MET Laboratories, Inc. *Safety Certification - EMI - Telecom Environmental Simulation*
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September 9, 2016

Stanley Black & Decker
701 East Joppa Road
Towson, MD 21286

Dear Kirwan Magdamo,

Enclosed is the EMC Wireless test report for compliance testing of the Stanley Black & Decker, DeWalt Jobsite Radio/Charger, DCR025 as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-06 ed.), 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.

Beth Kalb
Documentation Department

Reference: (\Stanley Black & Decker\EMC90881-FCC247 Rev. 4)

Electromagnetic Compatibility Criteria
Test Report

for the

Stanley Black & Decker
DeWalt Jobsite Radio/Charger, DCR025

Tested under
the FCC Certification Rules
contained in
15.247 Subpart C for Intentional Radiators

MET Report: EMC90881-FCC247 Rev. 4

September 9, 2016

Prepared For:

Stanley Black & Decker
701 East Joppa Road
Towson, MD 21286

Prepared By:
MET Laboratories, Inc.
914 West Patapsco Avenue, Baltimore, MD 21230

Electromagnetic Compatibility Criteria
Test Report

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Stanley Black & Decker
DeWalt Jobsite Radio/Charger, DCR025

Tested under
the FCC Certification Rules
contained in
15.247 Subpart C for Intentional Radiators

Deepak Giri, Project Engineer
Electromagnetic Compatibility Lab

Beth Kalb
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 Part 15.247 under normal use and maintenance.

Asad Bajwa,
Director, Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	August 8, 2016	Initial Issue.
1	August 18, 2016	Various updates per engineer.
2	August 30, 2016	Various updates per engineer.
3	September 7, 2016	Engineer corrections.
4	September 9, 2016	Added Radiated band edge plots.

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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**ilovolt
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
MHz	**M**ega**h**ertz
µH	**micro**henry
µ	**micro**farad
µs	**micro**seconds
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 Stanley Black & Decker DeWalt Jobsite Radio/Charger, DCR025, with the requirements of Part 15, §15.247. 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 DeWalt Jobsite Radio/Charger, DCR025. Stanley Black & Decker should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the DeWalt Jobsite Radio/Charger, DCR025, 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, §15.247, in accordance with Stanley Black & Decker, purchase order number M818816C. All tests were conducted using measurement procedure ANSI C63.4-2014 and ANSI C63.10-2013.

FCC Reference 47 CFR Part 15.247:2005	Description	Compliance
Title 47 of the CFR, Part 15 §15.203	Antenna Requirement	Compliant
Title 47 of the CFR, Part 15 §15.207(a)	Conducted Emission Limits	Compliant
Title 47 of the CFR, Part 15 §15.247(a)(2)	6dB Occupied Bandwidth	Compliant
Title 47 of the CFR, Part 15 §15.247(b)	Peak Power Output	Compliant
Title 47 of the CFR, Part 15 §15.247(d); §15.209; §15.205	Radiated Spurious Emissions Requirements	Compliant
Title 47 of the CFR, Part 15 §15.247(d)	RF Conducted Spurious Emissions Requirements	Not Applicable
Title 47 of the CFR, Part 15 §15.247(d)	RF Conducted Band Edge	Compliant
Title 47 of the CFR, Part 15; §15.247(e)	Peak Power Spectral Density	Compliant
Title 47 of the CFR, Part 15 §15.247(i)	Maximum Permissible Exposure (MPE)	Compliant

Table 1. Executive Summary of EMC Part 15.247 ComplianceTesting

II. Equipment Configuration

A. Overview

MET Laboratories, Inc. was contracted by Stanley Black & Decker to perform testing on the DeWalt Jobsite Radio/Charger, DCR025, under Stanley Black & Decker's purchase order number M818816C.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Stanley Black & Decker, DeWalt Jobsite Radio/Charger, DCR025.

