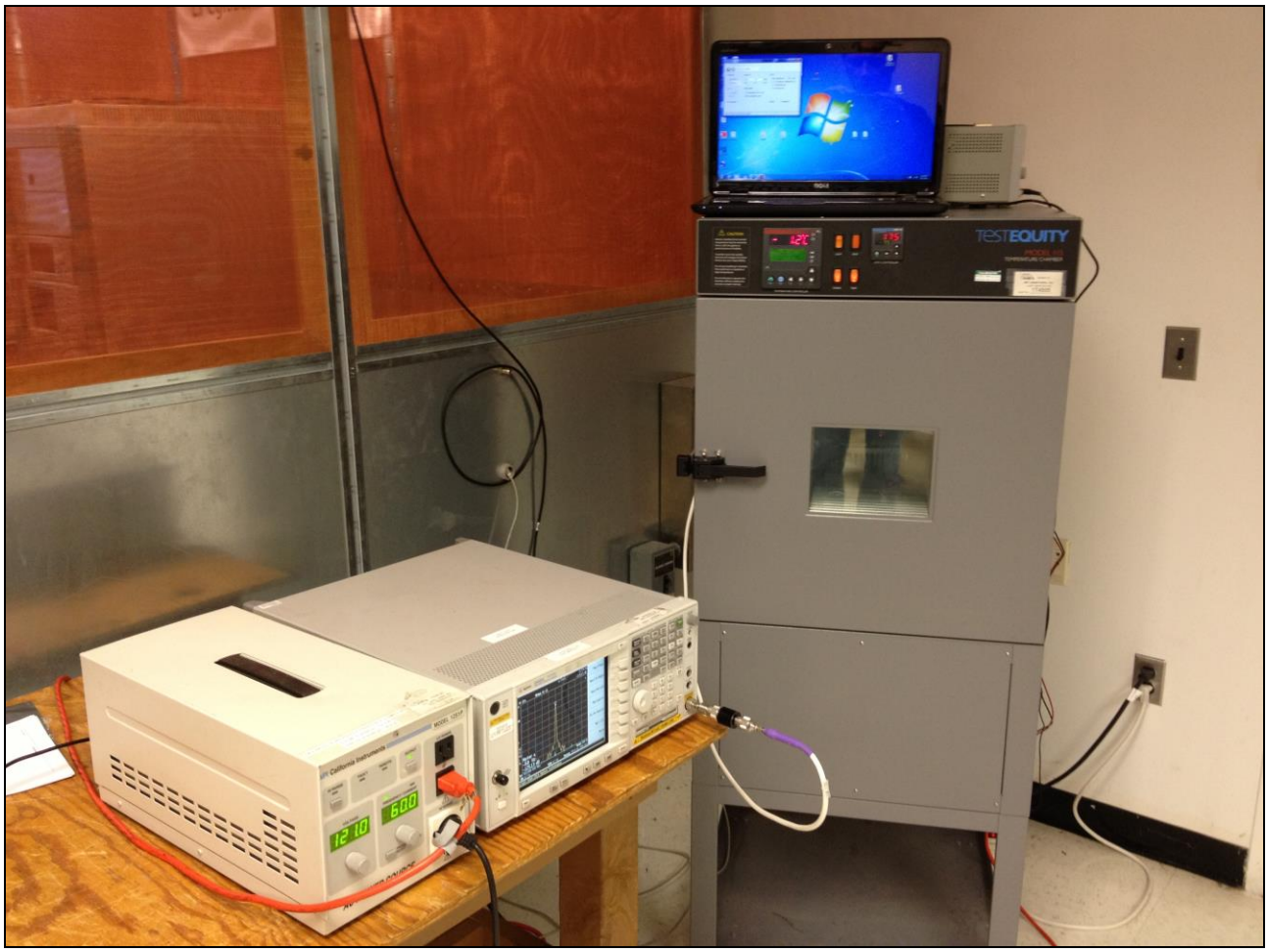
Table 20. Frequency Stability, TI D-LMR, 20 kHz, 409 – 430 MHz

450 - 470 MHz Range						
Test Frequency (MHz)	**Temperature (deg. C)**	**Voltage (VAC)**	**Frequency Error (Hz)**	**Frequency Error (ppm)**	**IC Limit (ppm)**	**FCC Limit (ppm)**
465	50	120	-114.578	-0.2464043	5	5
465	40	120	-66.006	-0.14194839	5	5
465	30	120	-43.19	-0.09288172	5	5
465	20	120	REF	REF	5	5
465	20	102	-12.063	-0.02594194	5	5
465	20	138	-13.755	-0.02958065	5	5
465	10	120	-67.1	-0.14430108	5	5
465	0	120	-107.841	-0.23191613	5	5
465	-10	120	-34.826	-0.07489462	5	5
465	-20	120	-4.964	-0.01067527	5	5
465	-30	120	-9.77	-0.02101075	5	5
Test Frequency (MHz)	**Temperature (deg. C)**	**Voltage (VDC)**	**Frequency Error (Hz)**	**Frequency Error (ppm)**	**IC Limit (ppm)**	**FCC Limit (ppm)**
465	20	7.4	N/A	REF	5	5
465	20	6.3	-7.636	-0.01642151	5	5
465	20	8.5	-0.189	-0.00040645	5	5

Table 21. Frequency Stability, TI D-LMR, 20 kHz, 450 – 470 MHz

450 - 470 MHz Range						
Test Frequency (MHz)	**Temperature (deg. C)**	**Voltage (VDC)**	**Frequency Error (Hz)**	**Frequency Error (ppm)**	**IC Limit (ppm)**	**FCC Limit (ppm)**
454.050	50	7.4	-141	-0.3105	5	5
454.050	40	7.4	-37	-0.0815	5	5
454.050	30	7.4	11	0.0242	5	5
454.050	20	7.4	REF	REF	5	5
454.050	20	6.3	-2	-0.0044	5	5
454.050	20	8.5	3	0.0066	5	5
454.050	10	7.4	-42	-0.0925	5	5
454.050	0	7.4	-27	-0.0595	5	5
454.050	-10	7.4	16	0.0352	5	5
454.050	-20	7.4	-37	-0.0815	5	5
454.050	-30	7.4	-62	-0.1365	5	5
Test Frequency (MHz)	**Temperature (deg. C)**	**Voltage (VAC)**	**Frequency Error (Hz)**	**Frequency Error (ppm)**	**IC Limit (ppm)**	**FCC Limit (ppm)**
454.050	20	120	REF	REF	5	5
454.050	20	102	12	0.0264	5	5
454.050	20	138	-1	-0.0022	5	5

Table 22. Frequency Stability, TI D-LMR, 20 kHz, 450 – 460 MHz



Photograph 3. Frequency Stability, Test Setup

4.8. Field Strength of Spurious Radiation

FCC §2.1053, §22.359, §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.

5.8.2 Emission Mask C for Transmitters not Equipped with an Audio Low-pass Filter

The power of any emission shall be attenuated below the transmitter output power P (dBW) as specified in Table 5.

Table 5 – Emission Mask C		
Displacement Frequency, f_d (kHz)	**Minimum Attenuation (dB)**	**Resolution Bandwidth (Hz)**
$5 < f_d \leq 10$	$83 \log_{10}(f_d/5)$	300
$10 < f_d \leq 50$	whichever is the lesser attenuation: 50 or $29 \log_{10}(f_d^2/11)$	300
$f_d > 50$	$43 + 10 \log_{10}(p)$	Specified in Section 4.2.1

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".

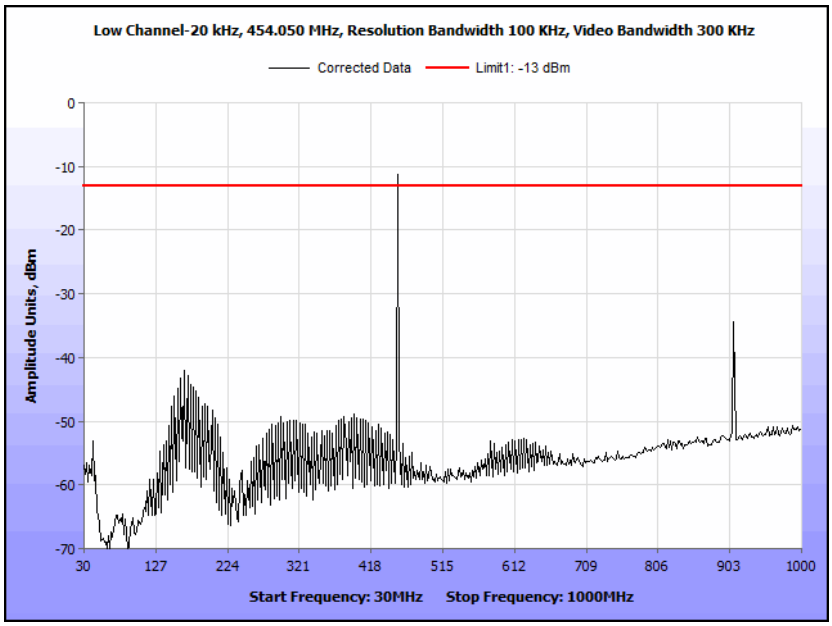
Radiated emission measurements were performed inside a 3 meter semi-anechoic chamber. The EUT's RF ports were terminated to 50ohm load. The EUT was tested using both bandwidths and at the low, mid, and high channels. The EUT was rotated about 360^0 and the receiving antenna scanned from 1-4m in order 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.

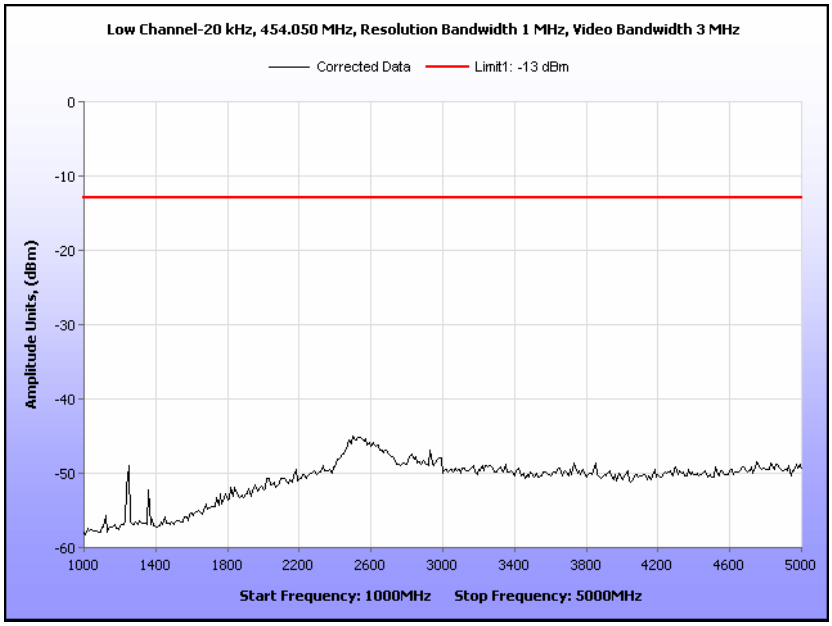
Test Results: Equipment complies with Section §2.1053, §22.359, and §90.210 and RSS-119.

Test Engineer(s): Len Knight

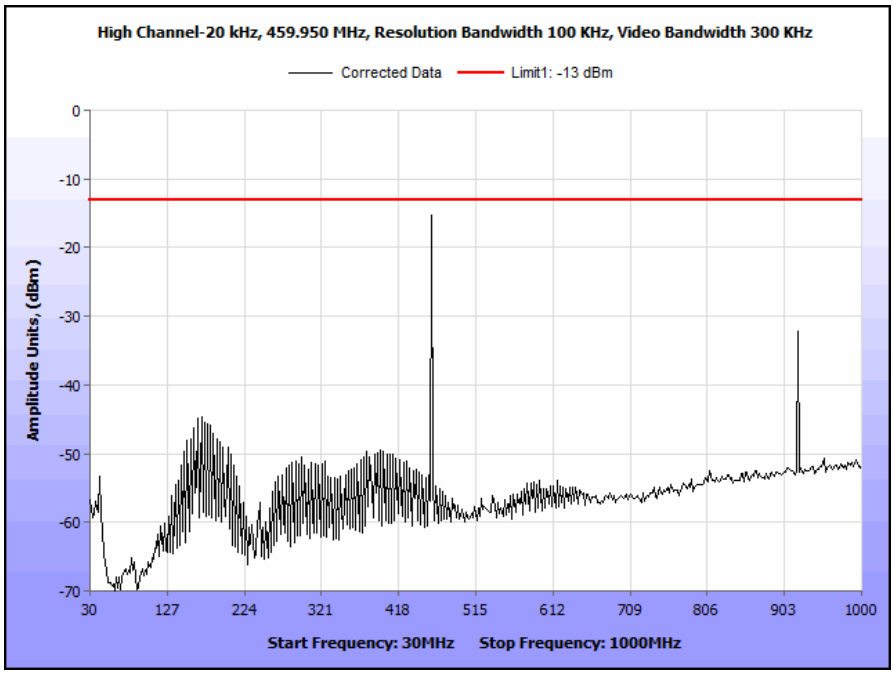
Test Date(s): 09/18/13 – 09/23/13



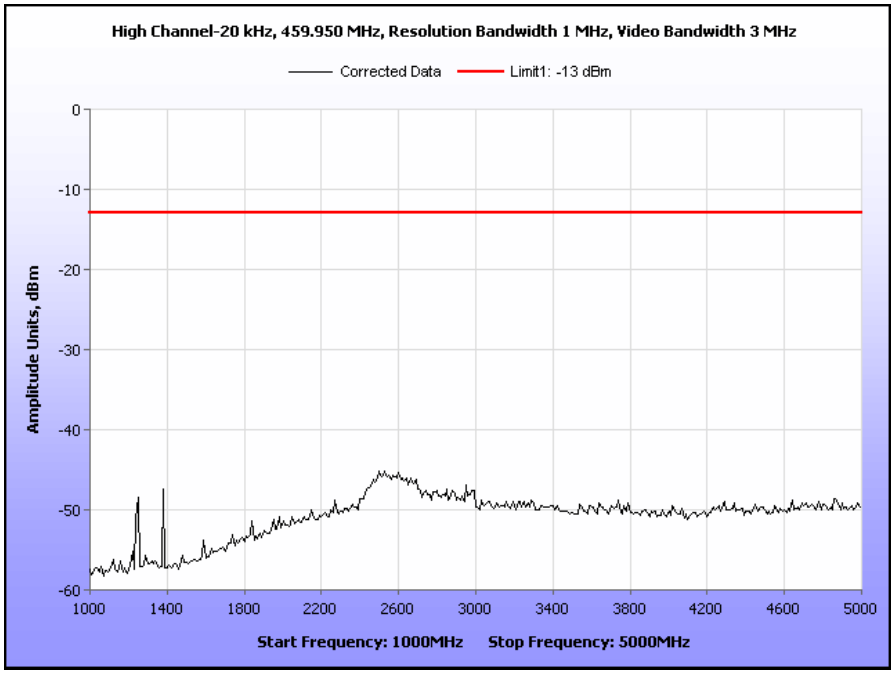
Plot 100. Radiated Spurious Emissions, Part 22, TI D-LMR (20 kHz), Low Channel, 454.050 MHz, 30 MHz – 1 GHz



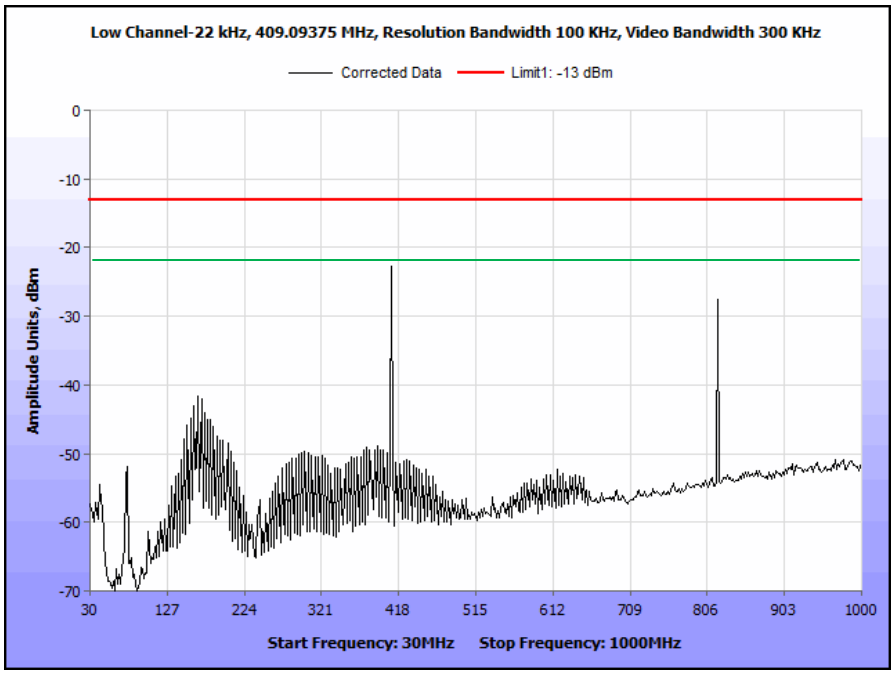
Plot 101. Radiated Spurious Emissions, Part 22, TI D-LMR (20 kHz), Low Channel, 454.050 MHz, 1 GHz – 5 GHz



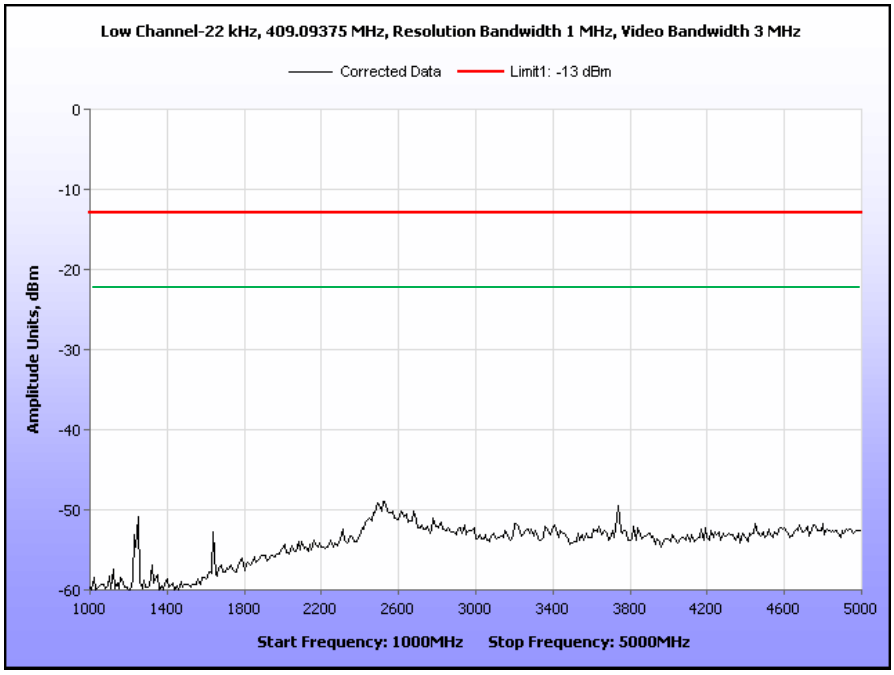
Plot 102. Radiated Spurious Emissions, Part 22, TI D-LMR (20 kHz), High Channel, 459.950 MHz, 30 MHz – 1 GHz



