MET Laboratories, Inc. *Safety Certification - EMI - Telecom Environmental Simulation*
914 WEST PATAPSCO AVENUE • BALTIMORE, MARYLAND 21230-3432 • PHONE (410) 354-3300 • FAX (410) 354-3313
33439 WESTERN AVENUE • UNION CITY, CALIFORNIA 94587 • PHONE (510) 489-6300 • FAX (510) 489-6372
3162 BELICK STREET • SANTA CLARA, CA 95054 • PHONE (408) 748-3585 • FAX (510) 489-6372
13301 MCCALLEN PASS • AUSTIN, TEXAS 78753 • PHONE (512) 287-2500 • FAX (512) 287-2513

May 20, 2013

Balogh T.A.G. Corp.
3637 S. Old US-23 Suite 100
Brighton, MI 48114

Dear Joseph Tomashik,

Enclosed is the EMC Wireless test report for compliance testing of the Balogh T.A.G. Corp., MOL 81 as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-06 ed.), Part 15, Subpart B for a Class A Digital Device, and FCC Part 15 Subpart C for Intentional Radiators.

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: (\Balogh T.A.G. Corp.\EMC38081-FCC Rev. 1)

Electromagnetic Compatibility Criteria
Test Report

for the

Balogh T.A.G. Corp.
MOL 81

Tested under
the FCC Certification Rules
contained in
Title 47 of the CFR, Parts 15 Subpart B
for Class A Digital Devices
&
15 Subpart C for Intentional Radiators

MET Report: EMC38081-FCC Rev. 1

May 20, 2013

Prepared For:

Balogh T.A.G. Corp.
3637 S. Old US-23 Suite 100
Brighton, MI 48114

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

Electromagnetic Compatibility Criteria
Test Report

for the

Balogh T.A.G. Corp.
MOL 81

Tested under
the FCC Certification Rules
contained in
Title 47 of the CFR, Parts 15 Subpart B
for Class A Digital Devices
&
15 Subpart C for Intentional Radiators

Benjamin Taylor, Project Engineer
Electromagnetic Compatibility Lab

Jennifer Warnell
Documentation Department

Engineering Statement: The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC Rules Parts 15B and 15C under normal use and maintenance.

Asad Bajwa,
Director, Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	May 7, 2013	Initial Issue.
1	May 20, 2013	Added a section to address the antenna.

Table of Contents

I. Executive Summary 1
A. Purpose of Test 2
B. Executive Summary 2
II. Equipment Configuration 3
A. Overview 4
B. References 5
C. Test Site 5
D. Description of Test Sample 6
E. Equipment Configuration 7
F. Support Equipment 7
G. Ports and Cabling Information 7
H. Mode of Operation 8
I. Method of Monitoring EUT Operation 8
J. Modifications 8
a) Modifications to EUT 8
b) Modifications to Test Standard 8
K. Disposition of EUT 8
III. Electromagnetic Compatibility Criteria for Unintentional Radiators 9
§ 15.107(a) Conducted Emissions Limits 10
§ 15.109(a) Radiated Emissions Limits 14
IV. Electromagnetic Compatibility Criteria for Intentional Radiators 17
§ 15.203 Antenna Requirement 18
§ 15.207(a) Conducted Emissions Limits 19
§ 15.209 Radiated Spurious Emissions Requirements and Band Edge 23
V. Test Equipment 31
VI. Certification & User's Manual Information 33
A. Certification Information 34
B. Label and User's Manual Information 38

List of Tables

Table 1. Executive Summary of EMC Part 15 Subpart C ComplianceTesting 2
Table 2. EUT Summary Table 4
Table 3. References 5
Table 4. Equipment Configuration 7
Table 5. Support Equipment 7
Table 6. Ports and Cabling Information 7
Table 7. Conducted Limits for Radio Frequency Devices calculated from FCC Part 15 Subsections 15.107(a) (b) 10
Table 8. Conducted Emissions - Voltage, AC Power, Phase Line (120 VAC, 60 Hz) 11
Table 9. Conducted Emissions - Voltage, AC Power, Neutral Line (120 VAC, 60 Hz) 12
Table 10. Radiated Emissions Limits calculated from FCC Part 15, §15.109 (a) (b) 14
Table 11. Radiated Emissions Limits, Test Results, 30 MHz – 1 GHz, FCC Limits 15
Table 12. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a) 19
Table 13. Conducted Emissions, 15.207(a), Phase Line, Test Results 20
Table 14. Conducted Emissions, 15.207(a), Neutral Line, Test Results 21
Table 15. Radiated Emissions Limits Calculated from FCC Part 15, § 15.209 (a) 23
Table 16. Test Equipment List 32

List of Plots

Plot 1. Conducted Emissions, Phase Line Plot 11
Plot 2. Conducted Emissions, Neutral Line Plot 12
Plot 3. Radiated Emissions, 30 MHz - 1 GHz, FCC Limits 15
Plot 4. Conducted Emissions, 15.207(a), Phase Line 20
Plot 5. Conducted Emissions, 15.207(a), Neutral Line 21
Plot 6. Radiated Spurious Emissions, 25 kHz – 490 kHz 24
Plot 7. Radiated Spurious Emissions, 125 kHz 24
Plot 8. Radiated Spurious Emissions, 490 kHz – 1.705 MHz 25
Plot 9. Radiated Spurious Emissions, 1.705 MHz – 30 MHz 25
Plot 10. Radiated Spurious Emissions, 30 MHz – 1 GHz 26

List of Figures

Figure 1. Block Diagram of Test Configuration 6

List of Photographs

Photograph 1. Conducted Emissions, Test Setup 13
Photograph 2. Radiated Emissions, Test Setup 16
Photograph 3. Conducted Emissions, 15.207(a), Test Setup 22
Photograph 4. Radiated Spurious Emissions, Test Setup, 9 kHz – 30 MHz 27
Photograph 5. Radiated Spurious Emissions, Test Setup, 30 MHz – 1 GHz 28
Photograph 6. Radiated Spurious Emissions, Test Setup, OATS 29
Photograph 7. Radiated Spurious Emissions, Test Setup, OATS 30

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

A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Balogh T.A.G. Corp. MOL 81, with the requirements of Part 15, §15C. 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 MOL 81. Balogh T.A.G. Corp. should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the MOL 81, has been **permanently** discontinued.

B. Executive Summary

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, §15C, in accordance with Balogh T.A.G. Corp., purchase order number 00003519. All tests were conducted using measurement procedure ANSI C63.4-2003.

FCC Reference 47 CFR Part 15 Subpart C	Description	Compliance
47 CFR Part 15.107 (a)	Conducted Emission Limits for a Class A Digital Device	Compliant
47 CFR Part 15.109 (a)	Radiated Emission Limits for a Class A Digital Device	Compliant
Title 47 of the CFR, Part 15 §15.207(a)	Conducted Emission Limits	Compliant
Title 47 of the CFR, Part 15 §15.209	Radiated Spurious Emissions Requirements	Compliant

Table 1. Executive Summary of EMC Part 15 Subpart C ComplianceTesting

II. Equipment Configuration

A. Overview

MET Laboratories, Inc. was contracted by Balogh T.A.G. Corp. to perform testing on the MOL 81, under Balogh T.A.G. Corp.'s purchase order number 00003519.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Balogh T.A.G. Corp., MOL 81.

The results obtained relate only to the item(s) tested.