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

Model(s) Tested:	DeWalt Jobsite Radio/Charger, DCR025	
Model(s) Covered:	DeWalt Jobsite Radio/Charger, DCR025	
EUT Specifications:	Primary Power: 120VAC	
	FCC ID: YJ7DCR025	
	Type of Modulations:	OFDM
	Equipment Code:	DTS
	Peak RF Output Power:	4.36 dBm
	EUT Frequency Ranges:	2402 – 2480 MHz
Analysis:	The results obtained relate only to the item(s) tested.	
Environmental Test Conditions:	Temperature: 15-35° C	
	Relative Humidity: 30-60%	
	Barometric Pressure: 860-1060 mbar	
Evaluated by:	Deepak Giri	
Report Date(s):	September 9, 2016	

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
ANSI C63.4:2014	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 C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices
KDB 558074	Guidance For Performing Compliance Measurements On Digital Transmission Systems (DTS) Operating Under §15.247

Table 3. References

C. Test Site

All testing was performed at MET Laboratories, Inc., 914 West Patapsco Avenue, 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 Stanley Black & Decker DeWalt Jobsite Radio/Charger, DCR025, Equipment Under Test (EUT), is an AM/FM radio for use in the rugged conditions typical of work areas where our DeWalt power tools are used. The radio can be powered by either AC mains or by our proprietary Li-ion power tool batteries. While attached to the AC mains, the DCR025 will also charge the installed power tool battery. The DCR025 has a Bluetooth radio to allow the streaming of audio from a Bluetooth-equipped source to the radio. It is also equipped with a USB Type A connector that only provides USB-level power and an AUX input jack for an external audio source. There are two convenience AC outlets on the side of the DCR025 for AC pass through.

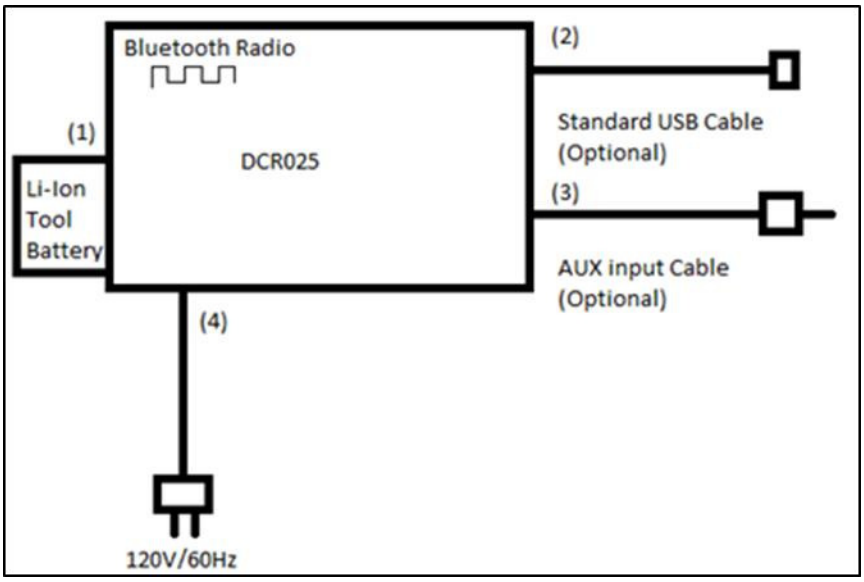


Figure 1. Block Diagram of Test Configuration

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	Part Number	Serial Number	Revision
N/A	Jobsite Radio/Charger	DCR025	N/A	N/A	N/A

Table 4. Equipment Configuration

F. Support Equipment

The EUT did not require any support equipment for operation or monitoring.

G. Ports and Cabling Information

Ref. ID	Port Name on EUT	Cable Description	Qty.	Length as tested (m)	Max Length (m)	Shielded (Y/N)	Termination Point
1	Battery Terminal	Direct connection for battery	1	N/A	N/A	N/A	Charger
2	USB Port	None sold with product	0	N/A	N/A	N/A	USB
3	AUX in Port	None sold with product	0	N/A	0.15m	No	AUX
4	AC In	AC power cord	1	1.8m	1.8m	No	AC In

Table 5. Ports and Cabling Information

H. Mode of Operation

For worse-case EMC operation, the DCR025 will be powered by connection to AC and a fully discharged power tool battery will be inserted into the charging port. The Bluetooth radio will be active as the audio source. The BT communication will need to be handled with a test configuration so that the frequency hopping aspects of BT can be controlled for test purposes. The BT radio can be operated in specific, set frequencies for purposes of EMC measurement. The USB port can also be resistively loaded in order to activate that output.