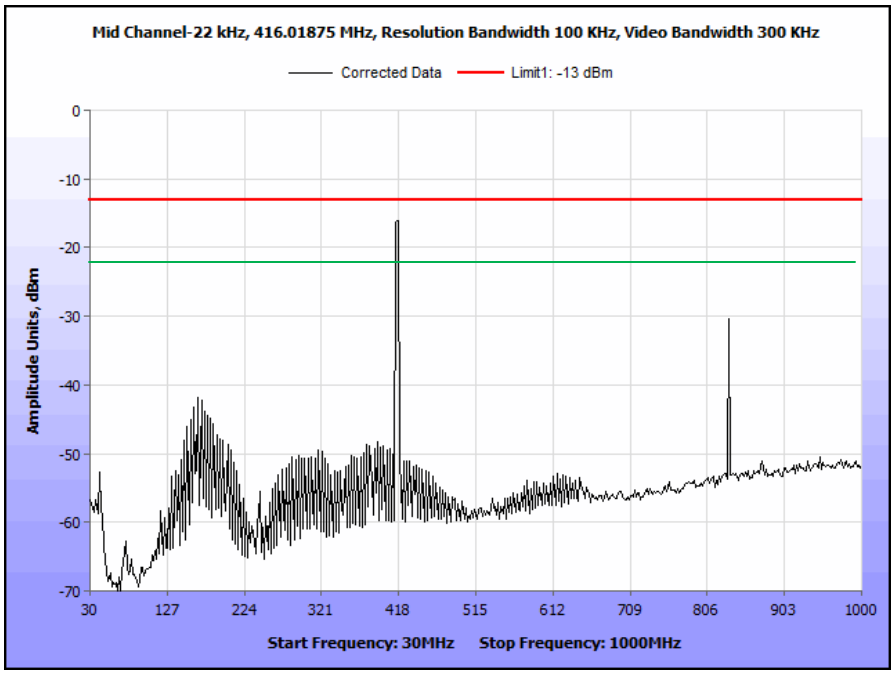
Plot 103. Radiated Spurious Emissions, Part 22, TI D-LMR (20 kHz), High Channel, 459.950 MHz, 1 GHz – 5 GHz



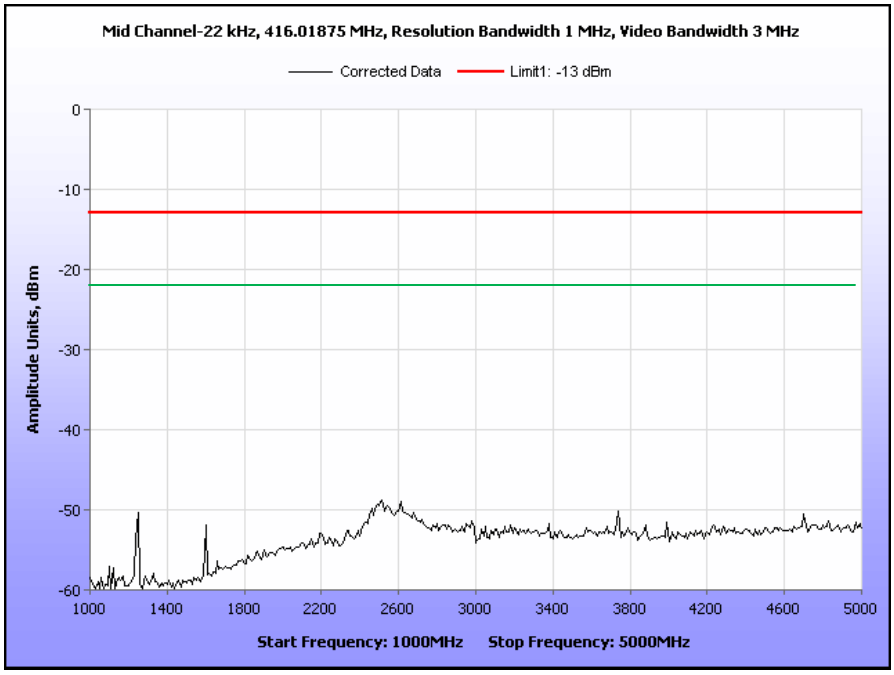
Plot 104. Radiated Spurious Emissions, TETRA, RSS-119 (22 kHz), Low Channel, 409.09375 MHz, 30 MHz – 1 GHz



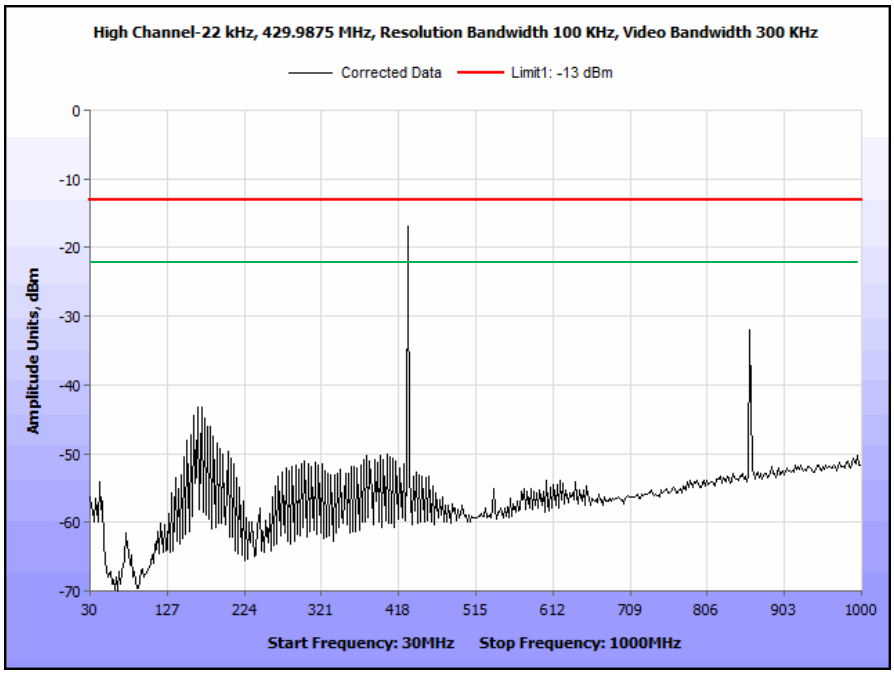
Plot 105. Radiated Spurious Emissions, TETRA, RSS-119 (22 kHz), Low Channel, 409.09375 MHz, 1 GHz – 5 GHz



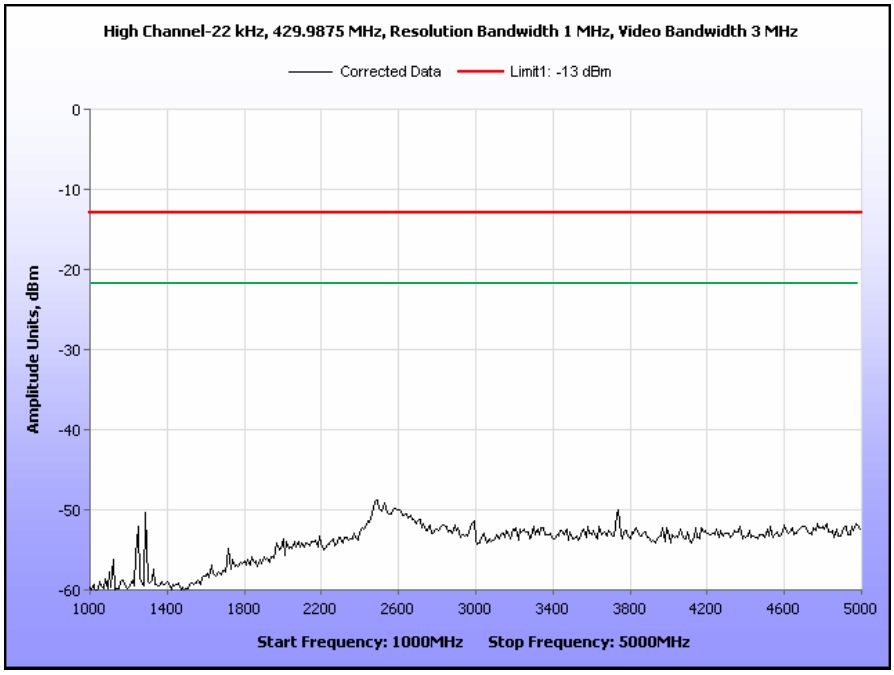
Plot 106. Radiated Spurious Emissions, TETRA, RSS-119 (22 kHz), Mid Channel, 416.01875 MHz, 30 MHz – 1 GHz



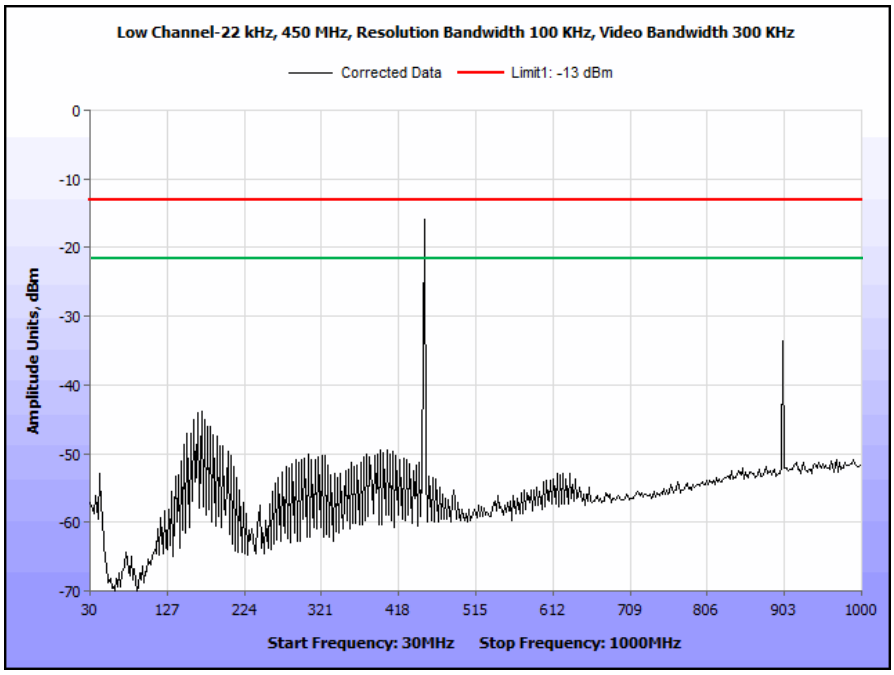
Plot 107. Radiated Spurious Emissions, TETRA, RSS-119 (22kHz), Mid Channel, 416.01875 MHz, 1 GHz – 5 GHz



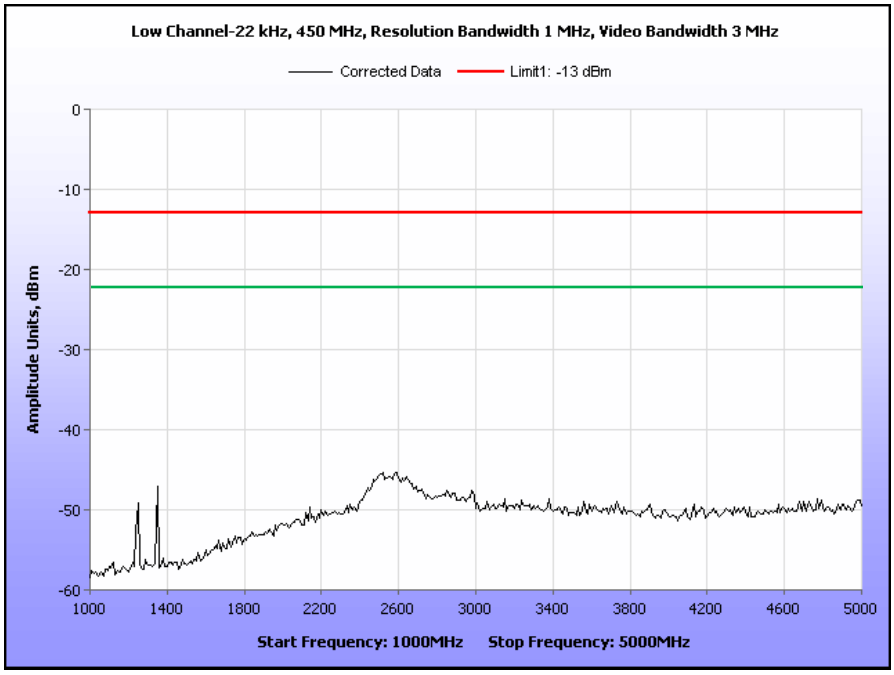
Plot 108. Radiated Spurious Emissions, TETRA, RSS-119 (22 kHz), High Channel, 429.9875 MHz, 30 MHz – 1 GHz



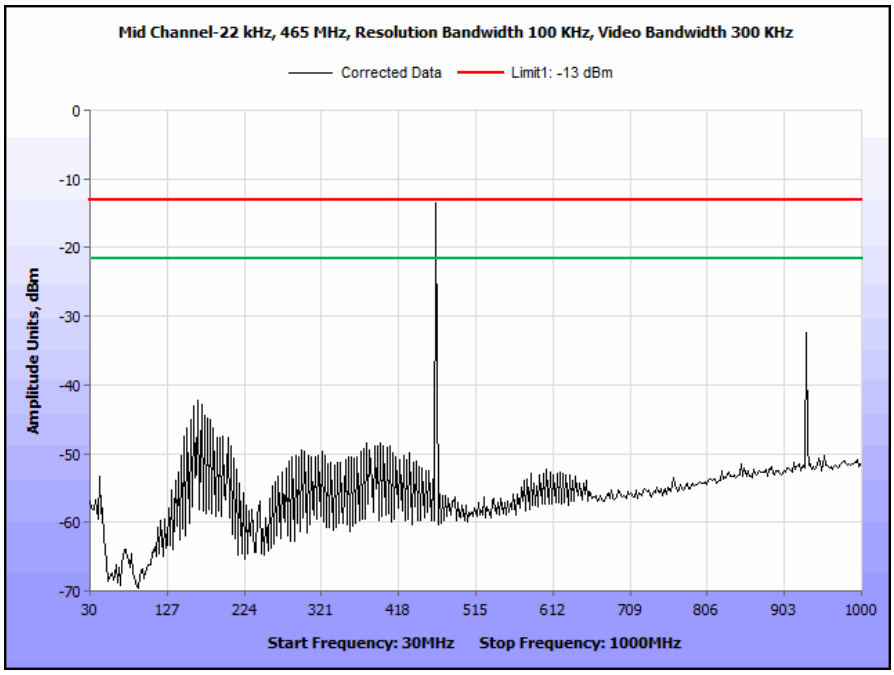
Plot 109. Radiated Spurious Emissions, TETRA, RSS-119 (22 kHz), High Channel, 429.9875 MHz, 1 GHz – 5 GHz



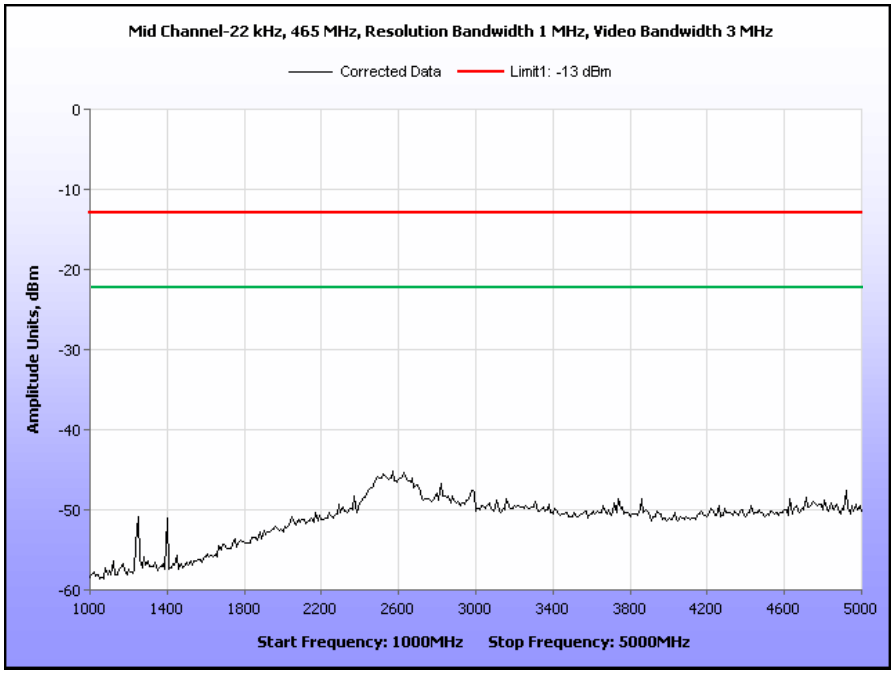
Plot 110. Radiated Spurious Emissions, TETRA, Part 90/RSS-119 (22 kHz), Low Channel, 450 MHz, 30 MHz – 1 GHz



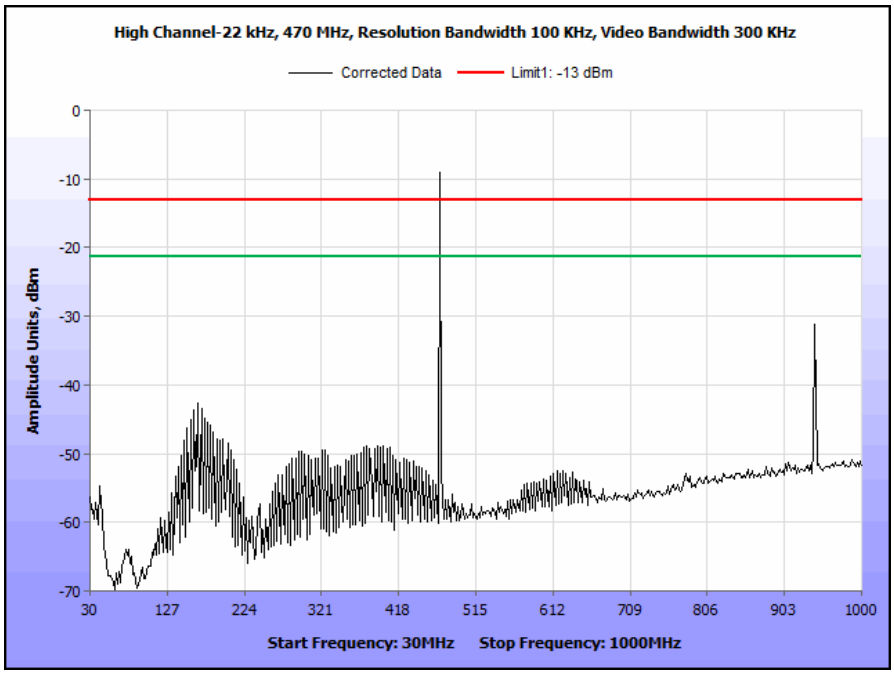
Plot 111. Radiated Spurious Emissions, TETRA, Part 90/RSS-119 (22 kHz), Low Channel, 450 MHz, 1 GHz – 5 GHz