Model(s) Tested:	MOL 81	
Model(s) Covered:	MOL 81	
EUT Specifications:	Primary Power: 120 VAC, 60 Hz	
	FCC ID: G8630RMOL81	
	Peak RF Output Power:	18.84 dBuV/m
	EUT Frequency Ranges:	125 kHz
Analysis:	The results obtained relate only to the item(s) tested.	
Environmental Test Conditions:	Temperature: 15-35º C	
	Relative Humidity: 30-60%	
	Barometric Pressure: 860-1060 mbar	
Evaluated by:	Benjamin Taylor	
Report Date(s):	May 20, 2013	

Table 2. EUT Summary Table

B. References

CFR 47, Part 15, Subpart C	Federal Communication Commission, Code of Federal Regulations, Title 47, Part 15: General Rules and Regulations, Allocation, Assignment, and Use of Radio Frequencies
CFR 47, Part 15, Subpart B	Electromagnetic Compatibility: Criteria for Radio Frequency Devices
ANSI C63.4:2003	Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz
ISO/IEC 17025:2005	General Requirements for the Competence of Testing and Calibration Laboratories
ANSI C63.10-2009	American National Standard for Testing Unlicensed Wireless Devices

Table 3. References

C. 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 3 meter 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.

D. Description of Test Sample

The Balogh T.A.G. Corp. MOL 81, Equipment Under Test (EUT), is a short range transceiver designed for railway applications. The MOL81 is a monoblock with integrated antenna and control interface. The MOL 81 is designed to exclusively Read the 2 byte contents of a Balogh type OMR 80 Beacon Tag. The MOL 81 will communicate its results to a host Programmable Logic Controller or a PC as a MODBUS RTU slave device. The communication hardware connection is RS-422 / RS-485.

The MOL 81 is a dual frequency system. The MOL 81 incorporates an un modulated 125 kHz transmitter to power the remote passive OMR 80 TAG and uses a 6.78 MHz receiver to receive data that is reported back from the Tag.

The MOL 81 also provides two parallel outputs. One output is active High when the 125 kHz emitter is functioning correctly. The second output is active High when the MOL 81 detects the Presents of the OMR 80 beacon tag within its field.

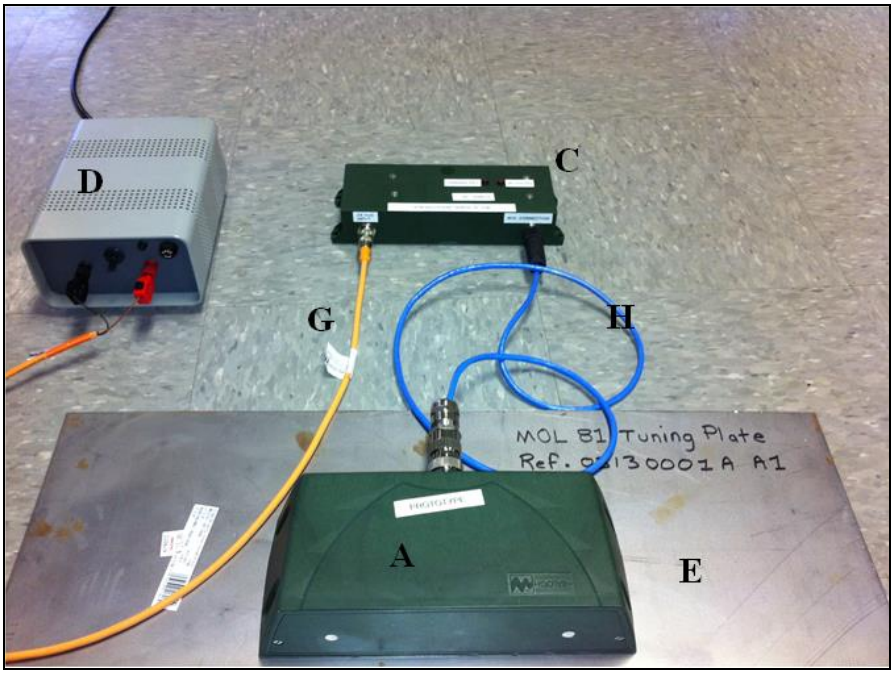


Figure 1. Block Diagram of Test Configuration

E. Equipment Configuration

The EUT was set up as outlined in Figure 1, Block Diagram of Test Setup. All cards, racks, etc., incorporated as part of the EUT is included in the following list.

Ref. ID	Name / Description	Model Number	Serial Number
A	MOL 81	MOL 81/ 485 / 1337	0809220301- 003 A

Table 4. Equipment Configuration

F. Support Equipment

Support equipment necessary for the operation and testing of the EUT is included in the following list.

Ref. ID	Name / Description	Manufacturer	Model Number	Serial Number
B	OMR 80	Balogh T.A.G.,Corp.	OMR 80 / 1320	1108229301 037 C
C	Signal Box	Balogh T.A.G.,Corp.	None	None
D	Lascar Adj DC Power Supply	Lascar	PSU 130	L201003 01250
E	MOL 81 Tuning Plate	Balogh T.A.G.,Corp.	None	Ref. 03130001A A1
F	OMR 08 Tuning Plate	Balogh T.A.G.,Corp.	None	None
G	Low Voltage DC Cable	Balogh T.A.G.,Corp.	None	None
H	Souriau Connector / Cable Assembly	Balogh T.A.G.,Corp.	None	None

Table 5. Support Equipment

G. Ports and Cabling Information

Ref. ID	Port Name on EUT	Cable Description	Qty.	Length (m)	Shielded (Y/N)	Termination Point
I	Port Combined Comm, Power and Signal 8 Pin Interface		1			

Table 6. Ports and Cabling Information

H. Mode of Operation

See document MOL 81 Quick Start Setup Guide.pdf that details the one and only mode that the device can be configured.

I. Method of Monitoring EUT Operation

The indication of the 125 kHz OK signal indicator LED is ON when the MOL 81 is operational. Meaning that the unmodulated 125 kHz coil is activated at full power.

The indication of the Tag Present OK signal LED is ON when the MOL 81 is in communications with the OMR 80 beacon tag.

J. Modifications

a) Modifications to EUT

No modifications were made to the EUT.

b) Modifications to Test Standard

No modifications were made to the test standard.

K. Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to Balogh T.A.G. Corp. upon completion of testing.

III. Electromagnetic Compatibility Criteria for Unintentional Radiators

Electromagnetic Compatibility Criteria

§ 15.107 Conducted Emissions Limits

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 7. 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 7. 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- 0.45	79	66	66 - 56	56 - 46
0.45 - 0.5	79	66	56	46
0.5 - 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 7. Conducted Limits for Radio Frequency Devices calculated from FCC Part 15 Subsections 15.107(a) (b)

Test Procedures:

The EUT was (placed on a non-metallic table, 80 cm above the horizontal ground plane and 40 cm from a vertical ground plane. 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 A requirement(s) of this section. Measured emissions were below applicable limits.

Test Engineer(s):

Ben Taylor

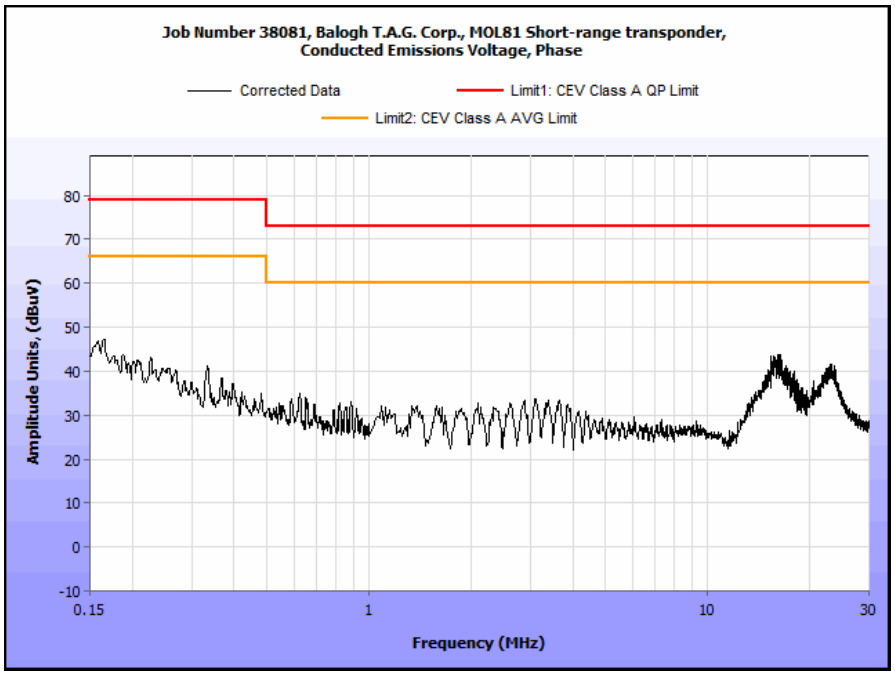
Test Date(s):