I. Method of Monitoring EUT Operation

The unintentional radiator portion of the circuit can be monitored with the status LED of the charger. This LED blinks while the battery is charging and remains steadily lit when the battery has completed charging and the charging circuitry goes inactive. The intentional radiator portion of the circuitry can be monitored either by streaming audio through the radio or with a provided test mode to fix the Bluetooth radio at frequencies throughout the BT spectrum.

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 Stanley Black & Decker upon completion of testing.

III. 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 EUT employs an integral antenna.

Test Engineer(s): Deepak Giri

Test Date(s): July 12, 2016

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

Test Procedure: The EUT was placed on a 0.8 m-high wooden table inside a screen room. The EUT was situated such that the back of the EUT was 0.4 m from one wall of the vertical ground plane, and the remaining sides of the EUT were no closer than 0.8 m from any other conductive surface. The EUT was powered from a 50 Ω/50 μH Line Impedance Stabilization Network (LISN). The EMC receiver scanned the frequency range from 150 kHz to 30 MHz. Conducted Emissions measurements were made in accordance with *ANSI C63.4-2014 "Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40 GHz"*. The measurements were performed over the frequency range of 0.15 MHz to 30 MHz using a 50 Ω/50 μH LISN as the input transducer to an EMC/field intensity meter. For the purpose of this testing, the transmitter was turned on. Scans were performed with the transmitter on.

Test Results: The EUT was compliant with this requirement. No anomalies detected.