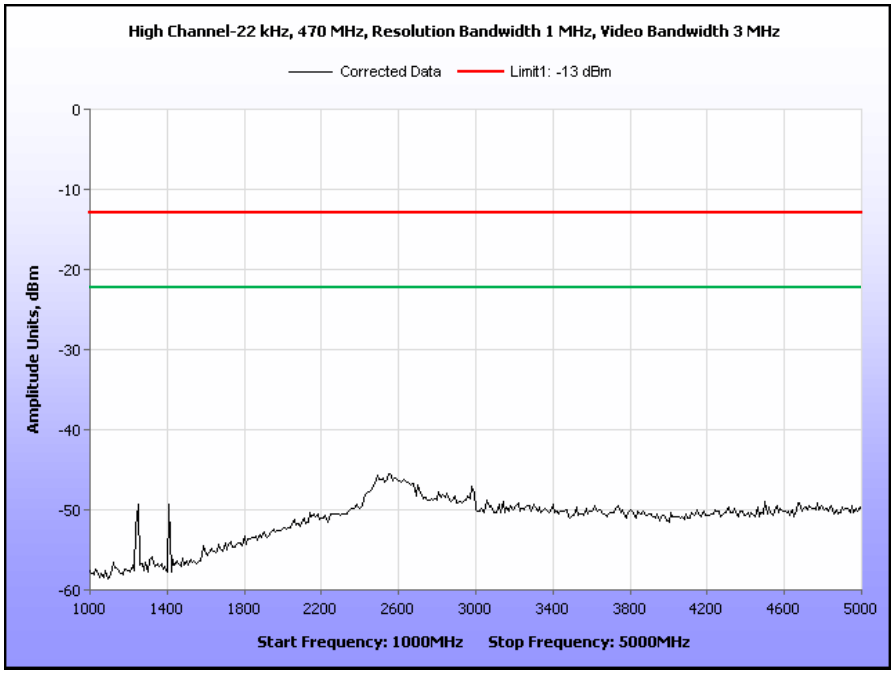
Plot 112. Radiated Spurious Emissions, TETRA, Part 90/RSS-119 (22 kHz), Mid Channel, 465 MHz, 30 MHz – 1 GHz



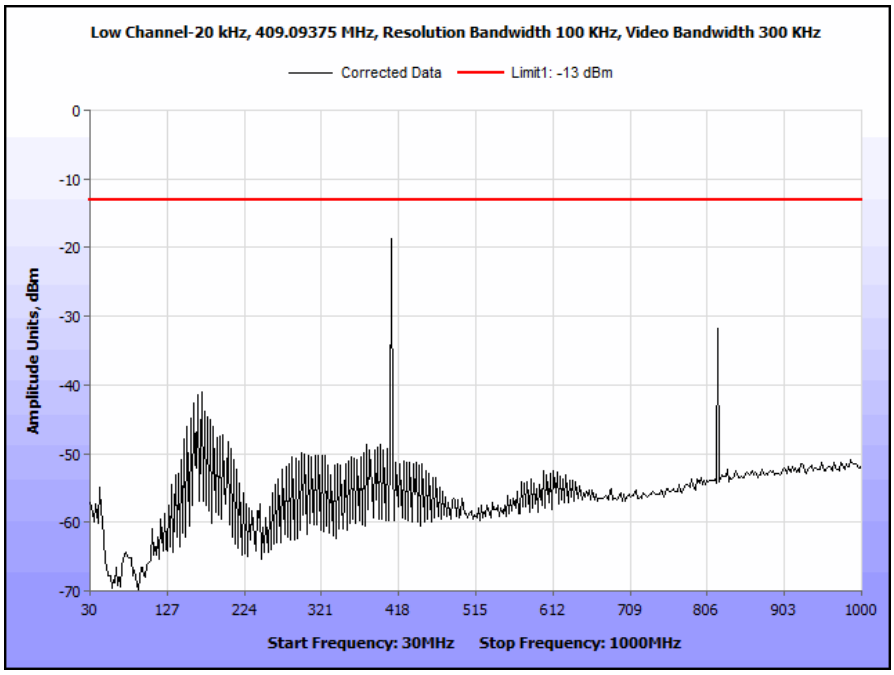
Plot 113. Radiated Spurious Emissions, TETRA, Part 90/RSS-119 (22 kHz), Mid Channel, 465 MHz, 1 GHz – 5 GHz



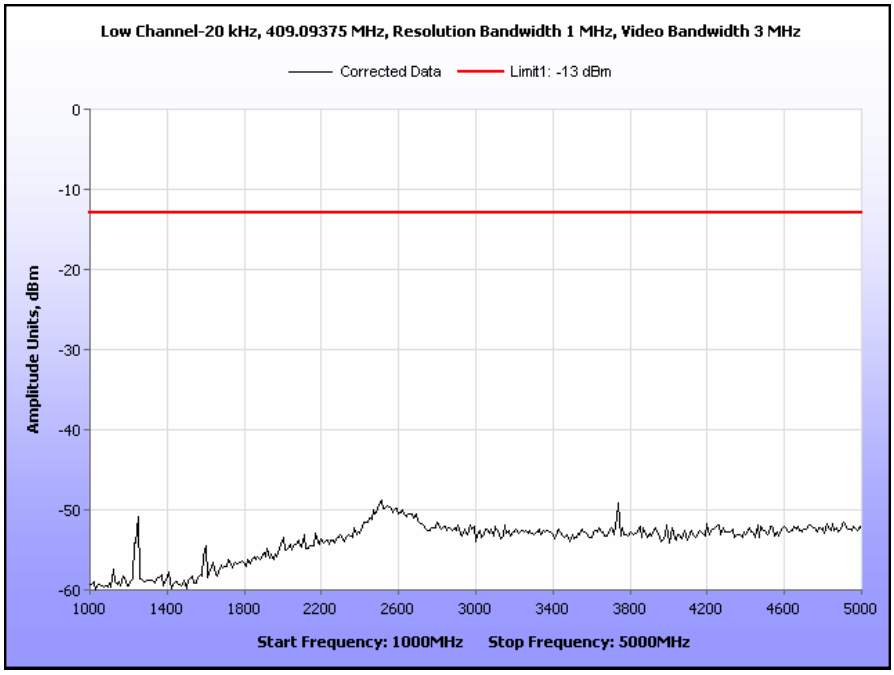
Plot 114. Radiated Spurious Emissions, TETRA, Part 90/RSS-119 (22 kHz), High Channel, 470 MHz, 30 MHz – 1 GHz



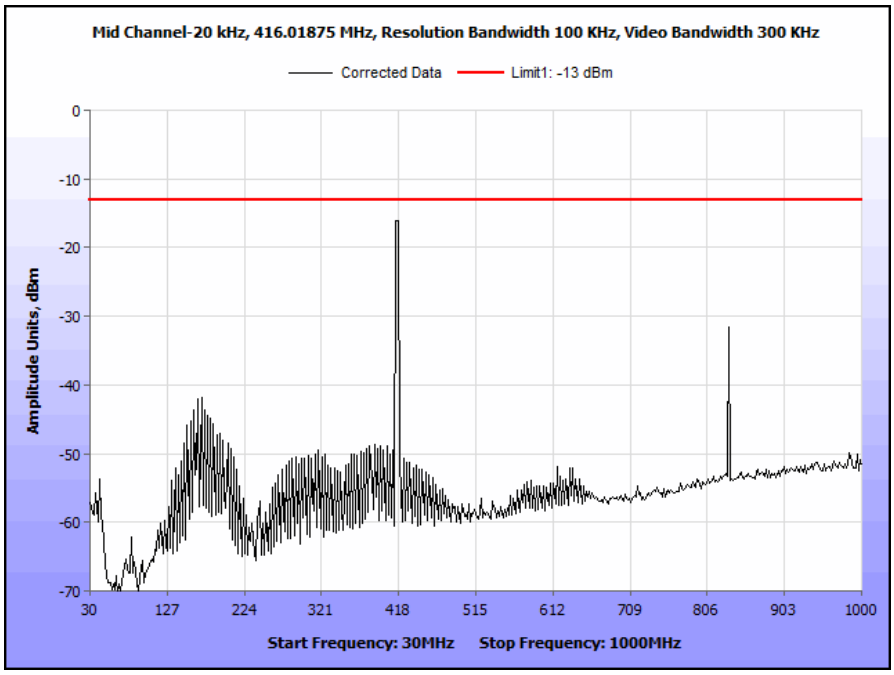
Plot 115. Radiated Spurious Emissions, TETRA, Part 90/RSS-119 (22 kHz), High Channel, 470 MHz, 1 GHz – 5 GHz



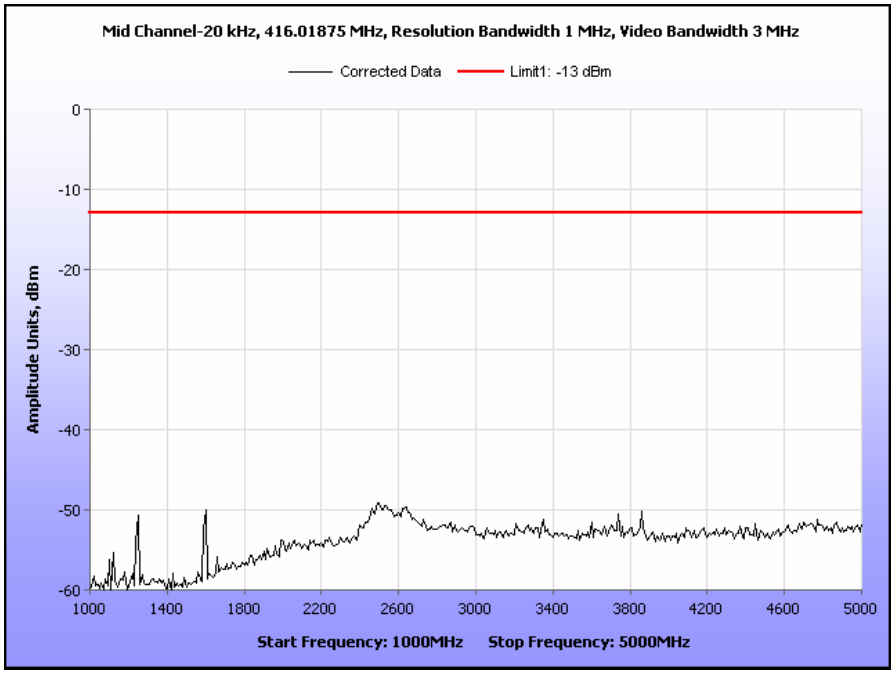
Plot 116. Radiated Spurious Emissions, TI D-LMR, Part 90/RSS-119 (20 kHz), Low Channel, 409.09375 MHz, 30 MHz – 1 GHz



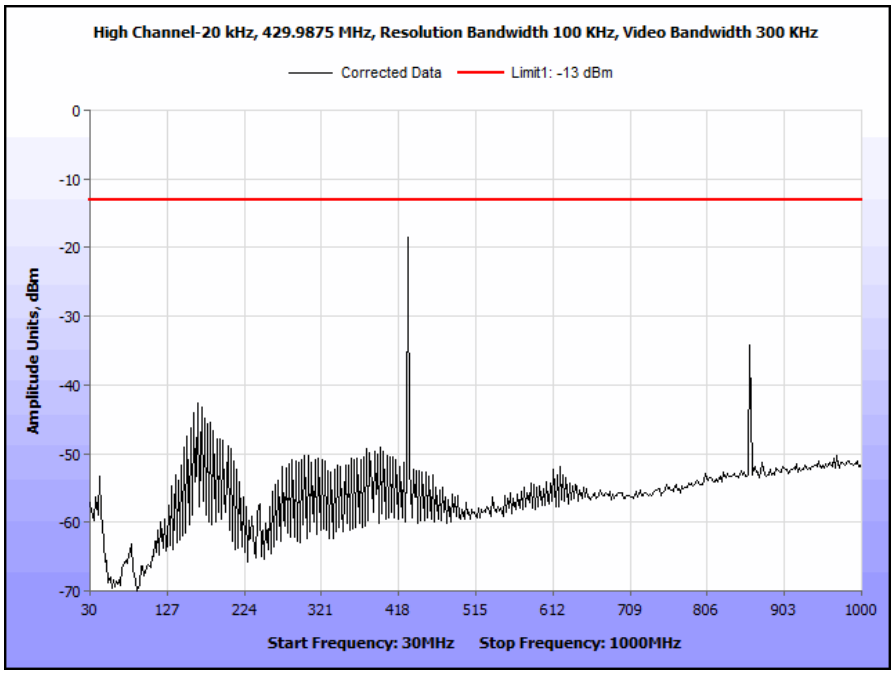
Plot 117. Radiated Spurious Emissions, TI D-LMR, Part 90/RSS-119 (20 kHz), Low Channel, 409.09375 MHz, 1 GHz – 5 GHz



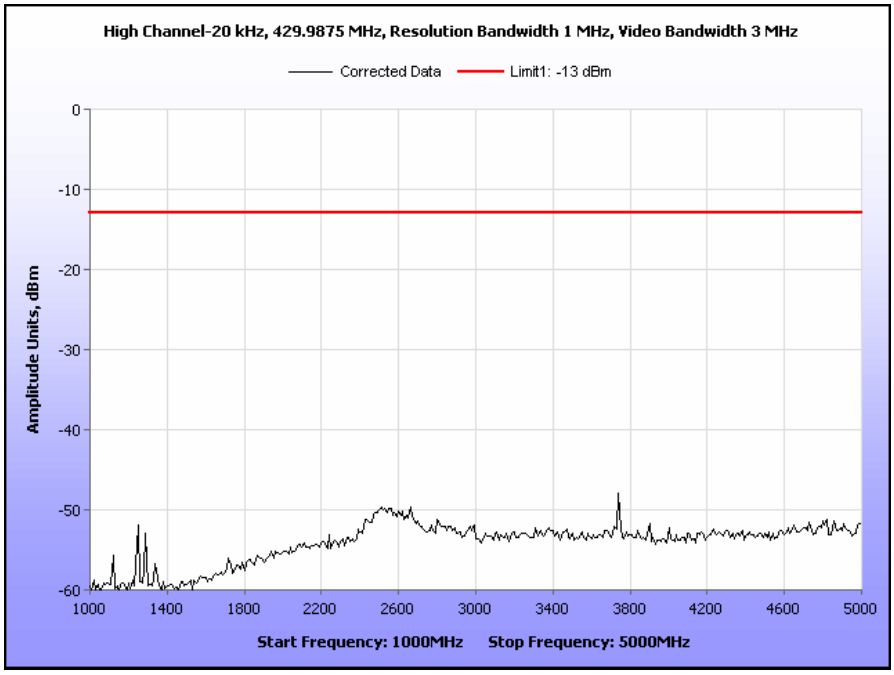
Plot 118. Radiated Spurious Emissions, TI D-LMR, Part 90/RSS-119 (20 kHz), Mid Channel, 416.01875 MHz, 30 MHz – 1 GHz



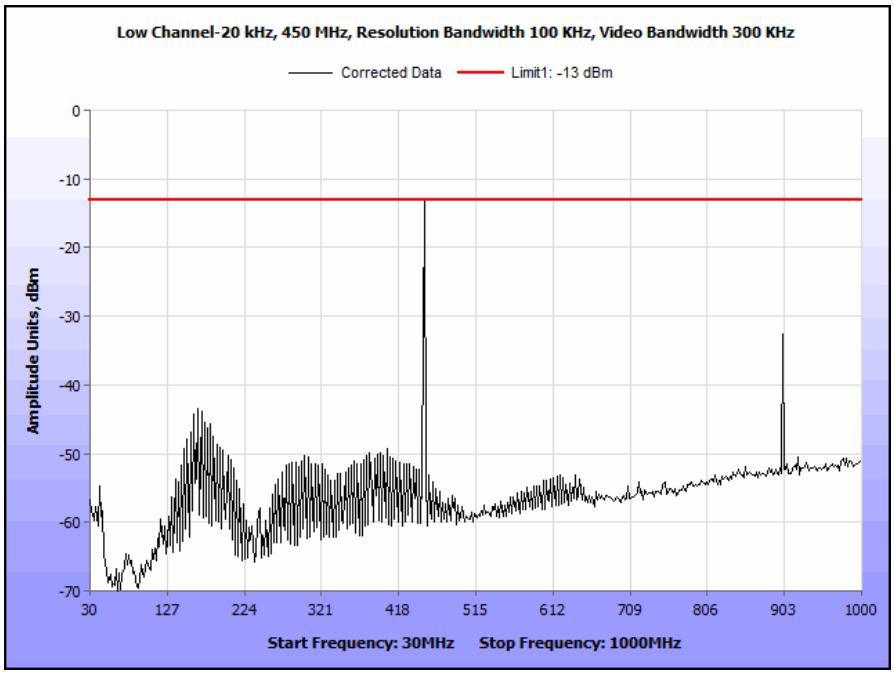
Plot 119. Radiated Spurious Emissions, TI D-LMR, Part 90/RSS-119 (20 kHz), Mid Channel, 416.01875 MHz, 1 GHz – 5 GHz



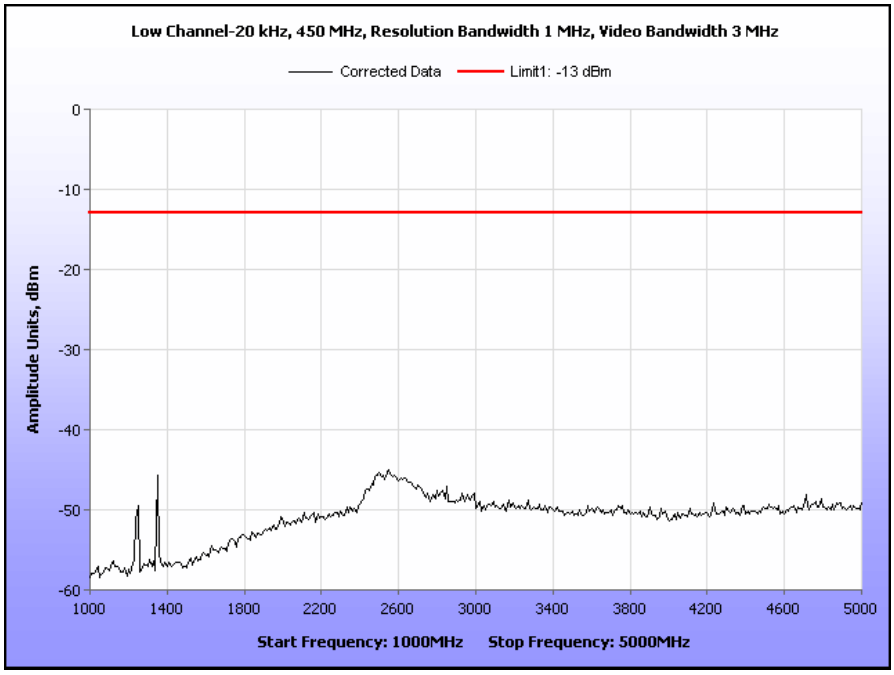
Plot 120. Radiated Spurious Emissions, TI D-LMR, Part 90/RSS-119 (20 kHz), High Channel, 429.9875 MHz, 30 MHz – 1 GHz