03/29/13

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

Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
0.3282	36.85	0	36.85	79	-42.15	31.53	0	31.53	66	-34.47
0.6037	24.34	0	24.34	73	-48.66	16.33	0	16.33	60	-43.67
1.083	30.11	0	30.11	73	-42.89	24.36	0	24.36	60	-35.64
3.645	31.13	0	31.13	73	-41.87	22.62	0	22.62	60	-37.38
16.616	35.42	0	35.42	73	-37.58	23.6	0	23.6	60	-36.4
23.116	38.17	0	38.17	73	-34.83	32.21	0	32.21	60	-27.79

Table 8. Conducted Emissions - Voltage, AC Power, Phase Line (120 VAC, 60 Hz)

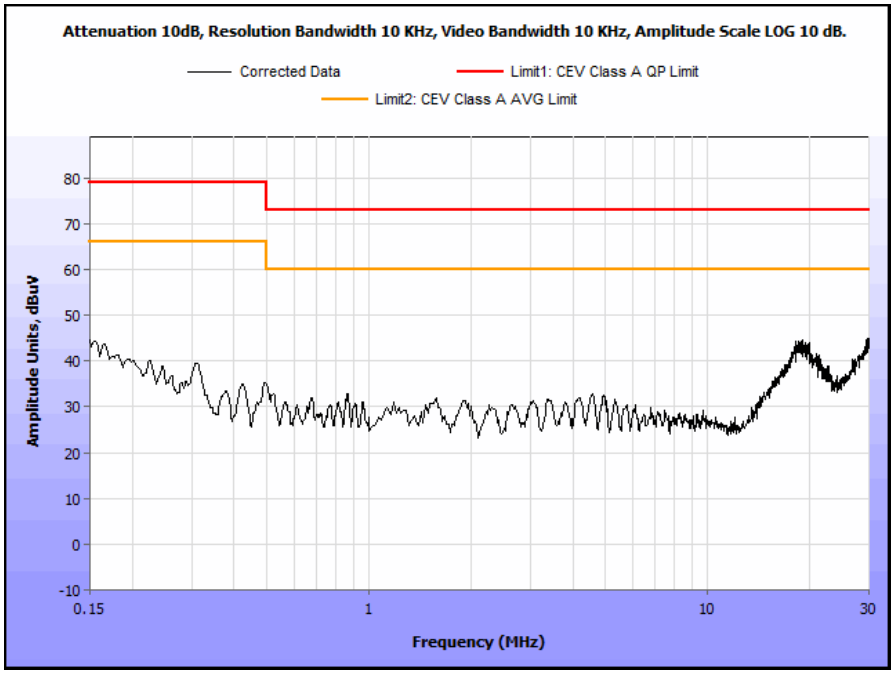


Plot 1. Conducted Emissions, Phase Line Plot

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

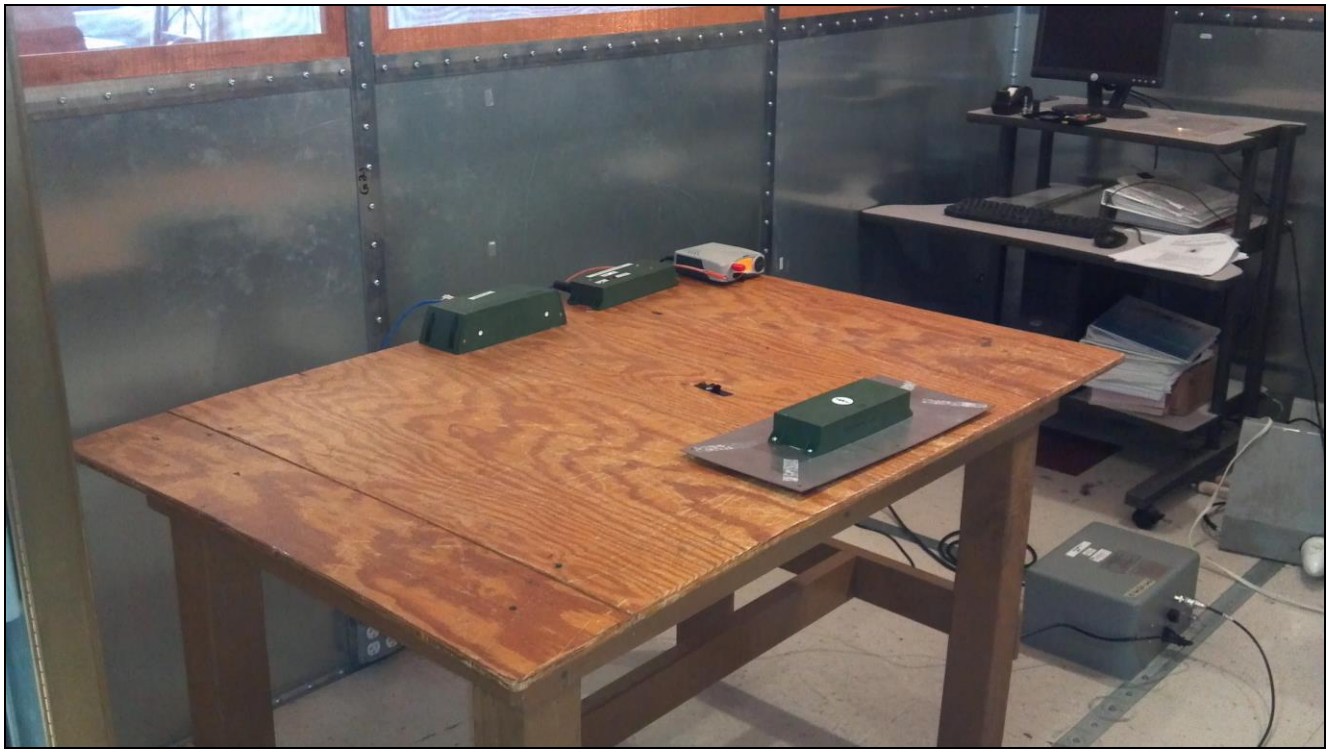
Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
0.3291	33.49	0	33.49	79	-45.51	27.28	0	27.28	66	-38.72
0.4216	22.71	0	22.71	79	-56.29	15.61	0	15.61	66	-50.39
1.349	28.41	0	28.41	73	-44.59	21.58	0	21.58	60	-38.42
3.613	28.39	0	28.39	73	-44.61	18.59	0	18.59	60	-41.41
14.941	35.28	0	35.28	73	-37.72	21.37	0	21.37	60	-38.63
22.875	40.03	0	40.03	73	-32.97	31.48	0	31.48	60	-28.52

Table 9. Conducted Emissions - Voltage, AC Power, Neutral Line (120 VAC, 60 Hz)



Plot 2. Conducted Emissions, Neutral Line Plot

Conducted Emissions Limits Test Setup



Photograph 1. Conducted Emissions, Test Setup

Radiated Emission Limits

§ 15.109 Radiated Emissions Limits

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 10.

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 10.

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 10. Radiated Emissions Limits calculated from FCC Part 15, §15.109 (a) (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 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 A requirement(s) of this section. Measured emissions were below applicable limits.