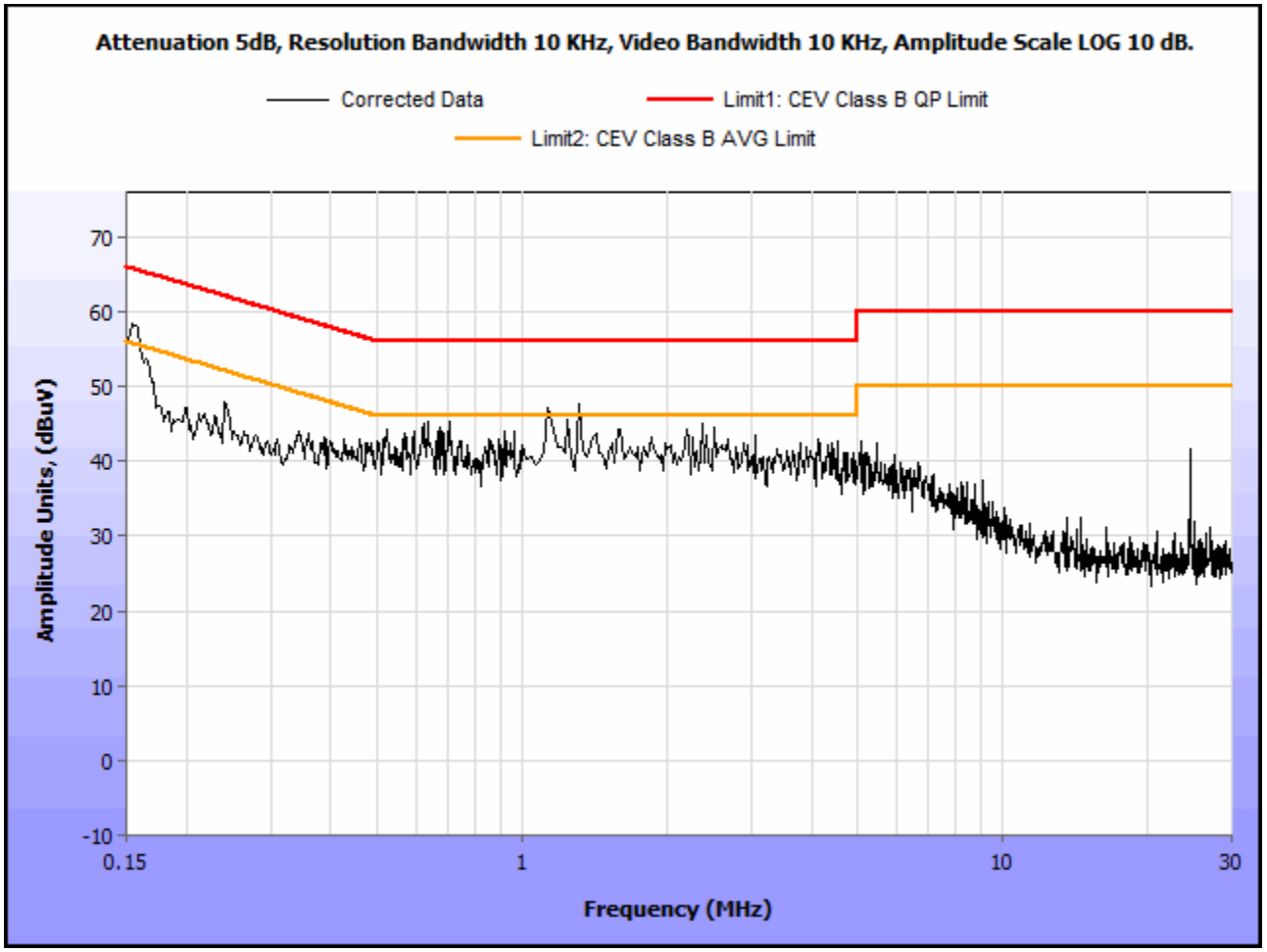
Test Engineer(s): Deepak Giri

Test Date(s): July 18, 2016

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
0.15	49.6	0	49.6	66	-16.4	27.15	0	27.15	56	-28.85
0.23	38.3	0	38.3	62.45	-24.15	22.26	0	22.26	52.45	-30.19
0.677	39.68	0	39.68	56	-16.32	36.18	0	36.18	46	-9.82
1.097	33.05	0	33.05	56	-22.95	21.52	0	21.52	46	-24.48
9	24.15	0.06	24.21	60	-35.79	14.16	0.06	14.22	50	-35.78
24.58	40.14	0.22	40.36	60	-19.64	39.73	0.22	39.95	50	-10.05