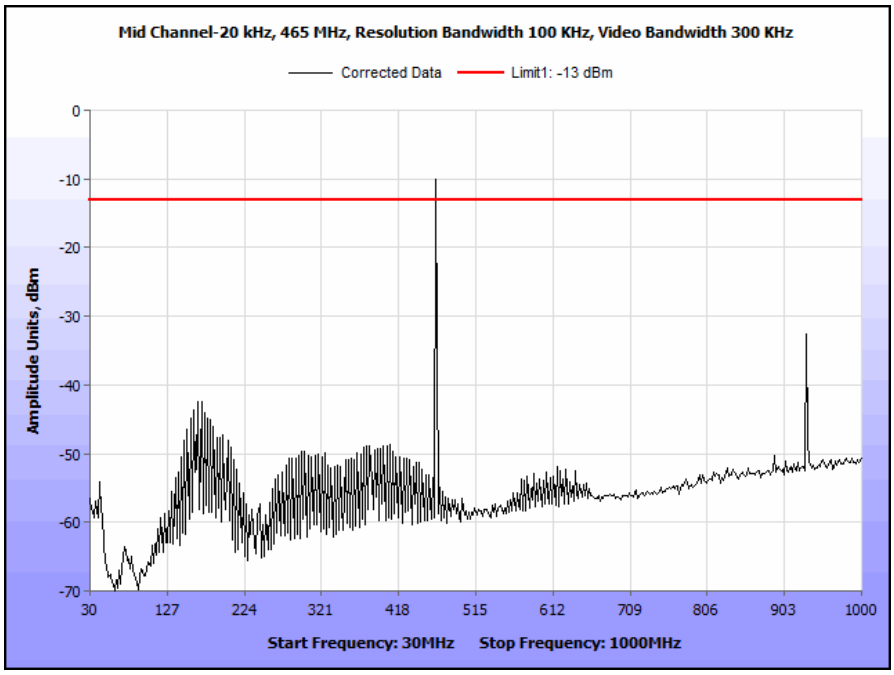
Plot 121. Radiated Spurious Emissions, TI D-LMR, Part 90/RSS-119 (20 kHz), High Channel, 429.9875 MHz, 1 GHz – 5 GHz



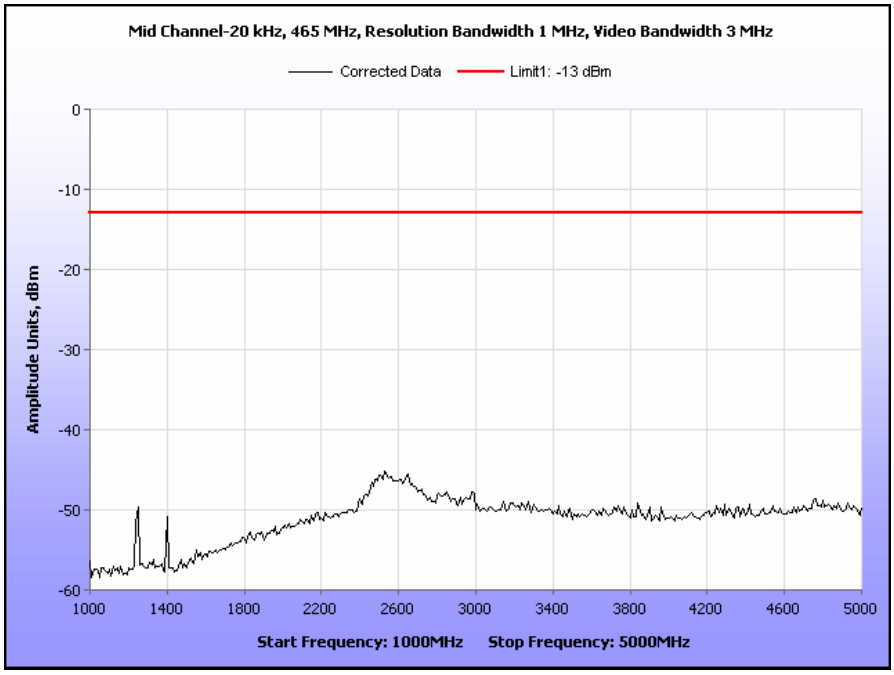
Plot 122. Radiated Spurious Emissions, TI D-LMR, Part 90/RSS-119 (20 kHz), Low Channel, 450 MHz, 30 MHz – 1 GHz



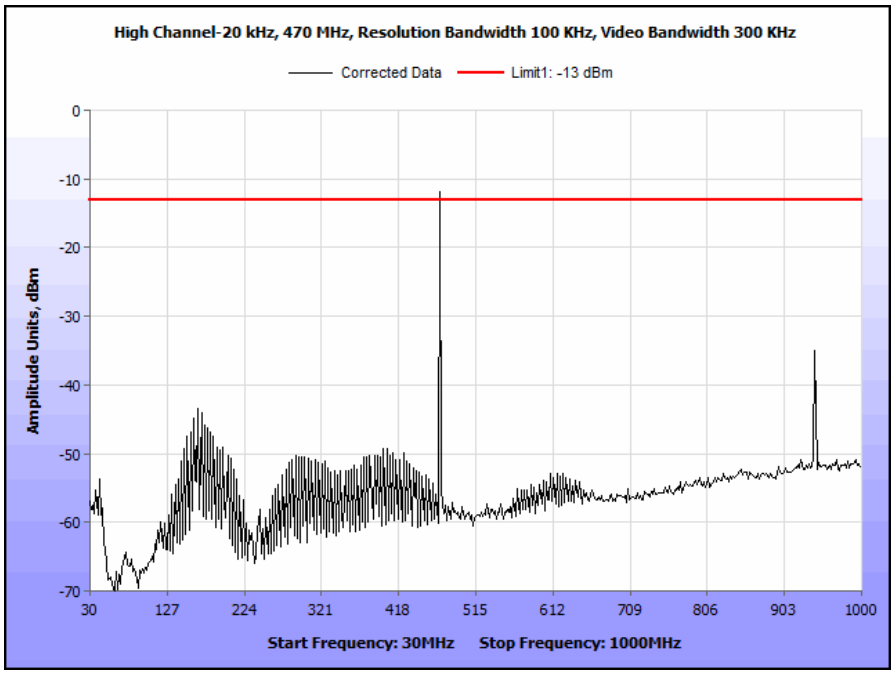
Plot 123. Radiated Spurious Emissions, TI D-LMR, Part 90/RSS-119 (20 kHz), Low Channel, 450 MHz, 1 GHz – 5 GHz



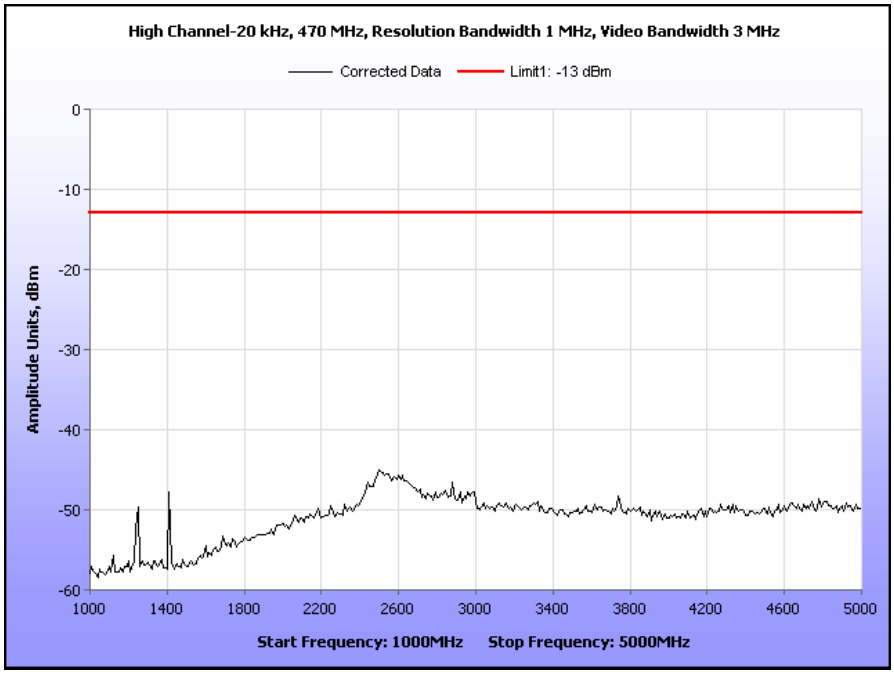
Plot 124. Radiated Spurious Emissions, TI D-LMR, Part 90/RSS-119 (20 kHz), Mid Channel, 465 MHz, 30 MHz – 1 GHz



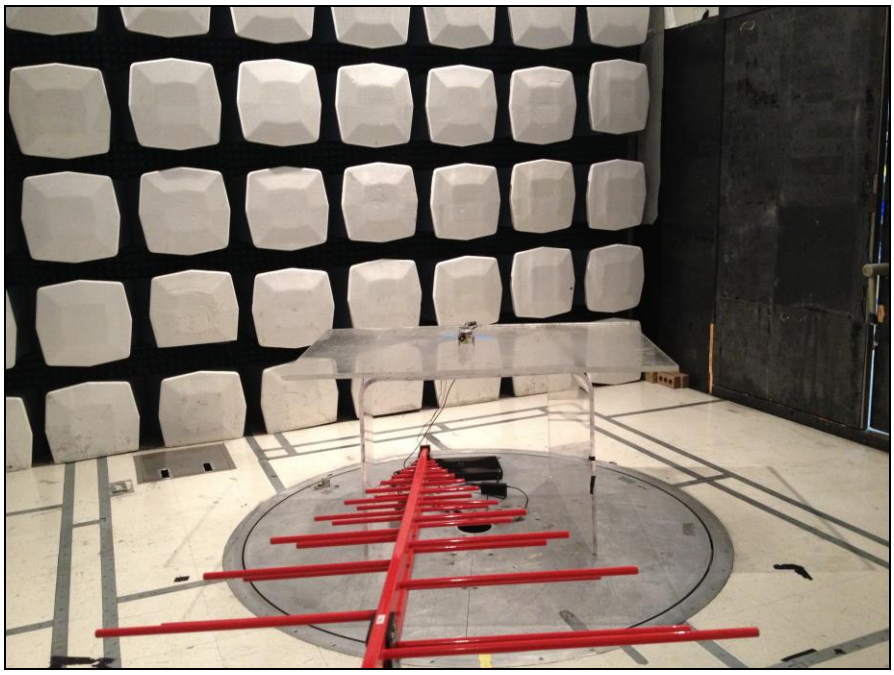
Plot 125. Radiated Spurious Emissions, TI D-LMR, Part 90/RSS-119 (20 kHz), Mid Channel, 465 MHz, 1 GHz – 5 GHz



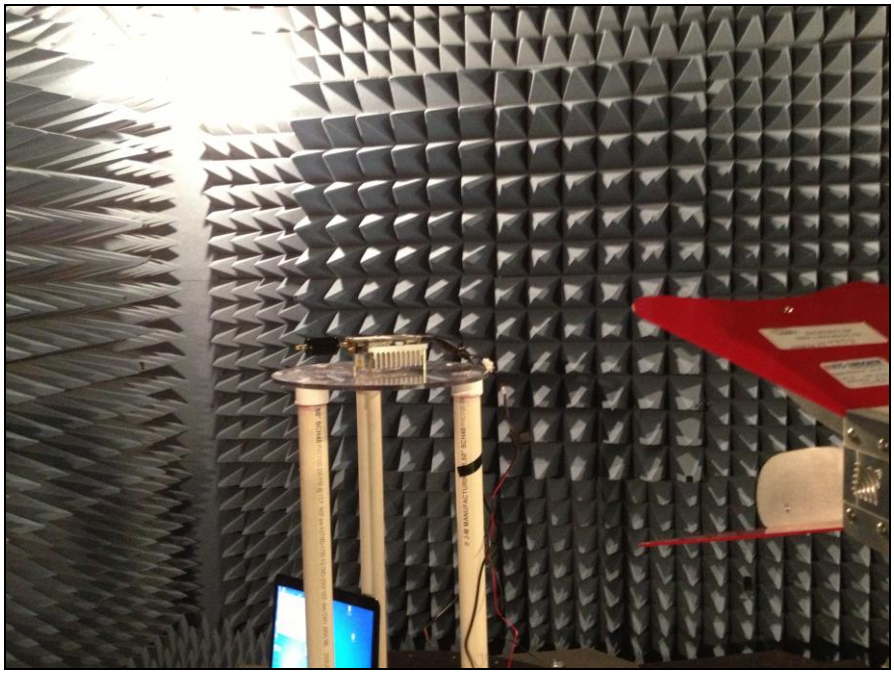
Plot 126. Radiated Spurious Emissions, TI D-LMR, Part 90/RSS-119 (20 kHz), High Channel, 470 MHz, 30 MHz – 1 GHz



Plot 127. Radiated Spurious Emissions, TI D-LMR, Part 90/RSS-119 (20 kHz), High Channel, 470 MHz, 1 GHz – 5 GHz



Photograph 4. Radiated Spurious Emissions, Test Setup, Below 1 GHz



Photograph 5. Radiated Spurious Emissions, Test Setup, Above 1 GHz

4.9. 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 Procedures: The method of testing used was from TIA-603-C, section 2.2.19 Transient Frequency Behavior, sub-section 2.2.19.2 Method of Measurement (using a Modulation Domain Analyzer).

The output of the EUT was connected to a power meter in order to get a reference power measurement. Once the reference power measurement was determined, an external signal source was connected to the Modulation Domain Analyzer in order to set the trigger level to -30 dBc.

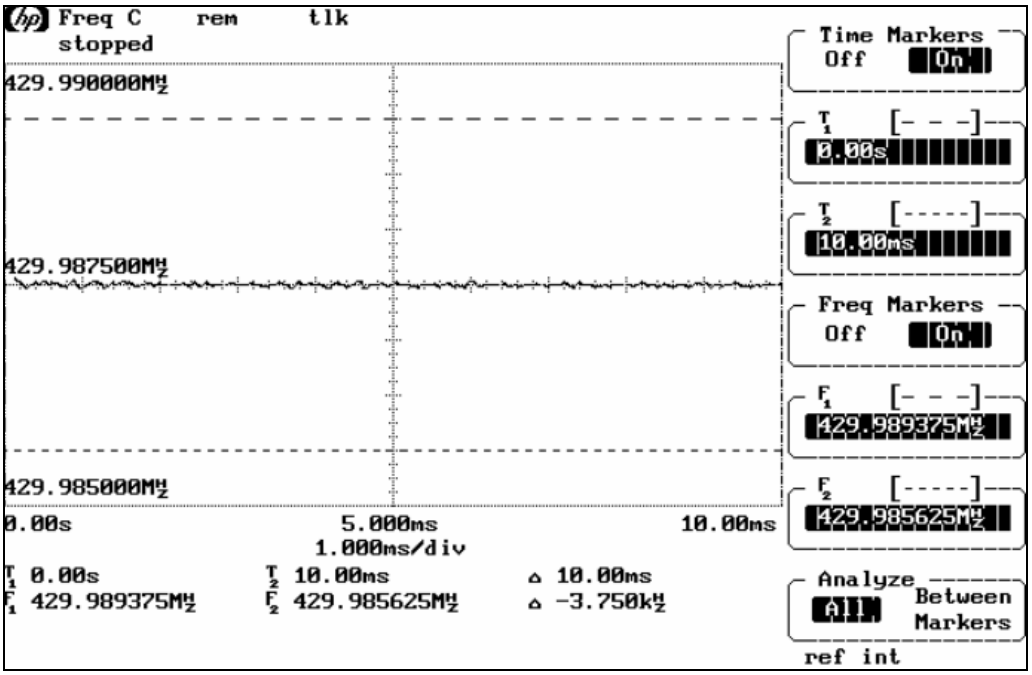
The EUT was connected to the Modulation Domain Analyzer. In order to capture a single-shot turn-on of the transmitter signal, the modulation domain analyzer was set to trigger on the rising edge of the waveform. Plots were taken.

The modulation domain analyzer was then adjusted to trigger on the falling edge of the transmitter waveform in order to capture a single-shot turn-off transient of the transmitter signal. Plots were taken.

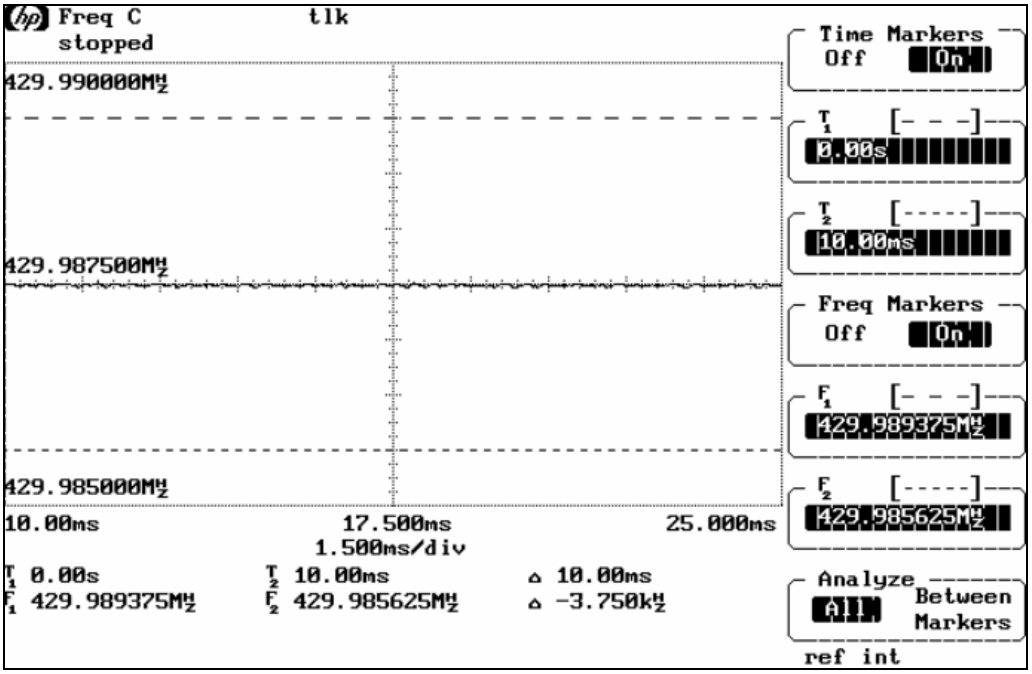
Test Results: Equipment complies with Section §90.214 and RSS-119.