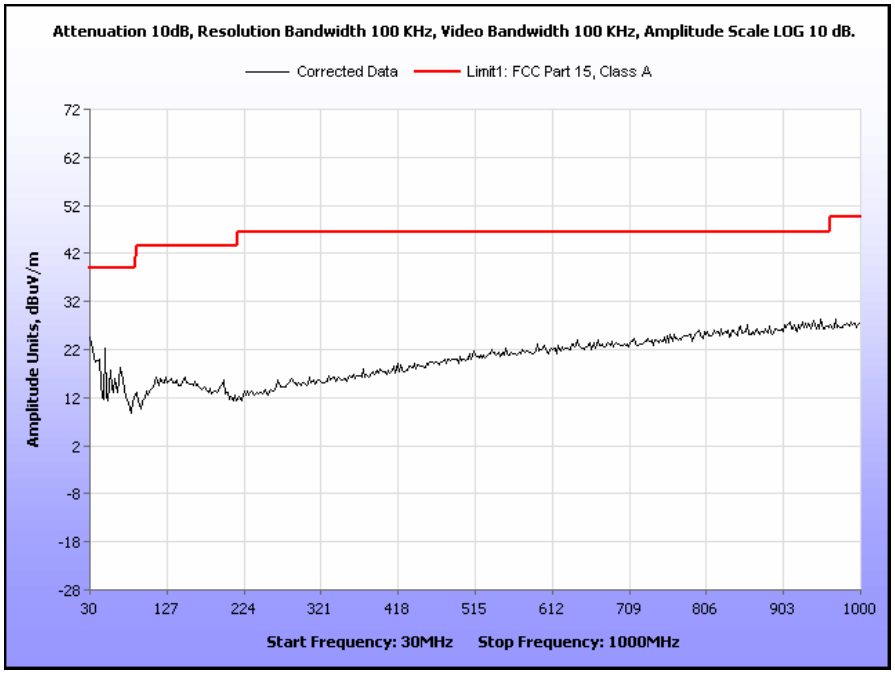
Test Engineer(s): Ben Taylor

Test Date(s): 04/01/13

Radiated Emissions Limits Test Results, Class A

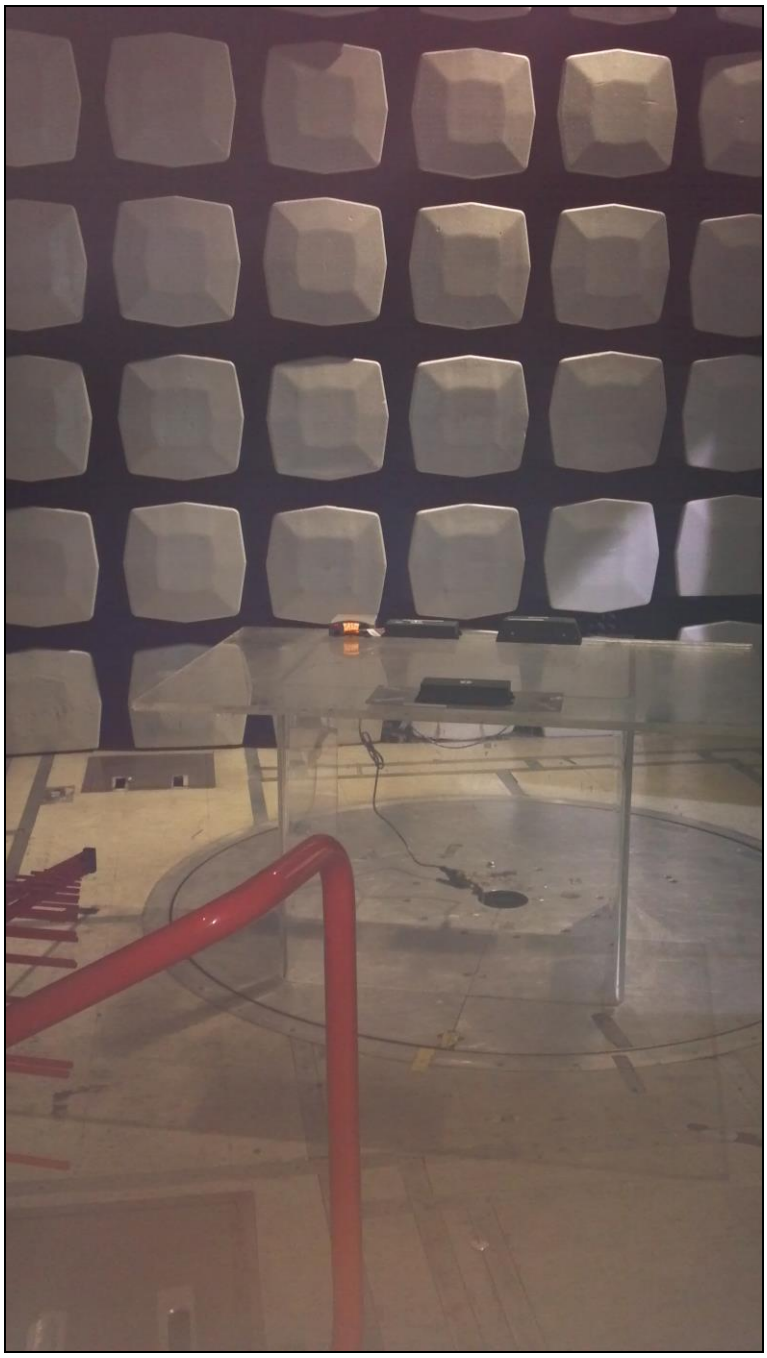
Frequency (MHz)	EUT Azimuth (Degrees)	Antenna Polarity (H/V)	Antenna HEIGHT (m)	Uncorrected Amplitude (dBuV)	Antenna Correction Factor (dB) (+)	Cable Loss (dB) (+)	Distance Correction Factor (dB) (-)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)
35.12	1	H	1.10	17.00	17.90	0.39	10.46	24.83	39.00	-14.17
35.12	5	V	1.30	19.00	17.90	0.39	10.46	26.83	39.00	-12.17
55	15	H	1.40	16.89	7.60	0.52	10.46	14.55	39.00	-24.45
55	10	V	1.02	17.49	7.60	0.52	10.46	15.15	39.00	-23.85
125.24	27	H	1.00	15.03	13.98	0.90	10.46	19.45	43.50	-24.05
125.24	2	V	1.50	16.21	13.98	0.90	10.46	20.63	43.50	-22.87
190.043	7	H	1.01	14.34	11.40	0.92	10.46	16.20	43.50	-27.30
190.043	11	V	1.09	15.69	11.40	0.92	10.46	17.55	43.50	-25.95
790	0	H	1.00	14.56	21.80	2.42	10.46	28.32	46.40	-18.08
790	0	V	1.10	15.23	21.80	2.42	10.46	28.99	46.40	-17.41
950	12	H	1.40	12.34	23.30	2.84	10.46	28.02	46.40	-18.38
950	12	V	1.50	13.23	23.30	2.84	10.46	28.91	46.40	-17.49

Table 11. Radiated Emissions Limits, Test Results, 30 MHz – 1 GHz, FCC Limits



Plot 3. Radiated Emissions, 30 MHz - 1 GHz, FCC Limits

Radiated Emission Limits Test Setup



Photograph 2. Radiated Emissions, Test Setup

IV. Electromagnetic Compatibility Criteria for Intentional Radiators

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.203 Antenna Requirement

Test Requirement: **§ 15.203:** An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

The structure and application of the EUT were analyzed to determine compliance with Section 15.203 of the Rules. Section 15.203 states that the subject device must meet at least one of the following criteria:

a.) Antenna must be permanently attached to the unit.

b.) Antenna must use a unique type of connector to attach to the EUT.

c.) Unit must be professionally installed. Installer shall be responsible for verifying that the correct antenna is employed with the unit.