Table 7. Conducted Emissions, 15.207(a), Phase Line, Test Results

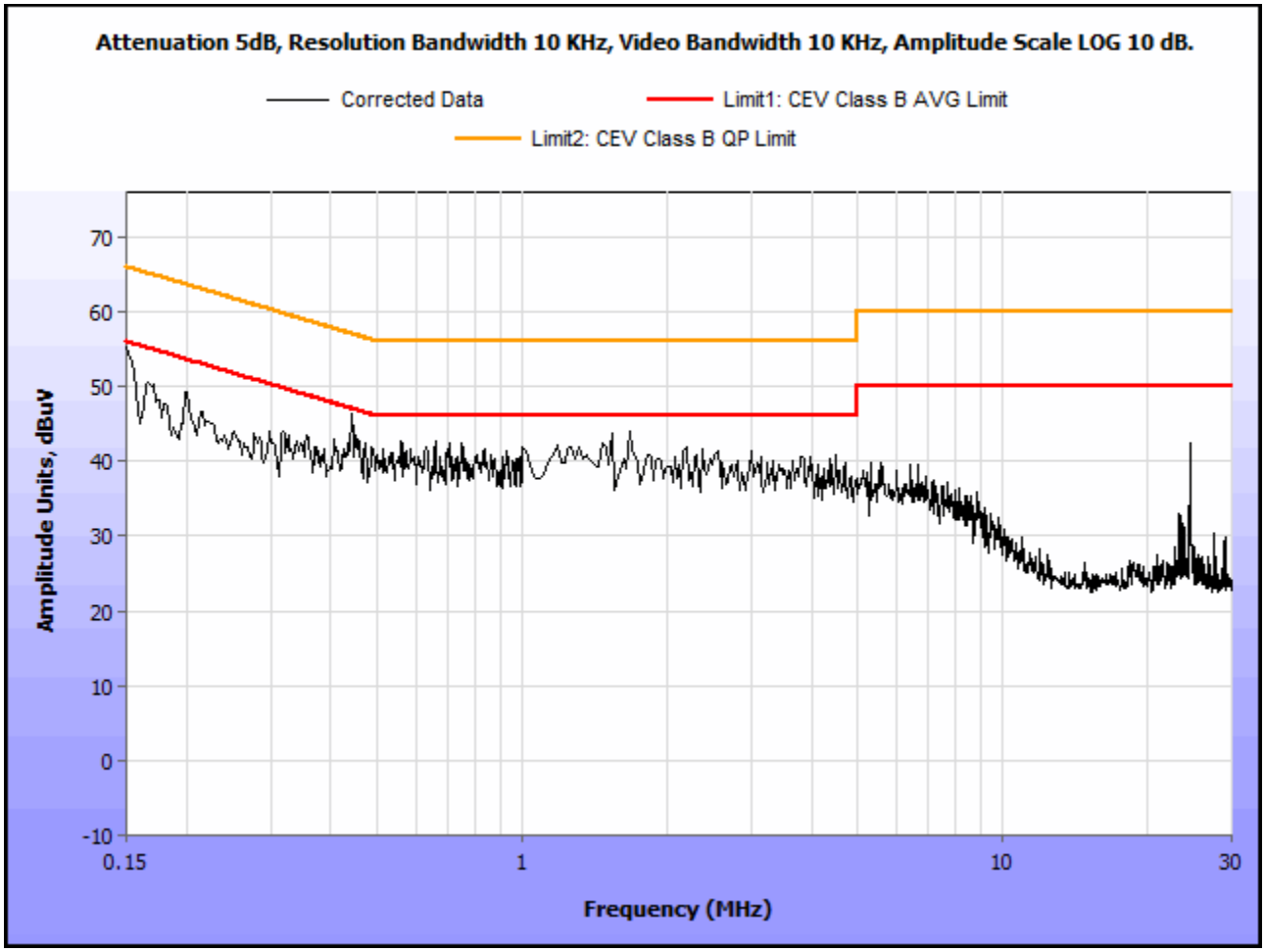


Plot 1. Conducted Emissions, 15.207(a), Phase Line

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
0.162	46.11	0	46.11	65.36	-19.25	24.15	0	24.15	55.36	-31.21
0.477	34.15	0	34.15	56.39	-22.24	20.86	0	20.86	46.39	-25.53
1.327	33.86	0	33.86	56	-22.14	20.71	0	20.71	46	-25.29
1.675	34.33	0	34.33	56	-21.67	19.46	0	19.46	46	-26.54
6.095	29.89	0	29.89	60	-30.11	17.26	0	17.26	50	-32.74
24.58	41.57	0.22	41.79	60	-18.21	41.34	0.22	41.56	50	-8.44

Table 8. Conducted Emissions, 15.207(a), Neutral Line, Test Results



Plot 2. Conducted Emissions, 15.207(a), Neutral Line

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(a)(2) 6 dB Bandwidth

Test Requirements: **§ 15.247(a)(2):** Operation under the provisions of this section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

For systems using digital modulation techniques, the EUT may operate in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands. The minimum 6dB bandwidth shall be at least 500 kHz.

Test Procedure: The transmitter was on and transmitting at the highest output power. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using a RBW approximately 1% of the total emission bandwidth, VBW > RBW. The 6 dB Bandwidth was measured and recorded. The measurements were performed on the low, mid and high channels.

Test Results The EUT was compliant with § 15.247 (a)(2). No anomalies detected.

The 6 dB Bandwidth was determined from the plots on the following pages.