Test Engineer(s): Len Knight

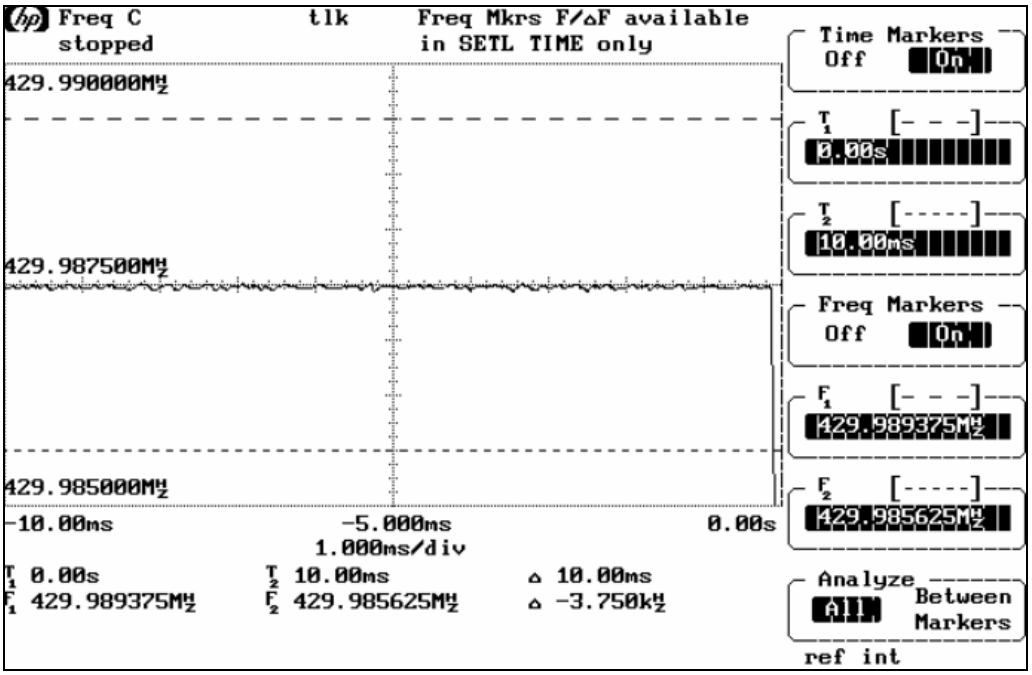
Test Date(s): 09/24/13 – 10/02/13



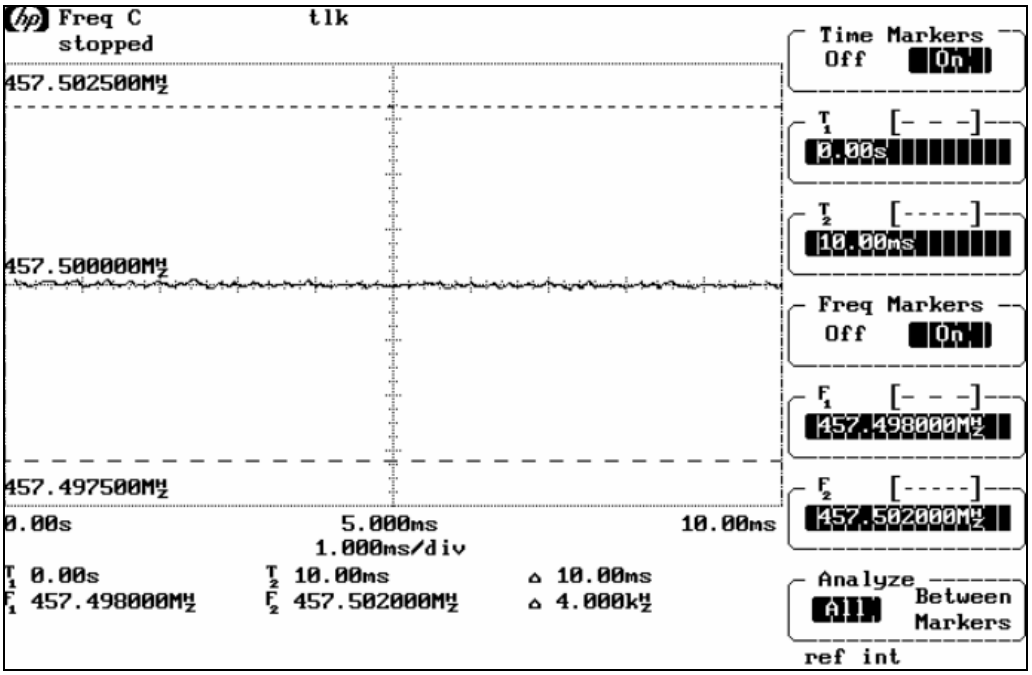
Plot 128. Transient Frequency Behavior, 429.9875 MHz, t_{on} to t_1



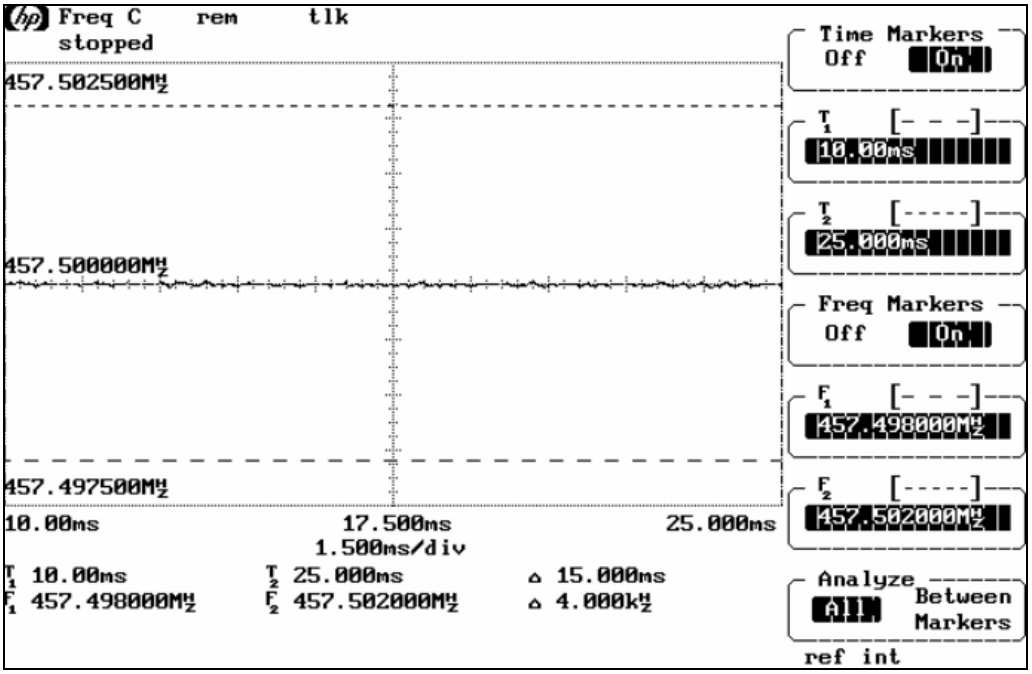
Plot 129. Transient Frequency Behavior, 429.9875 MHz, t_1 to t_2



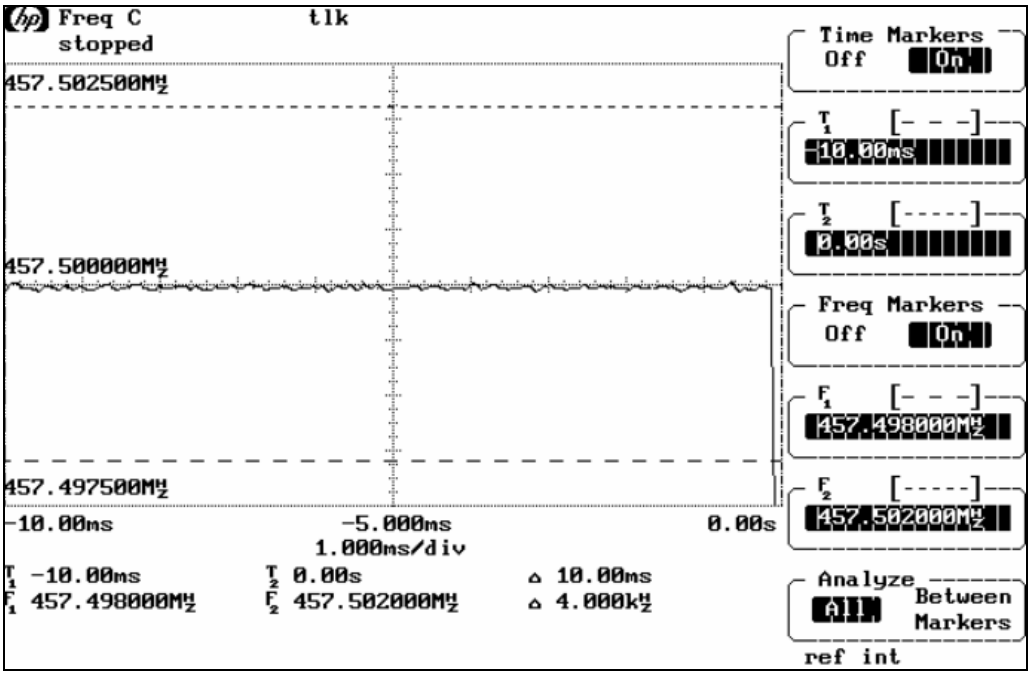
Plot 130. Transient Frequency Behavior, 429.9875 MHz, t_3 to t_{off}



Plot 131. Transient Frequency Behavior, 457.5 MHz, t_{on} to t_1



Plot 132. Transient Frequency Behavior, 457.5 MHz, t_1 to t_2



Plot 133. Transient Frequency Behavior, 457.5 MHz, t_3 to t_{off}

4.10. 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 complies with this Section.

Test Engineer(s): Len Knight

Test Date(s): 09/27/13

FCC - Limits for Maximum Permissible Exposure (MPE)

Requirements: FCC Guidelines for evaluating exposure to RF Emissions, from the FCC OET Bulletin 65, Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields.

(A) Limits for Occupational/Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $|E|^2$, $|H|^2$ or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	($900/f^2$)*	6
30-300	61.4	0.163	1.0	6
300-1500	--	--	f/300	6
1500-100,000	--	--	5	6

(B) Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $|E|^2$, $|H|^2$ or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	($180/f^2$)*	30
30-300	27.5	0.073	0.2	30
300-1500	--	--	f/1500	30
1500-100,000	--	--	1.0	30

f = frequency in MHz *Plane-wave equivalent power density

IC – RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Averaging Time (minutes)
0.003-1	280	2.19	-	6
1-10	$280/f$	$2.19/f$	-	6
10-30	28	$2.19/f$	-	6
30-300	28	0.073	2*	6
300-1500	$1.585f^{0.5}$	$0.0042f^{0.5}$	$f / 150$	6
1500-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000 / f^{1.2}$
150000-300000	$0.158f^{0.5}$	$4.21 \times 10^{-4} f^{0.5}$	$6.67 \times 10^{-5} f$	$616000 / f^{1.2}$

Note: f is frequency in MHz.
* Power density limit is applicable at frequencies greater than 100 MHz.

IC - RF Field Strength Limits for Controlled Devices (Controlled Environment)

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Averaging Time (minutes)
0.003-1	600	4.9	-	6
1-10	$600/f$	$4.9/f$	-	6
10-30	60	$4.9/f$	-	6
30-300	60	0.163	10*	6
300-1500	$3.54f^{0.5}$	$0.0094f^{0.5}$	$f / 30$	6
1500-15000	137	0.364	50	6
15000-150000	137	0.364	50	$616000 / f^{1.2}$
150000-300000	$0.354f^{0.5}$	$9.4 \times 10^{-4} f^{0.5}$	$3.33 \times 10^{-5} f$	$616000 / f^{1.2}$

Note: f is frequency in MHz.
* Power density limit is applicable at frequencies greater than 100 MHz.

Procedures:

Prior to radiated testing, the radio was connected to a power meter in order to see if any channel was significantly stronger than the rest for each band. For the purposes of testing, the channel with the highest power from each band was used.

Test Procedures:

1. The test setup was as described in the EUT Configuration section of this test report. The TETRA signal generator was on the outside of the chamber while the antenna was on the inside.
2. The antenna under test was mounted to a 30x30cm ground plane and placed on an 80cm test table.
3. The EUT was set to transmit continuously at the selected frequency and modulation at maximum RF power. The distance between the field intensity probe and the EUT's antenna was 20 cm since the calculated distance for uncontrolled environments was R < 20 cm.
4. Field intensity measurements were taken at different heights of the probe from the ground (0.1 to 2 meters) in 10cm increments, while rotating versus azimuth (from 0° to 360°).
5. Each maximized peak field intensity measurement was recorded.
6. Raw field strength was corrected with the field intensity probe correction factors.
7. The corrected field strength in V/m was converted to power density using the formula: $S = E^2 / Z_o$ where $Z_o = 120 \pi \approx 377\ \Omega$
8. Average values of power density were calculated for the imaginary whole human body (0.1–2.0 m), for the lower part of the body (0.1–0.9 m) and for the upper part of the body (1.0–2.0 m). The results of calculations are shown in the following tables.

Calculation for Part 90 TI D-LMR 409-430 MHz

highest conducted power = 33.06 *dBm* (429.9875 MHz), therefore, **Limit for Controlled Exposure: 1.43 mW/cm^2**

EUT maximum antenna gain = 8 *dBi*.

Equation from page 18 of OET 65, Edition 97-01

$S = PG / 4\pi R^2$ or $R = \sqrt{PG / 4\pi S}$

where, S = Power Density
P = Power Input to antenna (2023.02 mW)
G = Antenna Gain (6.31 numeric)
D.C. = Duty Cycle (25%)
R = 25 cm

$S = (D.C.)(P)(G) / 4\pi R^2$
$S = (0.25)(2023.02)(6.31) / 4\pi 625$
$S = 0.4$ mW/cm^2

Calculation for RSS-119 TETRA 409-430 MHz

highest conducted power = 35.48 *dBm* (409.09375 MHz), therefore, **Limit for Controlled Exposure: 1.36 mW/cm^2**

EUT maximum antenna gain = 8 *dBi*.

Equation from page 18 of OET 65, Edition 97-01

$S = PG / 4\pi R^2$ or $R = \sqrt{PG / 4\pi S}$

where, S = Power Density
P = Power Input to antenna (3531.8 mW)
G = Antenna Gain (6.31 numeric)
D.C. = Duty Cycle (25%)
R = 25 cm

$S = (D.C.)(P)(G) / 4\pi R^2$
$S = (0.25)(3531.8)(6.31) / 4\pi 625$
$S = 0.71$ mW/cm^2

Calculation for Part 22 TI D-LMR 454 - 460 MHz

highest conducted power = 33.04 *dBm* (454.05 MHz), therefore, **Limit for Controlled Exposure: 1.51 mW/cm^2**

EUT maximum antenna gain = 8 *dBi*.

Equation from page 18 of OET 65, Edition 97-01

$S = PG / 4\pi R^2$ or $R = \sqrt{PG / 4\pi S}$

where, S = Power Density
P = Power Input to antenna (2013.7 mW)
G = Antenna Gain (6.31 numeric)
D.C. = Duty Cycle (25%)
R = 25 cm

$S = (D.C.)(P)(G) / 4\pi R^2$
$S = (0.25)(2013.72)(6.31) / 4\pi 625$
$S = 0.4$ mW/cm^2

Calculation for Part 90 TI D-LMR 450 - 470 MHz

highest conducted power = 33.07 *dBm* (465 MHz), therefore, **Limit for Controlled Exposure: 1.5 mW/cm^2**

EUT maximum antenna gain = 8 *dBi*.

Equation from page 18 of OET 65, Edition 97-01

$S = PG / 4\pi R^2$ or $R = \sqrt{PG / 4\pi S}$

where, S = Power Density
P = Power Input to antenna (2027.6 mW)
G = Antenna Gain (6.31 numeric)
D.C. = Duty Cycle (25%)
R = 25 cm

$S = (D.C.)(P)(G) / 4\pi R^2$
$S = (0.25)(2027.6)(6.31) / 4\pi 625$
$S = 0.407$ mW/cm^2

Calculation for Part 90 TETRA 450 - 470 MHz

highest conducted power = 35.28 *dBm* (470 MHz), therefore, **Limit for Uncontrolled Exposure: 1.57 mW/cm^2**

EUT maximum antenna gain = 8 *dBi*.

Equation from page 18 of OET 65, Edition 97-01

$S = PG / 4\pi R^2$ or $R = \sqrt{PG / 4\pi S}$

where, S = Power Density
P = Power Input to antenna (3372.873 mW)
G = Antenna Gain (6.31 numeric)
D.C. = Duty Cycle (25%)

$S = (D.C.)(P)(G) / 4\pi R^2$
$S = (0.25)(3372.873)(6.31) / 4\pi 625$
$S = 0.68$ mW/cm^2

20 cm			
Probe height (cm)	**Raw V/m**	**Corrected V/m**	**PD mW/cm2**
10	2.63	1.9462	0.001005
20	2.52	1.8648	0.000922
30	3.32	2.4568	0.001601
40	4.81	3.5594	0.003361
50	6.89	5.0986	0.006895
60	8.55	6.327	0.010618
70	11	8.14	0.017575
80	19.71	14.5854	0.056428
90	20.84	15.4216	0.063084
100	19.41	14.3634	0.054723
110	18.03	13.3422	0.047219
120	12.71	9.4054	0.023465
130	9.06	6.7044	0.011923
140	6.69	4.9506	0.006501
150	5.03	3.7222	0.003675
160	4.05	2.997	0.002382
170	3.01	2.2274	0.001316
180	2.26	1.6724	0.000742
190	1.77	1.3098	0.000455
200	1.52	1.1248	0.000336

Occupational/Controlled Environment 20 cm	EBM 0dB Flex Whip 380-430 MHz
Part of the Body/Averaging Points	Averaged Power Density
Whole Body (0.1 m to 2.0 m)	0.01571
Lower Body (0.1 m to 0.9 m)	0.01794
Upper Body (1.0 m to 2.0 m)	0.01389

Table 23. MPE Measurement, 416.01875 MHz, 20 kHz

20 cm			
Probe height (cm)	**Raw V/m**	**Corrected V/m**	**PD mW/cm2**
10	3.72	2.604	0.0017986
20	5.12	3.584	0.0034072
30	7.18	5.026	0.0067004
40	9.73	6.811	0.012305
50	12.24	8.568	0.0194723
60	15.8	11.06	0.0324466
70	22.39	15.673	0.0651573
80	36.73	25.711	0.1753463
90	32.06	22.442	0.1335924
100	27.7	19.39	0.0997273
110	20.81	14.567	0.0562858
120	15.13	10.591	0.0297531
130	11.12	7.784	0.0160718
140	8.62	6.034	0.0096576
150	7.06	4.942	0.0064783
160	6.63	4.641	0.0057132
170	5.15	3.605	0.0034472
180	4.03	2.821	0.0021109
190	3.24	2.268	0.0013644
200	2.69	1.883	0.0009405

Occupational/Controlled Environment 20 cm	EBM BASE 0dB Flx 430 - 472.5 MHz
Part of the Body/Averaging Points	Averaged Power Density
Whole Body (0.1 m to 2.0 m)	0.03409
Lower Body (0.1 m to 0.9 m)	0.05003
Upper Body (1.0 m to 2.0 m)	0.02105

Table 24. MPE Measurement, 459.950 MHz, 20 kHz

20 cm			
Probe height (cm)	**Raw V/m**	**Corrected V/m**	**PD mW/cm2**
10	3.71	2.597	0.001789
20	4.88	3.416	0.0030952
30	6.71	4.697	0.0058519
40	9.12	6.384	0.0108105
50	11.61	8.127	0.0175194
60	14.16	9.912	0.0260604
70	18.88	13.216	0.0463296
80	34.42	24.094	0.1539843
90	34.81	24.367	0.1574936
100	31.24	21.868	0.126846
110	25.96	18.172	0.0875919
120	19.59	13.713	0.0498797
130	14.05	9.835	0.0256571
140	11.05	7.735	0.0158701
150	8.52	5.964	0.0094348
160	6.65	4.655	0.0057478
170	5.27	3.689	0.0036097
180	4.41	3.087	0.0025277
190	3.65	2.555	0.0017316
200	2.94	2.058	0.0011234