Results: The EUT as tested is compliant the criteria of §15.203. The antenna is professional installed.

Test Engineer(s): Ben Taylor

Test Date(s): 04/10/13

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.207(a) Conducted Emissions Limits

Test Requirement(s): **§ 15.207 (a):** For an intentional radiator 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 30MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 Σ line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency range (MHz)	§ 15.207(a), Conducted Limit (dBμV)	
	Quasi-Peak	Average
* 0.15- 0.45	66 - 56	56 - 46
0.45 - 0.5	56	46
0.5 - 30	60	50

Table 12. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)

Test Procedure: The EUT was (placed on a non-metallic table, 80 cm above the horizontal ground plane and 40 cm from a vertical ground plane. 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. For the purpose of this testing, the transmitter was turned on. Scans and all measurements were performed with the transmitter on.

Test Results: The EUT was compliant with this requirement. Measured emissions were below applicable limits.

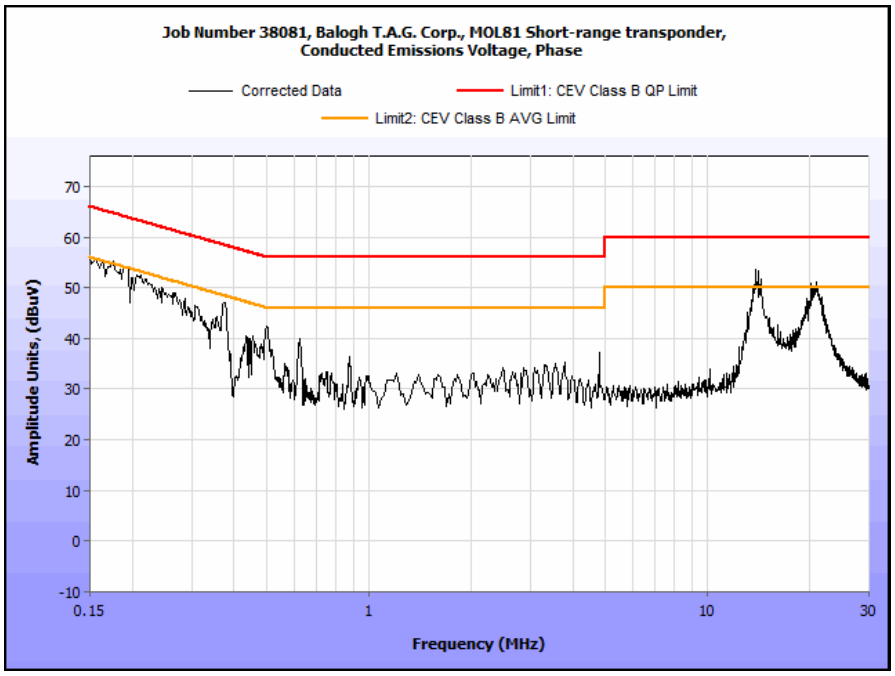
Test Engineer(s): Ben Taylor

Test Date(s): 04/10/13

15.207(a) Conducted Emissions Test Results

Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
0.1535	47.32	0	47.32	65.81	-18.49	30.05	0	30.05	55.81	-25.76
0.25	45.9	0	45.9	61.76	-15.86	35.55	0	35.55	51.76	-16.21
0.375	42.44	0	42.44	58.39	-15.95	30.53	0	30.53	48.39	-17.86
0.5125	35.95	0	35.95	56	-20.05	28.3	0	28.3	46	-17.7
0.625	33.1	0	33.1	56	-22.9	23.5	0	23.5	46	-22.5
4.165	31.1	0.03	31.13	56	-24.87	21.97	0.03	22	46	-24
14.07	48.44	0	48.44	60	-11.56	34	0	34	50	-16
21.01	46.01	0	46.01	60	-13.99	38.59	0	38.59	50	-11.41

Table 13. Conducted Emissions, 15.207(a), Phase Line, Test Results

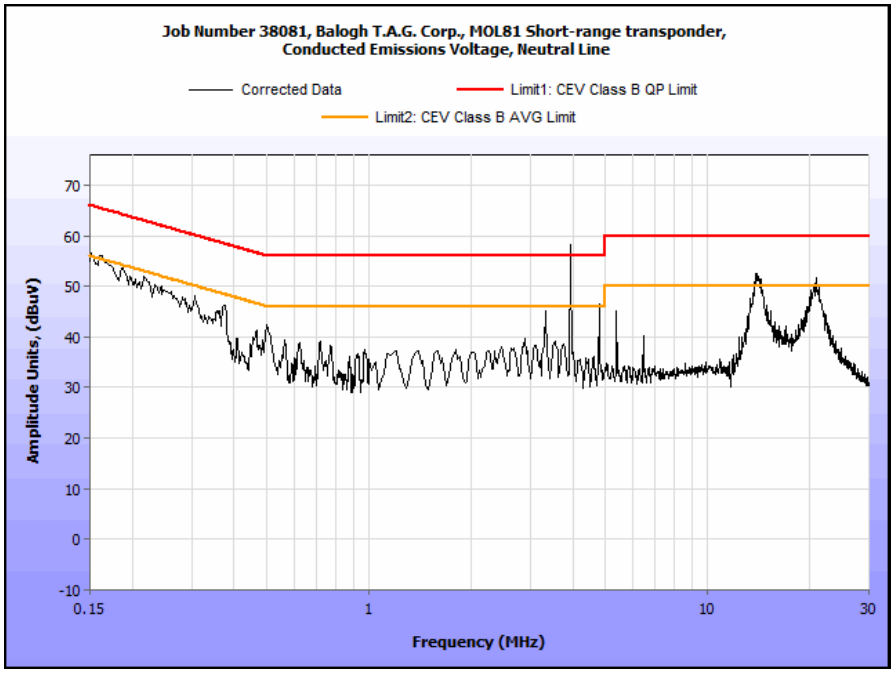


Plot 4. Conducted Emissions, 15.207(a), Phase Line

15.207(a) Conducted Emissions Test Results

Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
0.1524	47.51	0	47.51	65.87	-18.36	33.02	0	33.02	55.87	-22.85
0.3752	43.06	0	43.06	58.39	-15.33	31.89	0	31.89	48.39	-16.5
3.54	34.82	0	34.82	56	-21.18	25.55	0	25.55	46	-20.45
3.929	48.99	0.11	49.1	56	-6.9	29.09	0.11	29.2	46	-16.8
4.8	41.08	0.17	41.25	56	-14.75	24.7	0.17	24.87	46	-21.13
14.07	43.91	0	43.91	60	-16.09	29.99	0	29.99	50	-20.01
21.11	44.16	0	44.16	60	-15.84	36.27	0	36.27	50	-13.73

Table 14. Conducted Emissions, 15.207(a), Neutral Line, Test Results



Plot 5. Conducted Emissions, 15.207(a), Neutral Line

15.207(a) Conducted Emissions Test Setup Photo

Photograph 3. Conducted Emissions, 15.207(a), Test Setup

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.209 Radiated Spurious Emissions Requirements

Test Requirement(s): **§ 15.209 (a):** Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in Table 15.