Test Engineer(s): Deepak Giri

Test Date(s): July 12, 2016

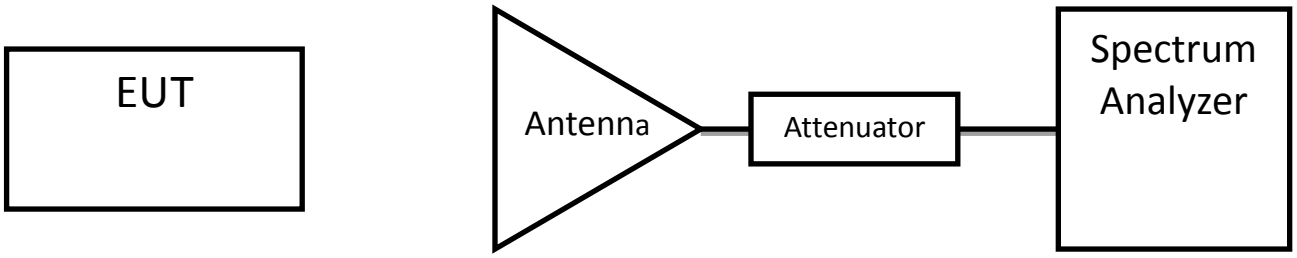


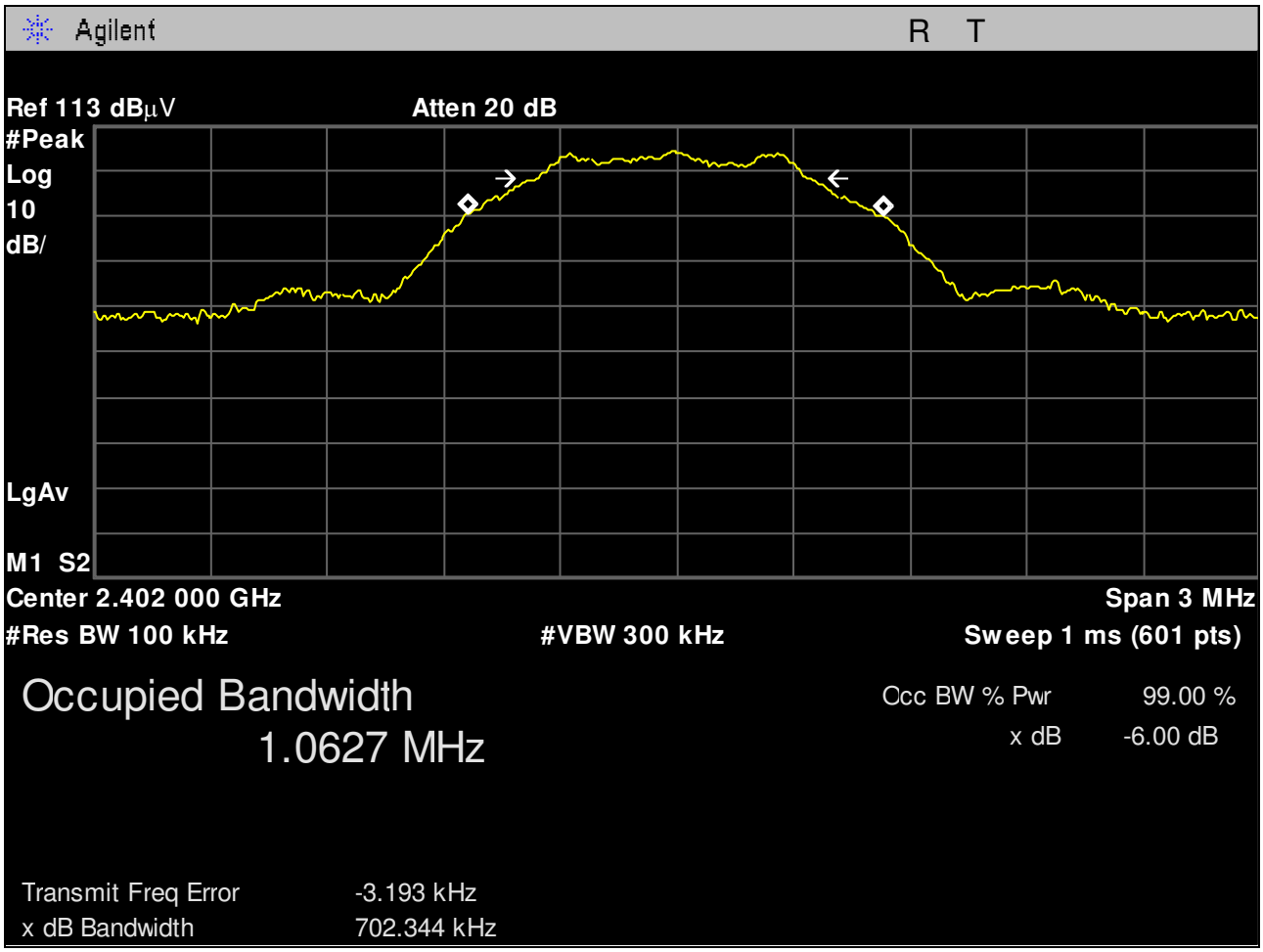
Figure 2. Block Diagram, Occupied Bandwidth Test Setup