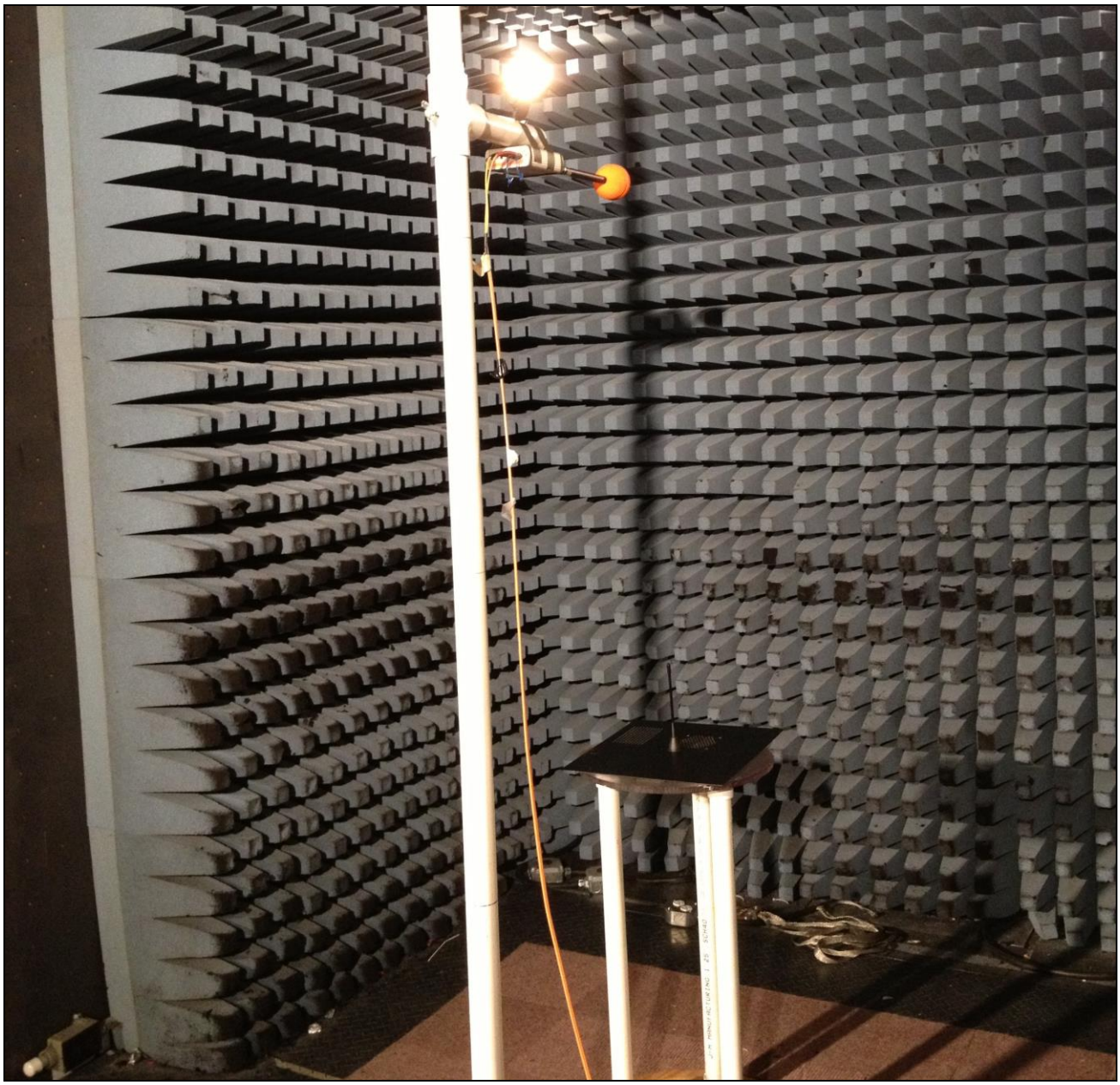
Occupational/Controlled Environment 20 cm	EBM BASE 0dB Flx 430 - 472.5 MHz
Part of the Body/Averaging Points	Averaged Power Density
Whole Body (0.1 m to 2.0 m)	0.03765
Lower Body (0.1 m to 0.9 m)	0.04699
Upper Body (1.0 m to 2.0 m)	0.03000

Table 25. MPE Measurement, 465 MHz, 20 kHz

20 cm			
Probe height (cm)	**Raw V/m**	**Corrected V/m**	**PD mW/cm2**
10	4.03	2.821	0.0021109
20	5.25	3.675	0.0035824
30	7.34	5.138	0.0070024
40	10.14	7.098	0.0133638
50	12.5	8.75	0.0203084
60	15.33	10.731	0.0305449
70	19.83	13.881	0.0511093
80	33.02	23.114	0.1417127
90	37.89	26.523	0.1865967
100	35.08	24.556	0.1599462
110	30.86	21.602	0.1237789
120	22.05	15.435	0.0631934
130	14.97	10.479	0.0291272
140	10.98	7.686	0.0156697
150	8.38	5.866	0.0091273
160	6.61	4.627	0.0056788
170	5.49	3.843	0.0039174
180	2.82	1.974	0.0010336
190	2.43	1.701	0.0007675
200	1.95	1.365	0.0004942

Occupational/Controlled Environment 20 cm	EBM BASE 0dB Flx 430 - 472.5 MHz
Part of the Body/Averaging Points	Averaged Power Density
Whole Body (0.1 m to 2.0 m)	0.04345
Lower Body (0.1 m to 0.9 m)	0.05070
Upper Body (1.0 m to 2.0 m)	0.03752

Table 26. MPE Measurement, 470 MHz, 22 kHz



Photograph 6. RF Exposure, Test Setup

4.11. 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 6.2
Test Requirement(s): Antenna Conducted Limits

If the receiver has a detachable antenna of known impedance, antenna conducted spurious emissions measurement is permitted as an alternative to radiated measurement. However, the radiated method of Section 6.1 is recommended: see Note below.

The antenna conducted test shall be performed with the antenna disconnected and the receiver antenna terminals connected to a measuring instrument having equal impedance to that specified for the antenna.

The receiver spurious emissions measured at the antenna terminals by the antenna conducted method shall then comply with the following limits:

Receiver spurious emissions at any discrete frequency shall not exceed 2 nanowatts in the band 30–1000 MHz, and 5 nanowatts above 1000 MHz

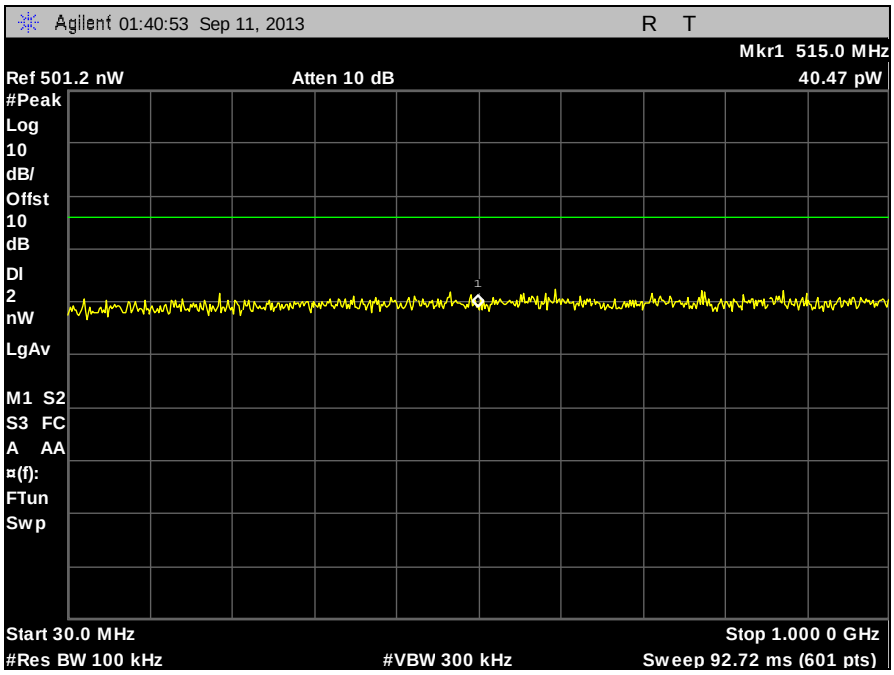
RSS-GEN, Section 4.10
Test Requirement(s): The receiver shall be operated in the normal receive mode near the mid-point of the band in which the receiver is designed to operate.
Radiated emission measurements are to be performed on a test site registered with Industry Canada. As an alternative, the conducted 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 1 MHz resolution was used for measurements done above 1 GHz. All plots are corrected for cable loss.

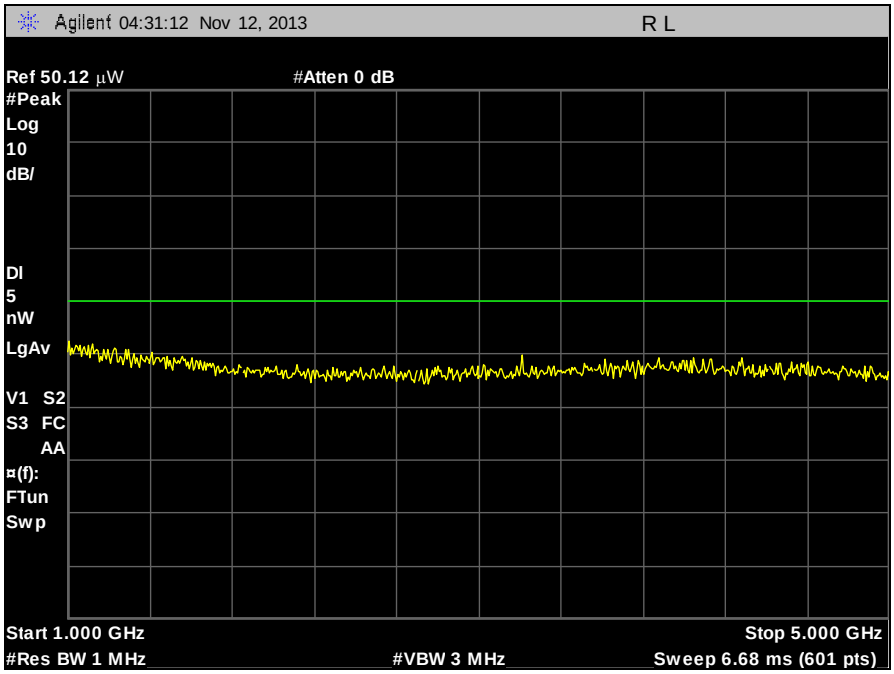
Test Results: Equipment is compliant with the Receiver Spurious Emissions Requirements of RSS-GEN and RSS-119.

Test Engineer(s): Shawn McMillen

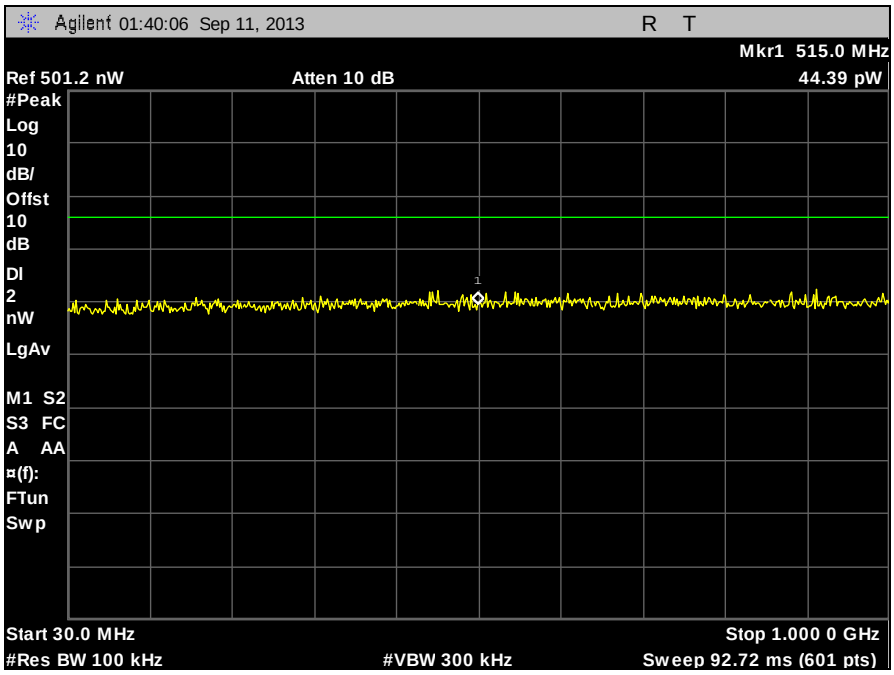
Test Date(s): 09/11/13



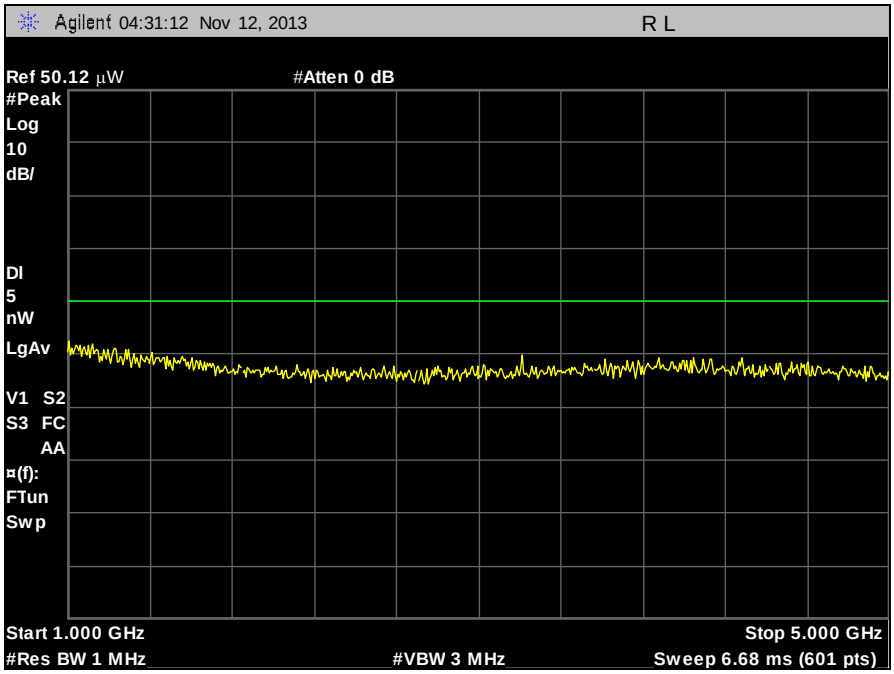
Plot 134. Receiver Spurious Emissions, TETRA, 22 kHz, Low Channel, 409 MHz, 30 MHz – 1 GHz



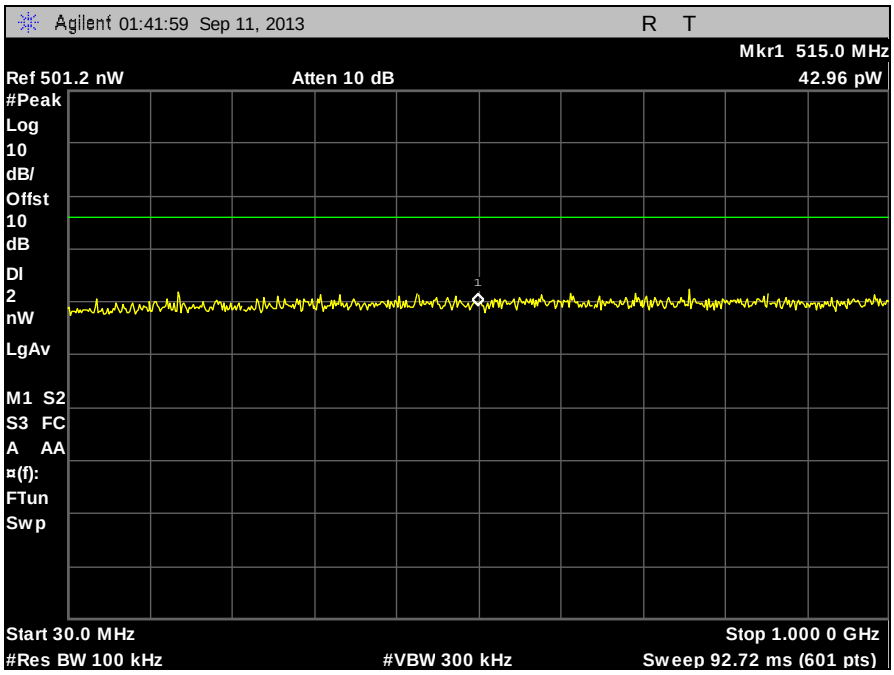
Plot 135. Receiver Spurious Emissions, TETRA, 22 kHz, Low Channel, 409 MHz, 1 GHz – 5 GHz



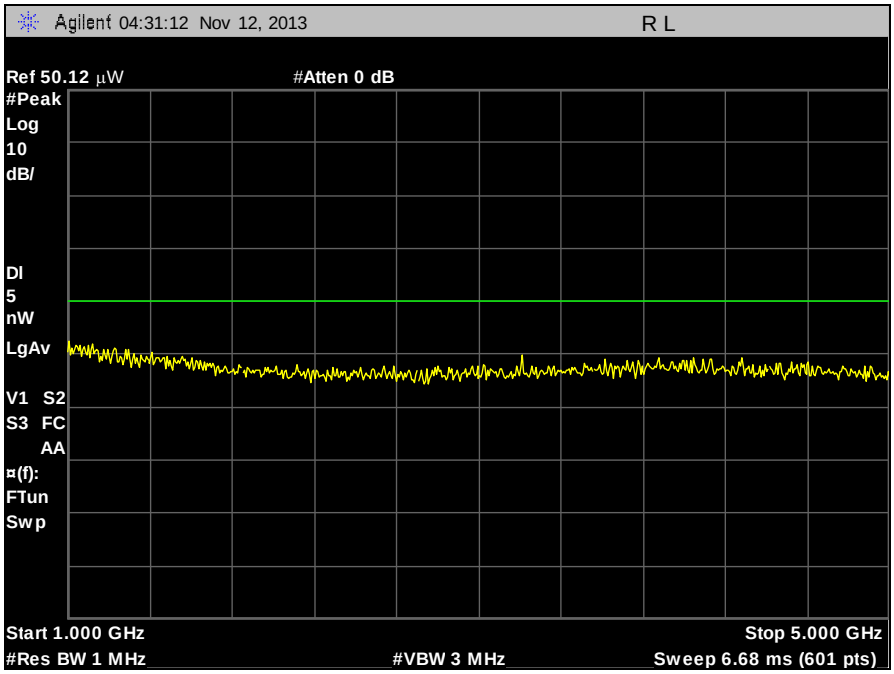
Plot 136. Receiver Spurious Emissions, TETRA, 22 kHz, Low Channel, 450 MHz, 30 MHz – 1 GHz