Frequency (MHz)	§ 15.209(a),Radiated Emission Limits (dBµV) @ 3m
30 - 88	40.00
88 - 216	43.50
216 - 960	46.00
Above 960	54.00

Table 15. Radiated Emissions Limits Calculated from FCC Part 15, § 15.209 (a)

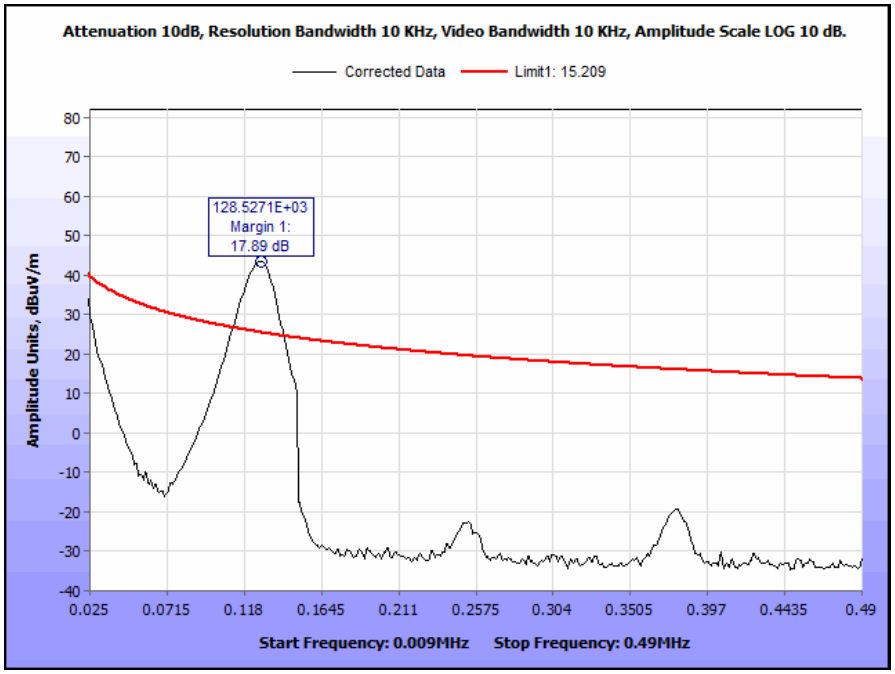
Test Procedures: The EUT was compliant with the Radiated Spurious Emission limits of **§ 15.209**. Initially, the fundamental frequency of 125 kHz appeared to exceed the 15.209 limits when measured at 3 meters in a semi-anechoic chamber (plot 6). The fundamental frequency of 125 kHz was re-measured at 10 meters on the OATS, to alleviate any potential near-field effects as well as obtain a more accurate Distance Correction Factor. Relative measurements were taken at 10 and 3 meters to calculate the specific Distance Correction Factor for the frequency in question. Based on the roll-off those calculations demonstrated, a DCF of 47log(d1/d2) was used at 125 kHz for the final measurement (plot 7), measured at 10 meters on the OATS.

Test Results: The EUT was compliant with the Radiated Spurious Emission limits of **§ 15.209**. The fundamental frequency of 125 kHz was re-measured at 10 meters on the OATS. Relative measurements were taken between 10 and 3 meters, and based on the roll-off those calculations proved, a DCF of 47log(d1/d2) was used at 125 kHz.

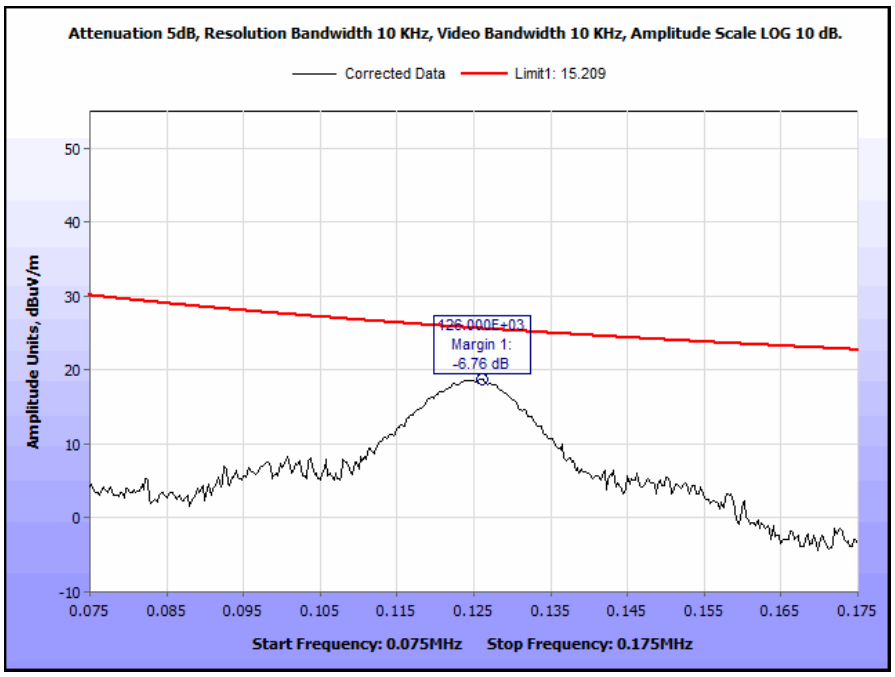
Test Engineer(s): Ben Taylor

Test Date(s): 04/10/13

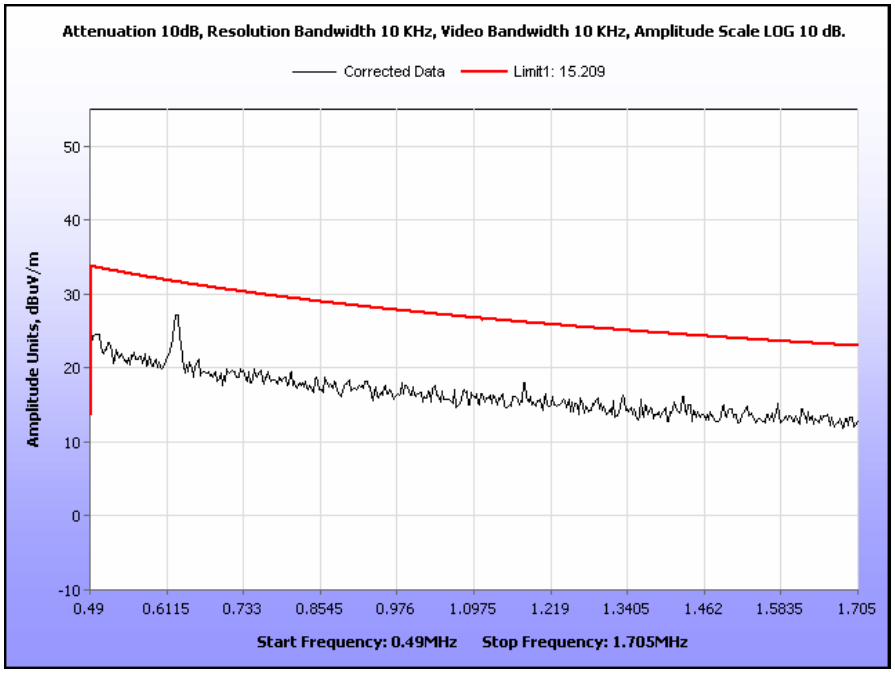
Radiated Spurious Emissions Test Results