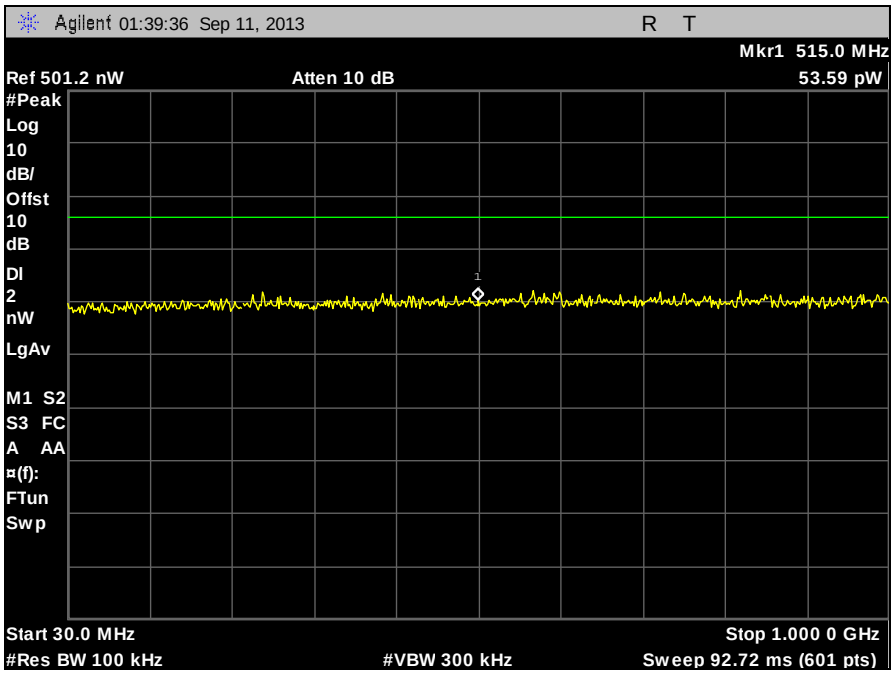
Plot 137. Receiver Spurious Emissions, TETRA, 22 kHz, Low Channel, 450 MHz, 1 GHz – 5 GHz



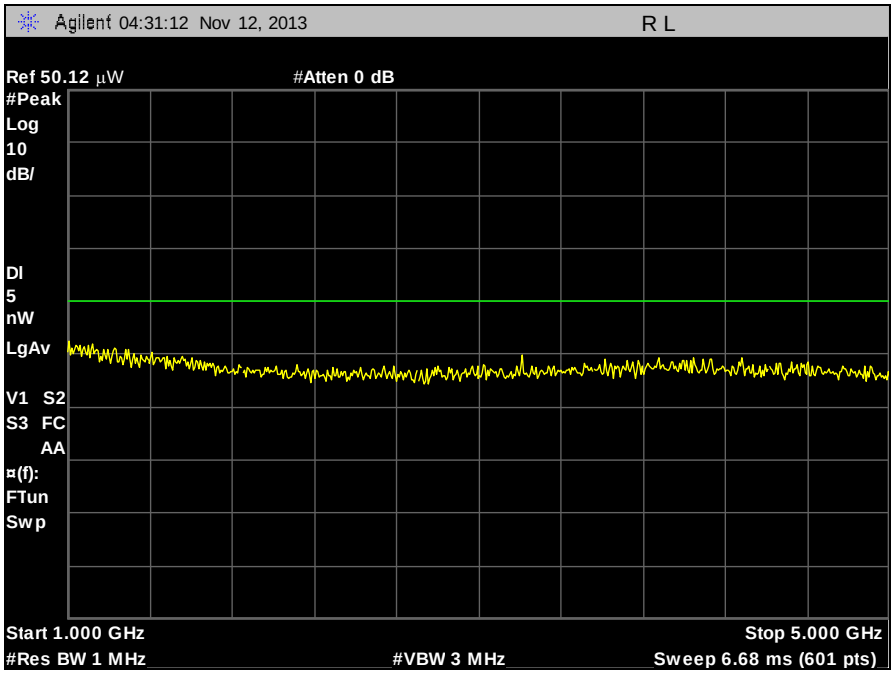
Plot 138. Receiver Spurious Emissions, TETRA, 22 kHz, Mid Channel, 416 MHz, 30 MHz – 1 GHz



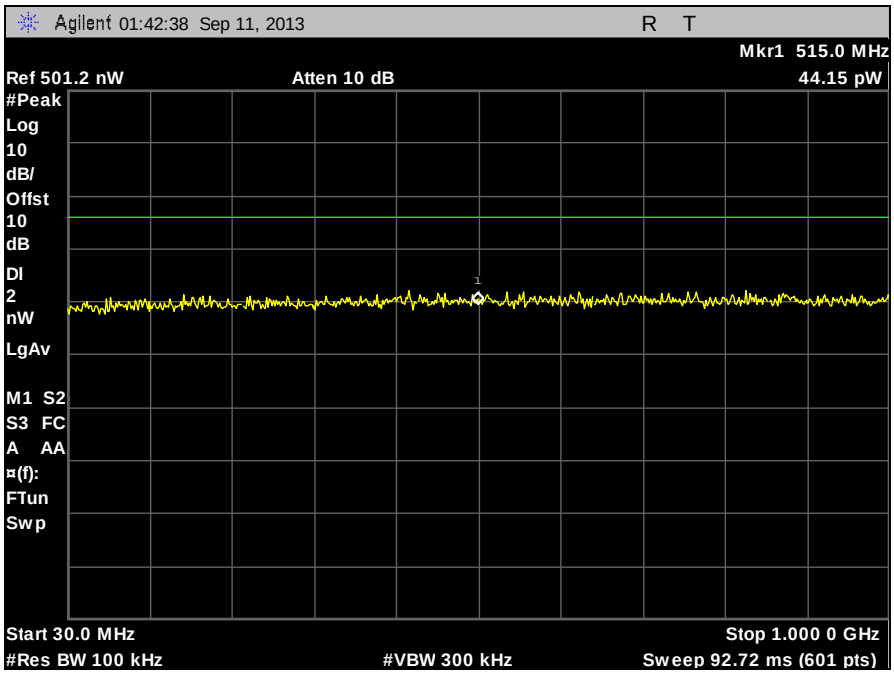
Plot 139. Receiver Spurious Emissions, TETRA, 22 kHz, Mid Channel, 416 MHz, 1 GHz – 5 GHz



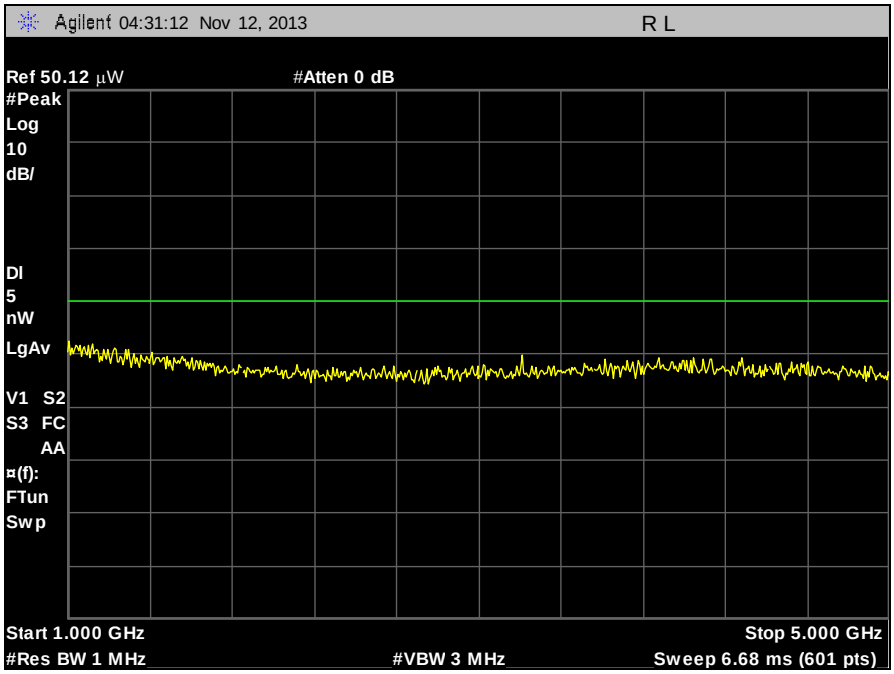
Plot 140. Receiver Spurious Emissions, TETRA, 22 kHz, Mid Channel, 465 MHz, 30 MHz – 1 GHz



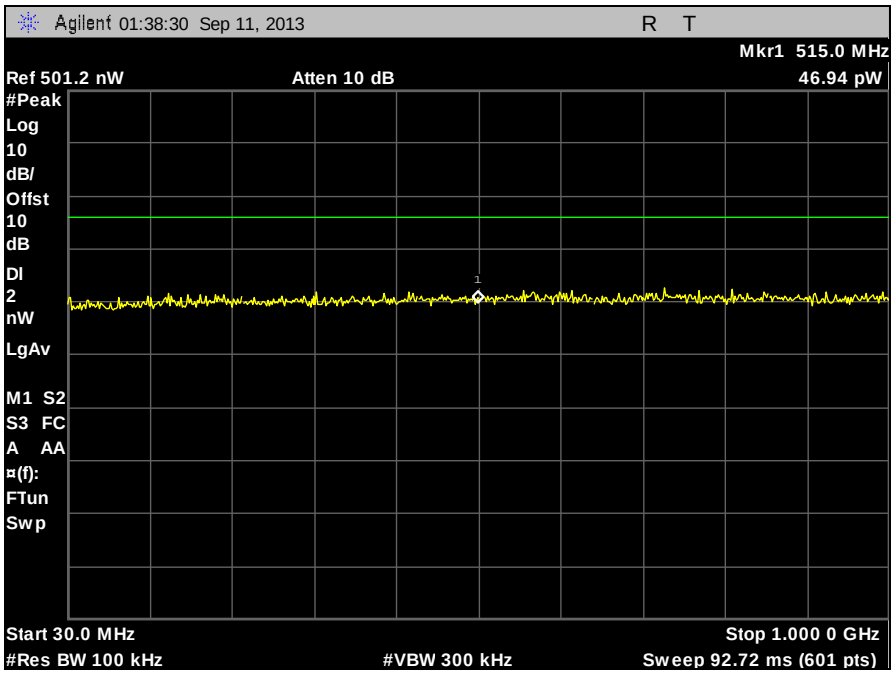
Plot 141. Receiver Spurious Emissions, TETRA, 22 kHz, Mid Channel, 465 MHz, 1 GHz – 5 GHz



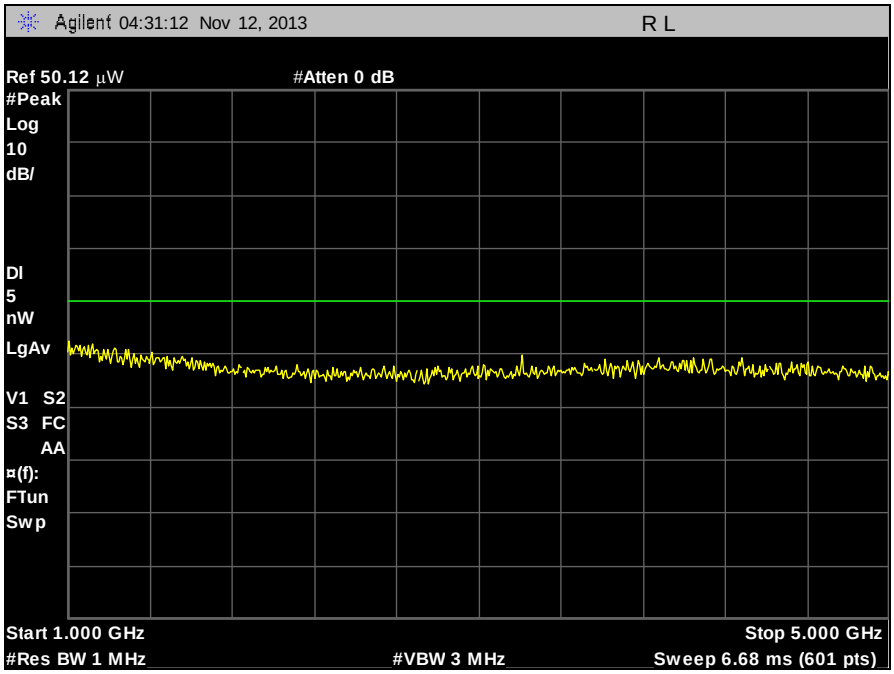
Plot 142. Receiver Spurious Emissions, TETRA, 22 kHz, High Channel, 430 MHz, 30 MHz – 1 GHz



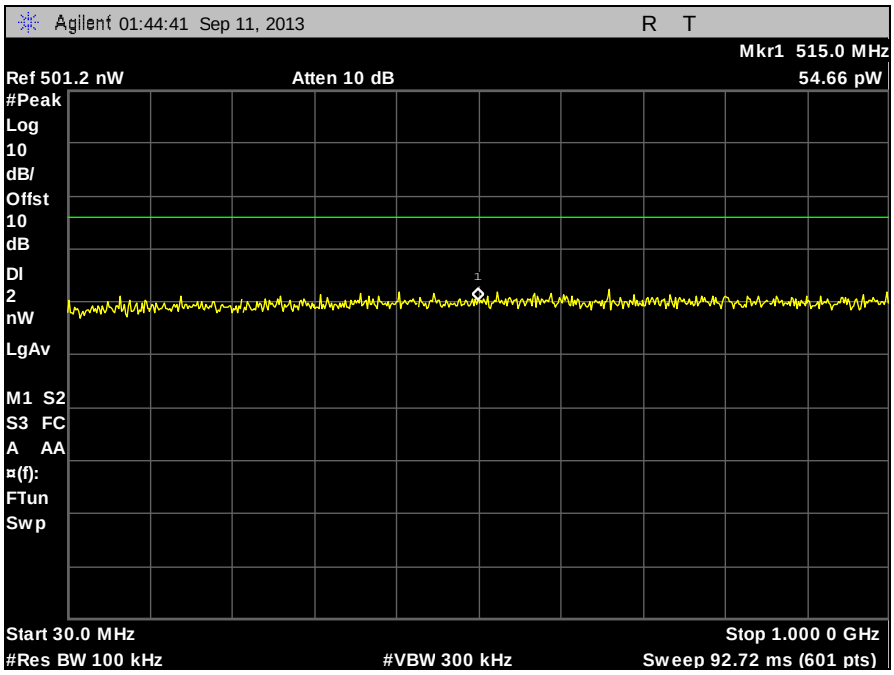
Plot 143. Receiver Spurious Emissions, TETRA, 22 kHz, High Channel, 430 MHz, 1 GHz – 5 GHz



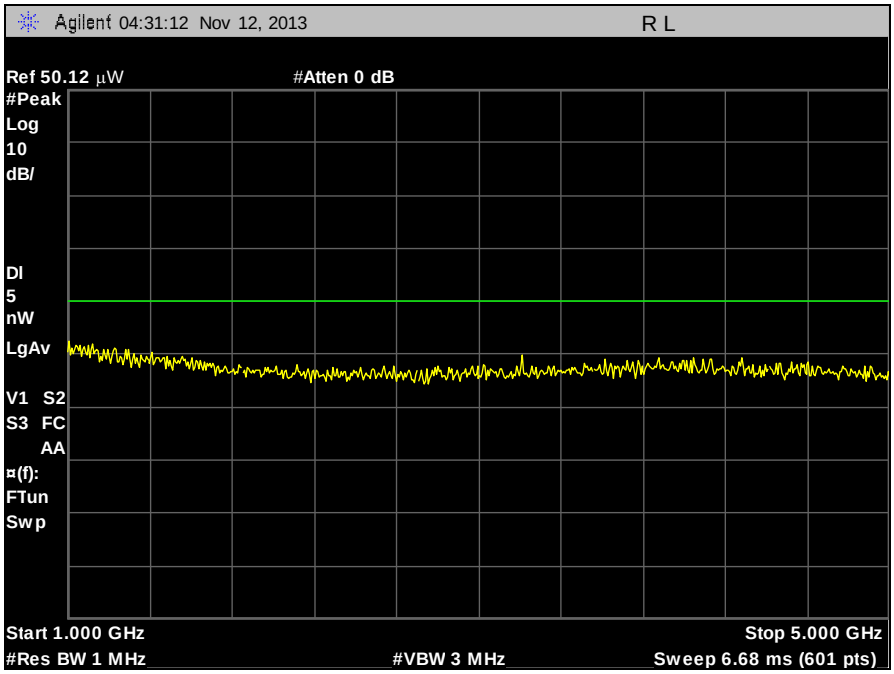
Plot 144. Receiver Spurious Emissions, TETRA, 22 kHz, High Channel, 470 MHz, 30 MHz – 1 GHz



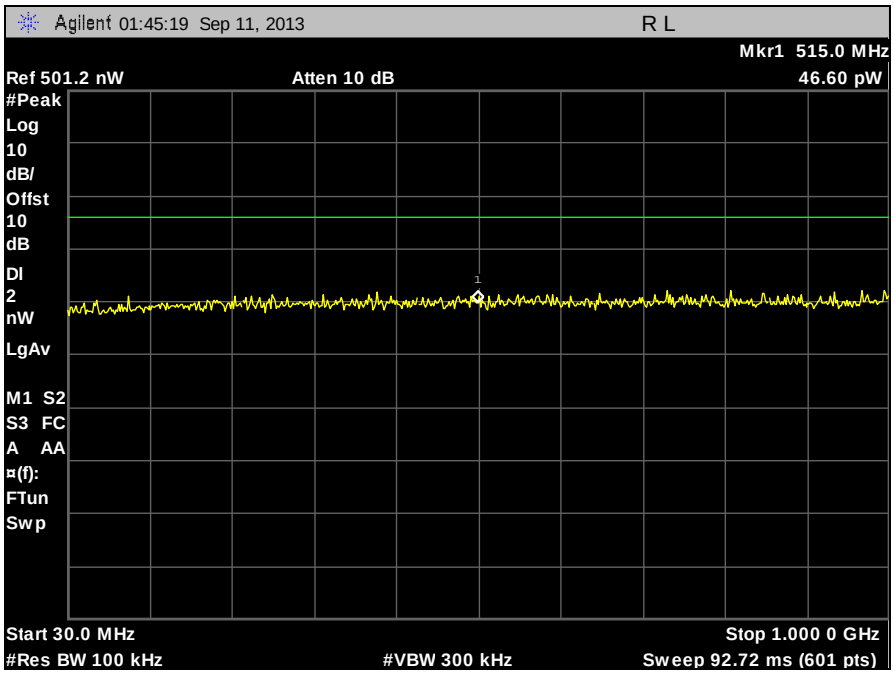
Plot 145. Receiver Spurious Emissions, TETRA, 22 kHz, High Channel, 470 MHz, 1 GHz – 5 GHz