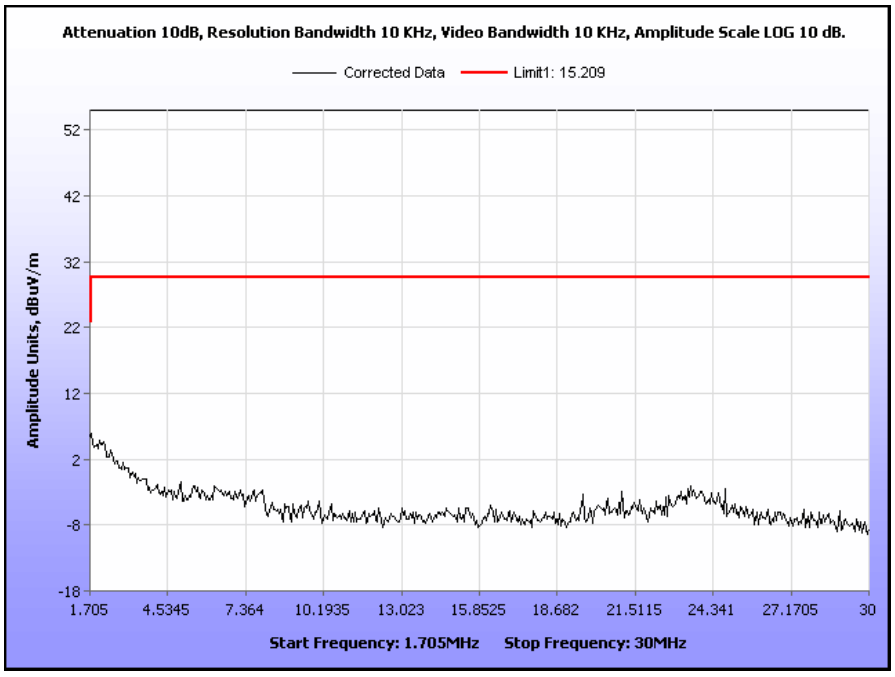
Plot 6. Radiated Spurious Emissions, 25 kHz – 490 kHz



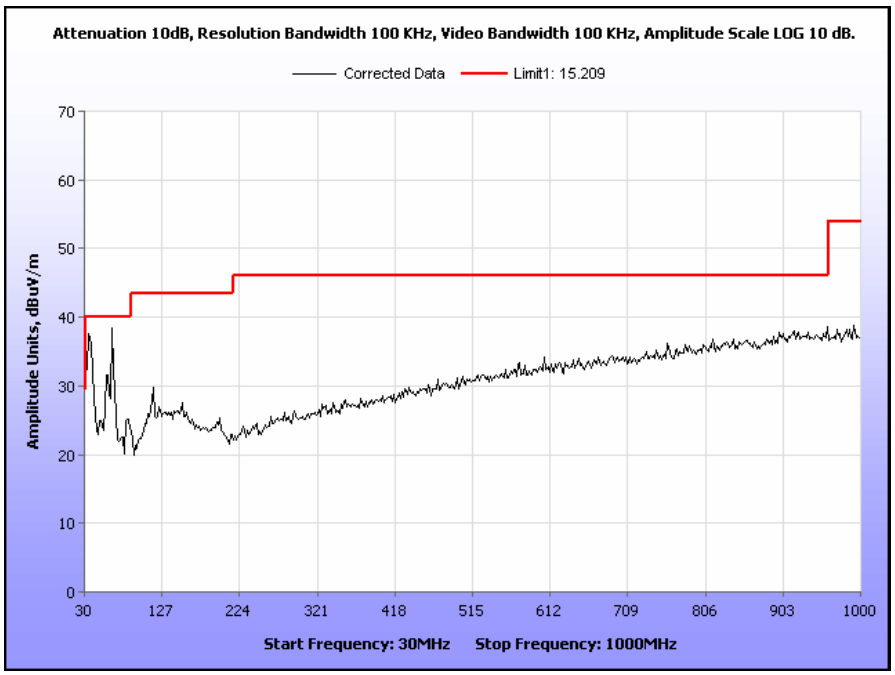
Plot 7. Radiated Spurious Emissions, 125 kHz