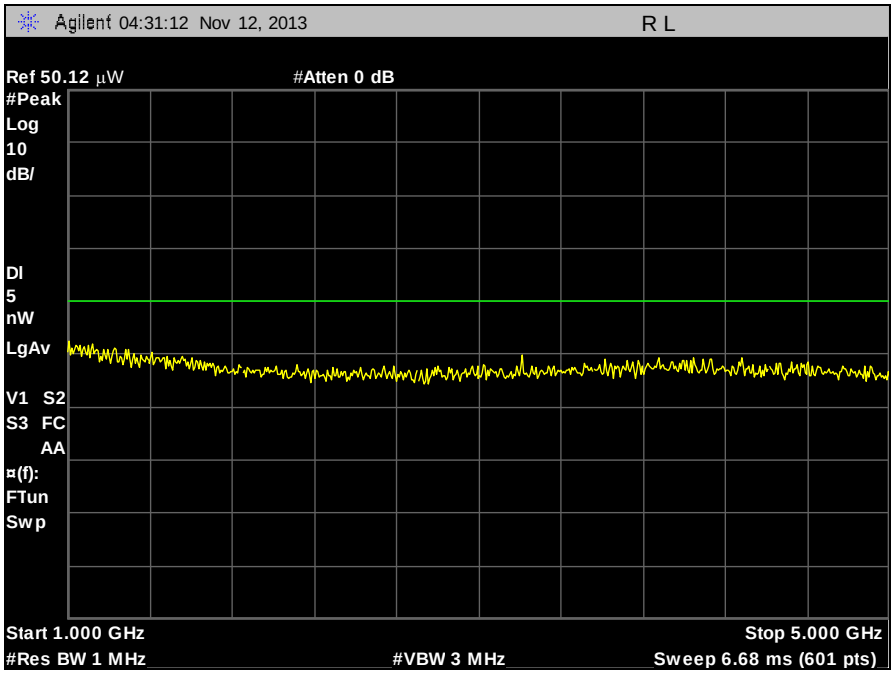
Plot 146. Receiver Spurious Emissions, TI D-LMR, 20 kHz, Low Channel, 409 MHz, 30 MHz – 1 GHz



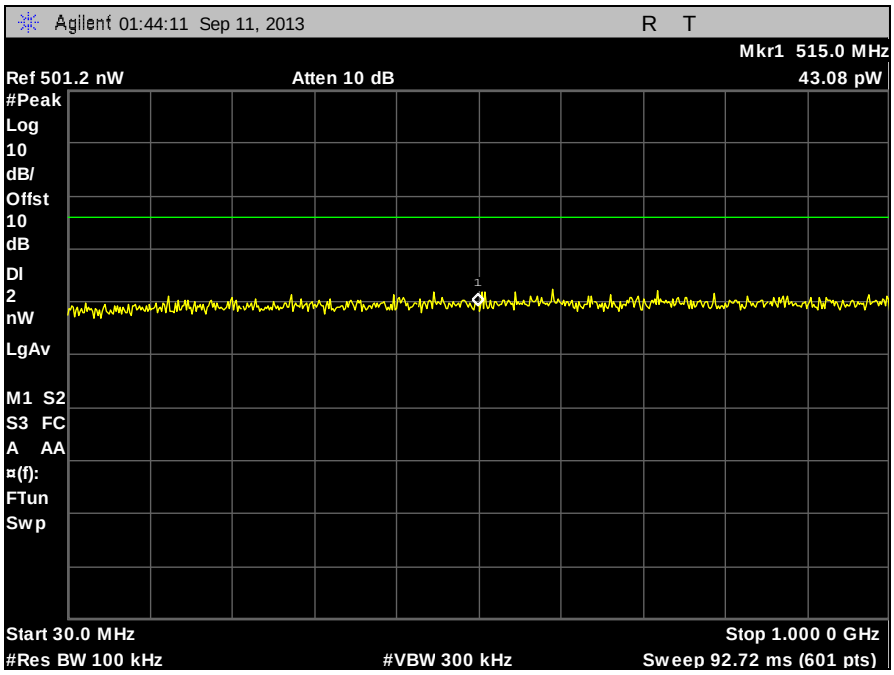
Plot 147. Receiver Spurious Emissions, TI D-LMR, 20 kHz, Low Channel, 409 MHz, 1 GHz – 5 GHz



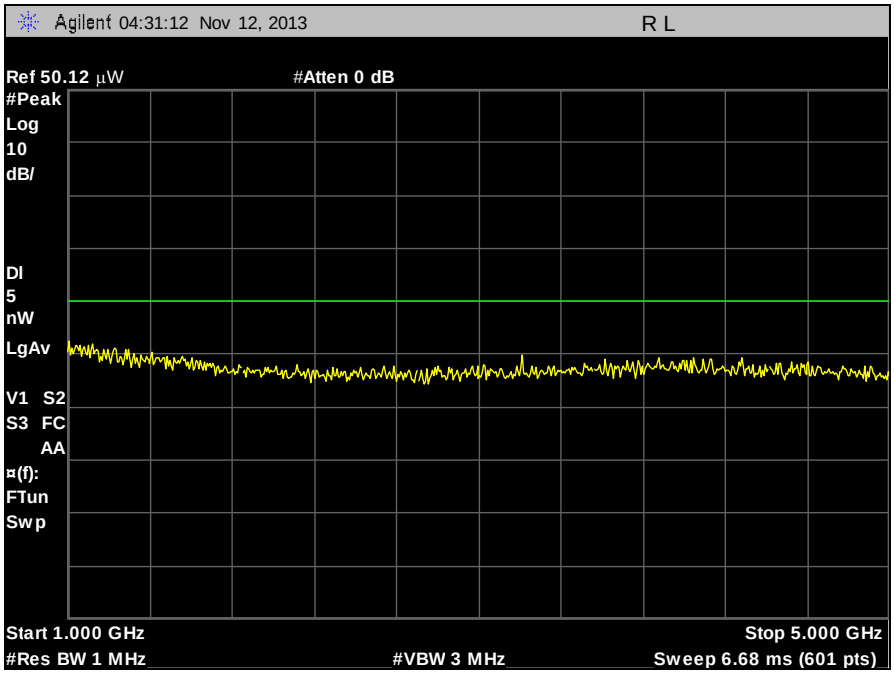
Plot 148. Receiver Spurious Emissions, TI D-LMR, 20 kHz, Low Channel, 450 MHz, 30 MHz – 1 GHz



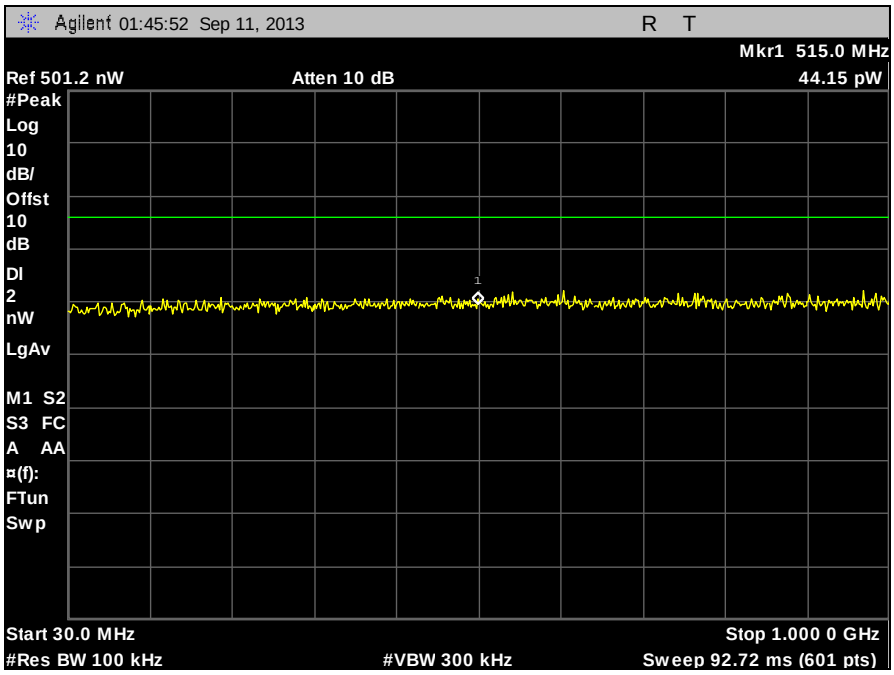
Plot 149. Receiver Spurious Emissions, TI D-LMR, 20 kHz, Low Channel, 450 MHz, 1 GHz – 5 GHz



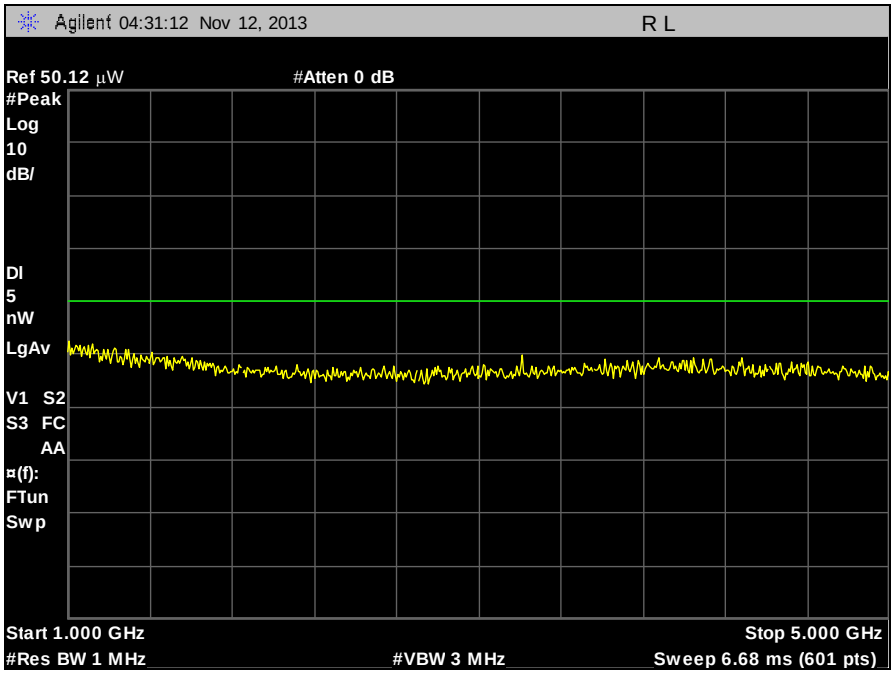
Plot 150. Receiver Spurious Emissions, TI D-LMR, 20 kHz, Mid Channel, 416 MHz, 30 MHz – 1 GHz



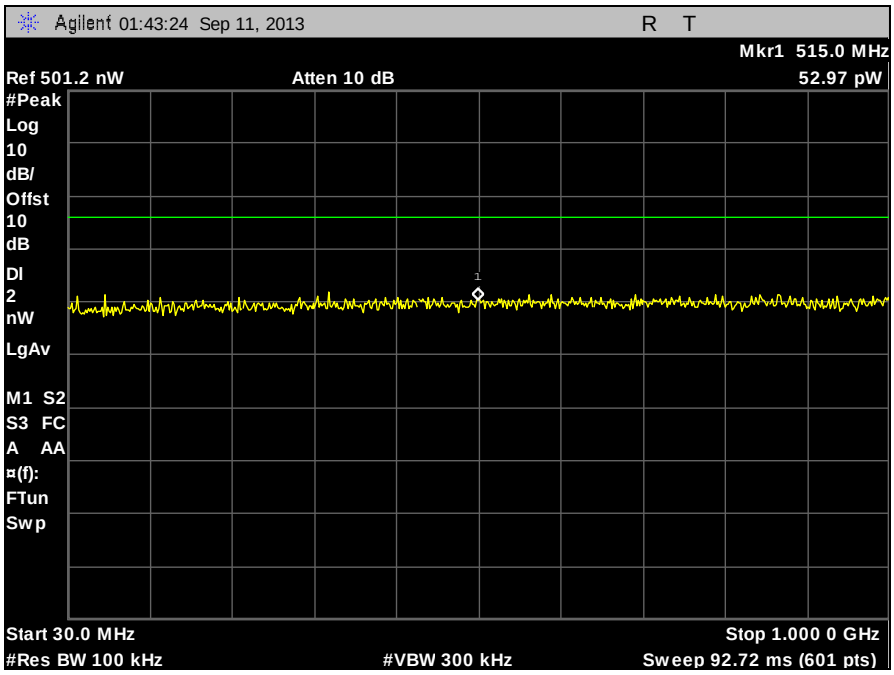
Plot 151. Receiver Spurious Emissions, TI D-LMR, 20 kHz, Mid Channel, 416 MHz, 1 GHz – 5 GHz



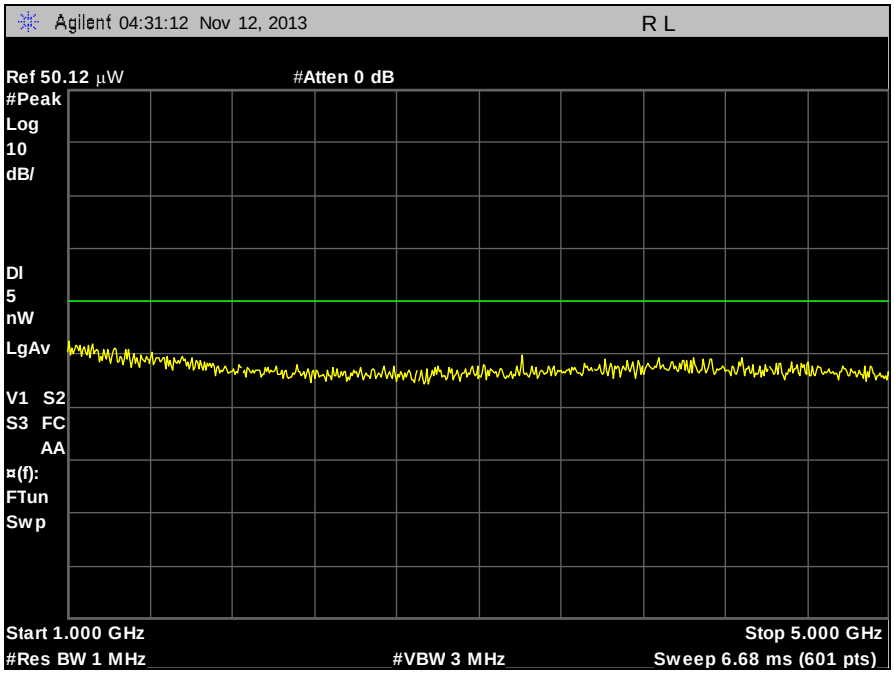
Plot 152. Receiver Spurious Emissions, TI D-LMR, 20 kHz, Mid Channel, 465 MHz, 30 MHz – 1 GHz



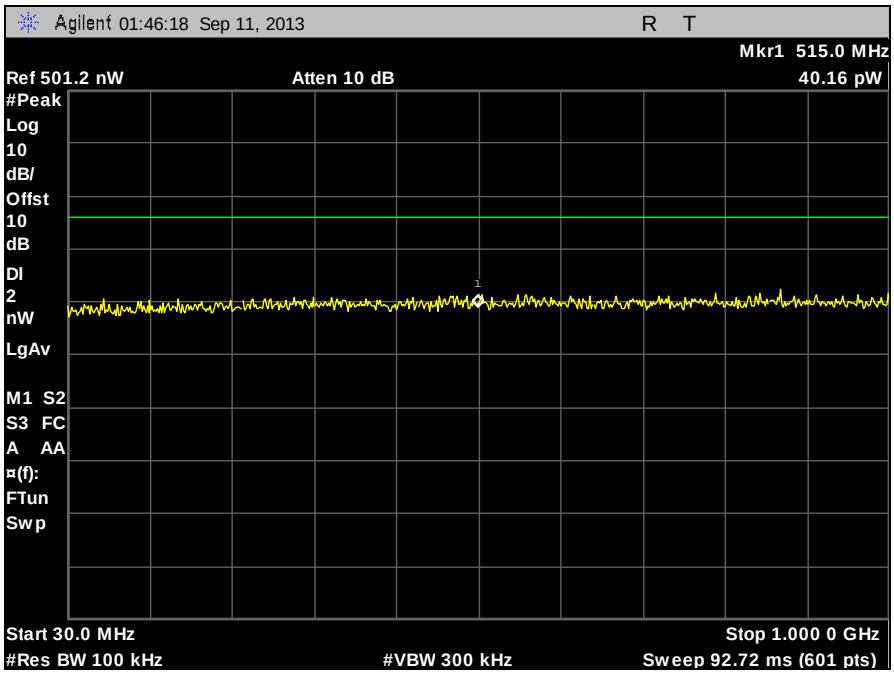
Plot 153. Receiver Spurious Emissions, TI D-LMR, 20 kHz, Mid Channel, 465 MHz, 1 GHz – 5 GHz



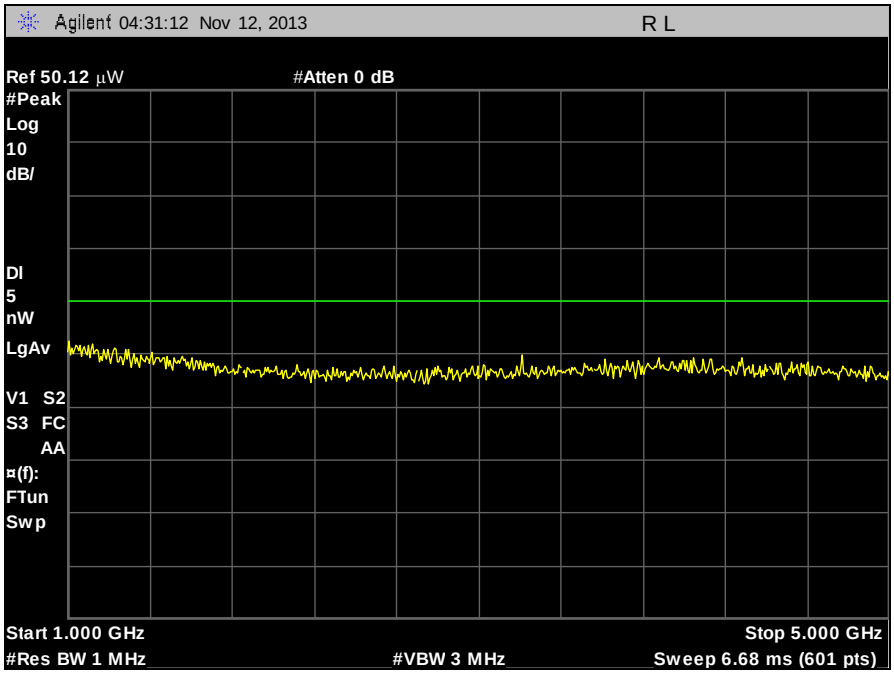
Plot 154. Receiver Spurious Emissions, TI D-LMR, 20 kHz, High Channel, 430 MHz, 30 MHz – 1 GHz



Plot 155. Receiver Spurious Emissions, TI D-LMR, 20 kHz, High Channel, 430 MHz, 1 GHz – 5 GHz



Plot 156. Receiver Spurious Emissions, TI D-LMR, 20 kHz, High Channel, 470 MHz, 30 MHz – 1 GHz



Plot 157. Receiver Spurious Emissions, TI D-LMR, 20 kHz, High Channel, 470 MHz, 1 GHz – 5 GHz

V. Test Equipment

5. 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
RENTAL	TETRA TEST SET	MARCONI INSTRUMENTS	2968	05/27/2013	05/27/2014

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

VI. Certification & User's Manual Information

6. Certification Label & User's Manual Information

6.1. 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.

6.2. 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