Plot 8. Radiated Spurious Emissions, 490 kHz – 1.705 MHz

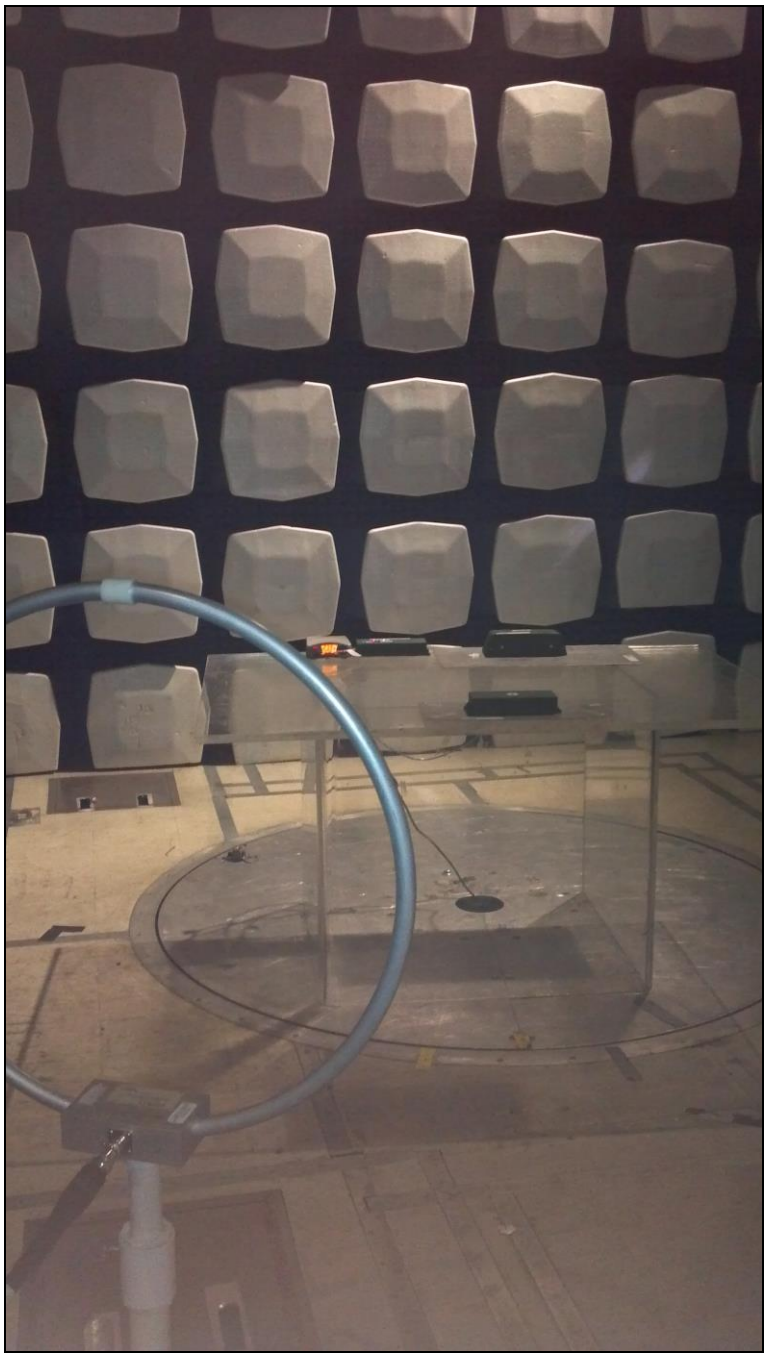


Plot 9. Radiated Spurious Emissions, 1.705 MHz – 30 MHz

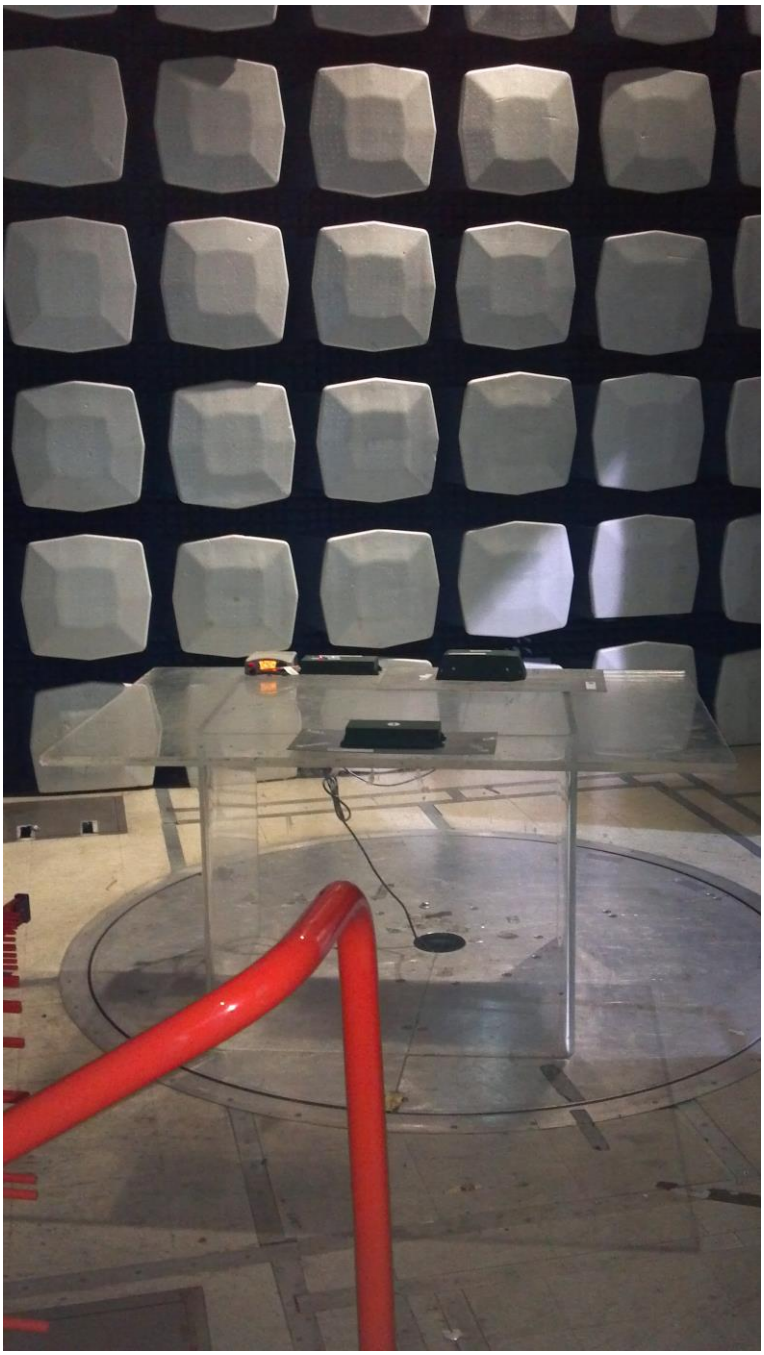


Plot 10. Radiated Spurious Emissions, 30 MHz – 1 GHz

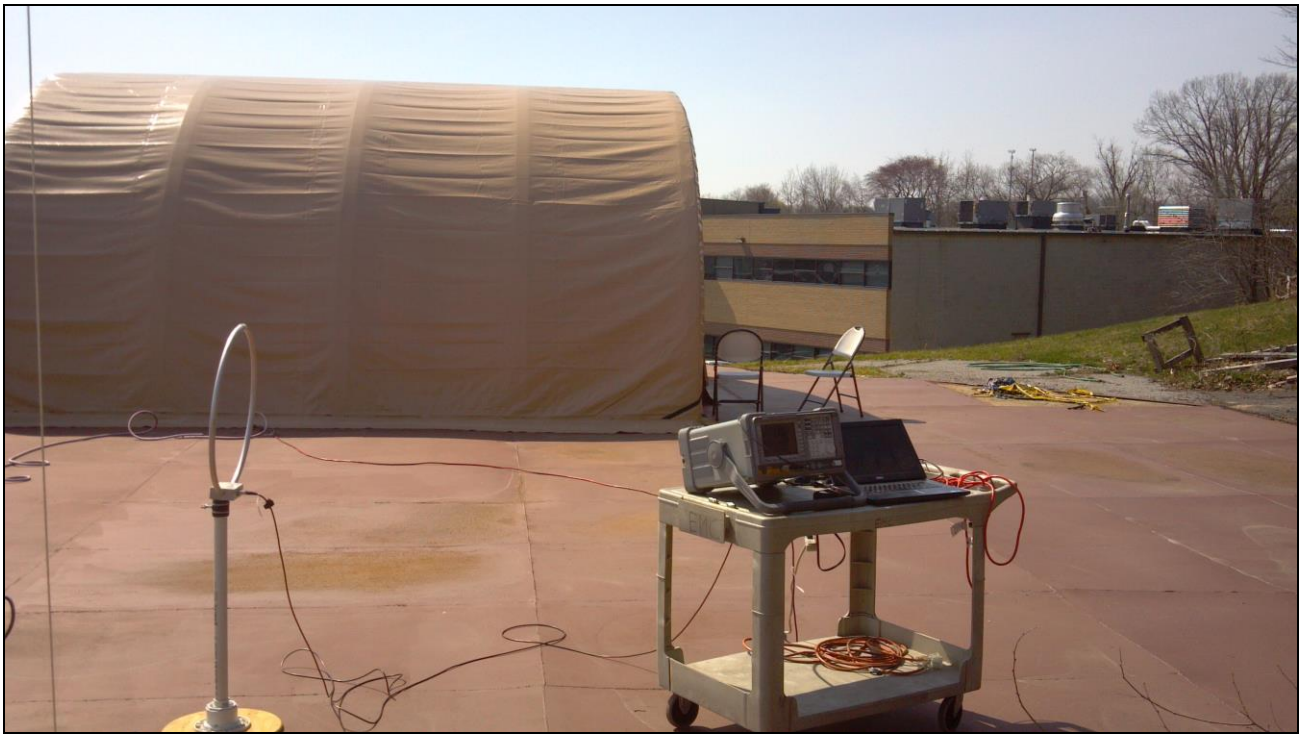
Radiated Spurious Emissions Test Setup



Photograph 4. Radiated Spurious Emissions, Test Setup, 9 kHz – 30 MHz



Photograph 5. Radiated Spurious Emissions, Test Setup, 30 MHz – 1 GHz



Photograph 6. Radiated Spurious Emissions, Test Setup, OATS

Photograph 7. Radiated Spurious Emissions, Test Setup, OATS

IV. Test Equipment

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
1T4771	PSA SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4446A	02/15/2013	08/15/2014
1T4502	COMB GENERATOR	COM-POWER	CGC-255	08/21/2012	02/21/2014
1T4563	LISN (10 AMP)	SOLAR ELECTRONICS	9322-50-R-10-BNC	11/27/2012	05/27/2014
1T4787	HYGROMETER/THERMOMETER/BAROMETER/DEW POINT PEN	CONTROL COMPANY	15-078-198, FB70423, 245CD	02/15/2012	02/15/2014
1T4269	ANTENNA; LOOP	EMCO	6511	11/13/2012	05/13/2014
1T4800	ANTENNA, LOOP	EMCO	6512	08/06/2012	02/06/2014
1T4300	SEMI-ANECHOIC CHAMBER # 1 (NSA)	EMC TEST SYSTEMS	NONE	07/24/2012	01/24/2014
1T4409	EMI RECEIVER	ROHDE & SCHWARZ	ESIB7	07/16/2012	07/16/2013
1T4751	ANTENNA - BILOG	SUNOL SCIENCES	JB6	01/08/2013	07/08/2014
1T4322	NSA - 10 METER OPEN AIR TEST SITE (OATS)	MET LABORATORIES	NONE	01/09/2013	07/09/2014
1T4612	SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4407B	05/23/2012	11/23/2013

Table 16. Test Equipment List

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

V. Certification & User's Manual Information

Certification & User's Manual Information

A. 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 proviso that such a determination of compliance be made and is the responsibility of the party responsible for verification of the equipment.

Certification & User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart J — 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.

§ 2.907 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.

Certification & User's Manual Information

§ 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.

Certification & User's Manual Information

1. 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 user's 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.

Verification & User's Manual Information

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 A 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 A 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 commercial 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. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at own expense.

(b) 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.

End of Report