Occupied Bandwidth Test Results

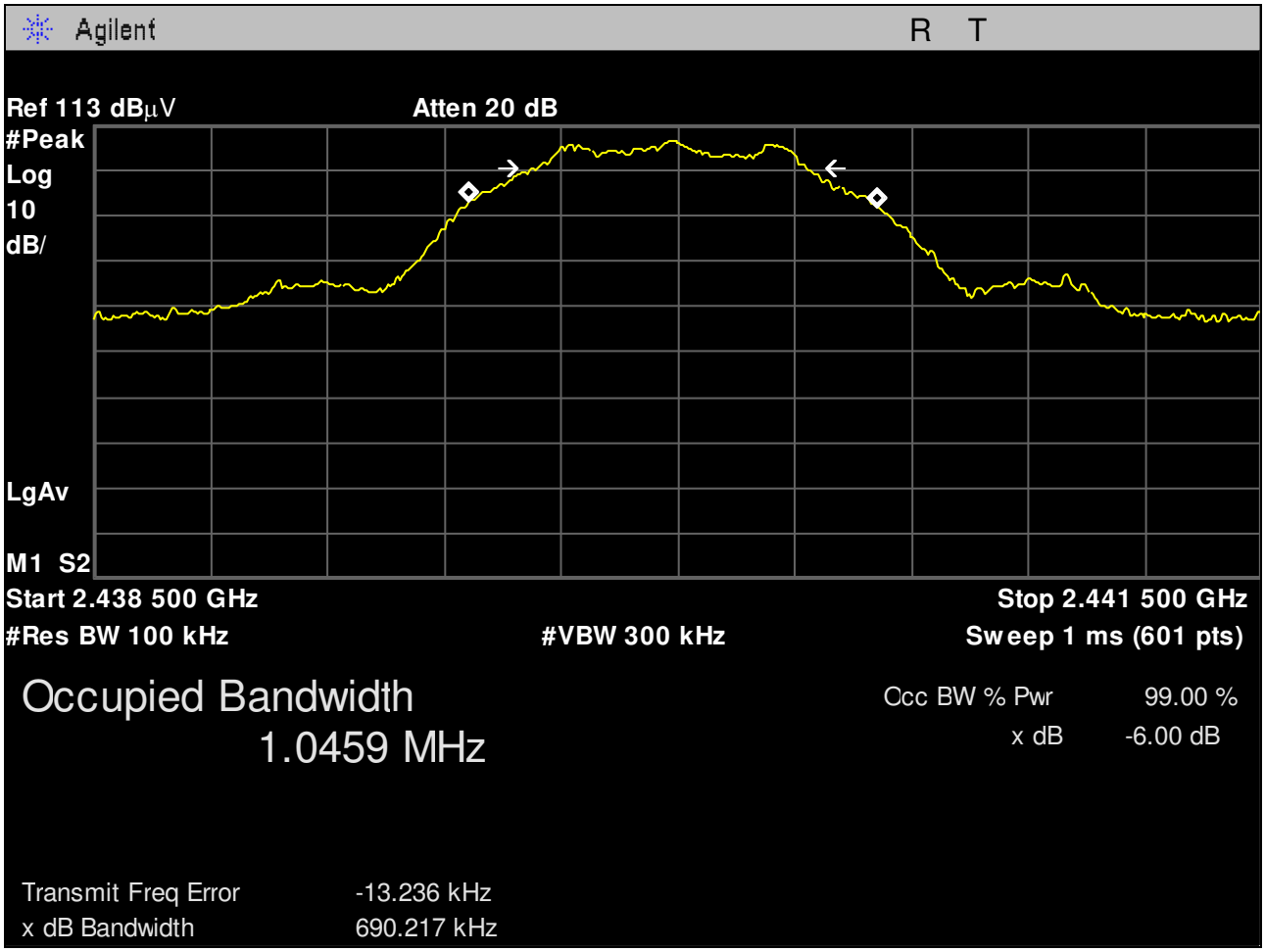
Occupied Bandwidth		
Carrier Channel	**Frequency (MHz)**	**Measured 6 dB Bandwidth (kHz)**
Low	2402	1062
Mid	2438	1045.9
High	2480	1039.7

Table 9. 6 dB Occupied Bandwidth, Test Results

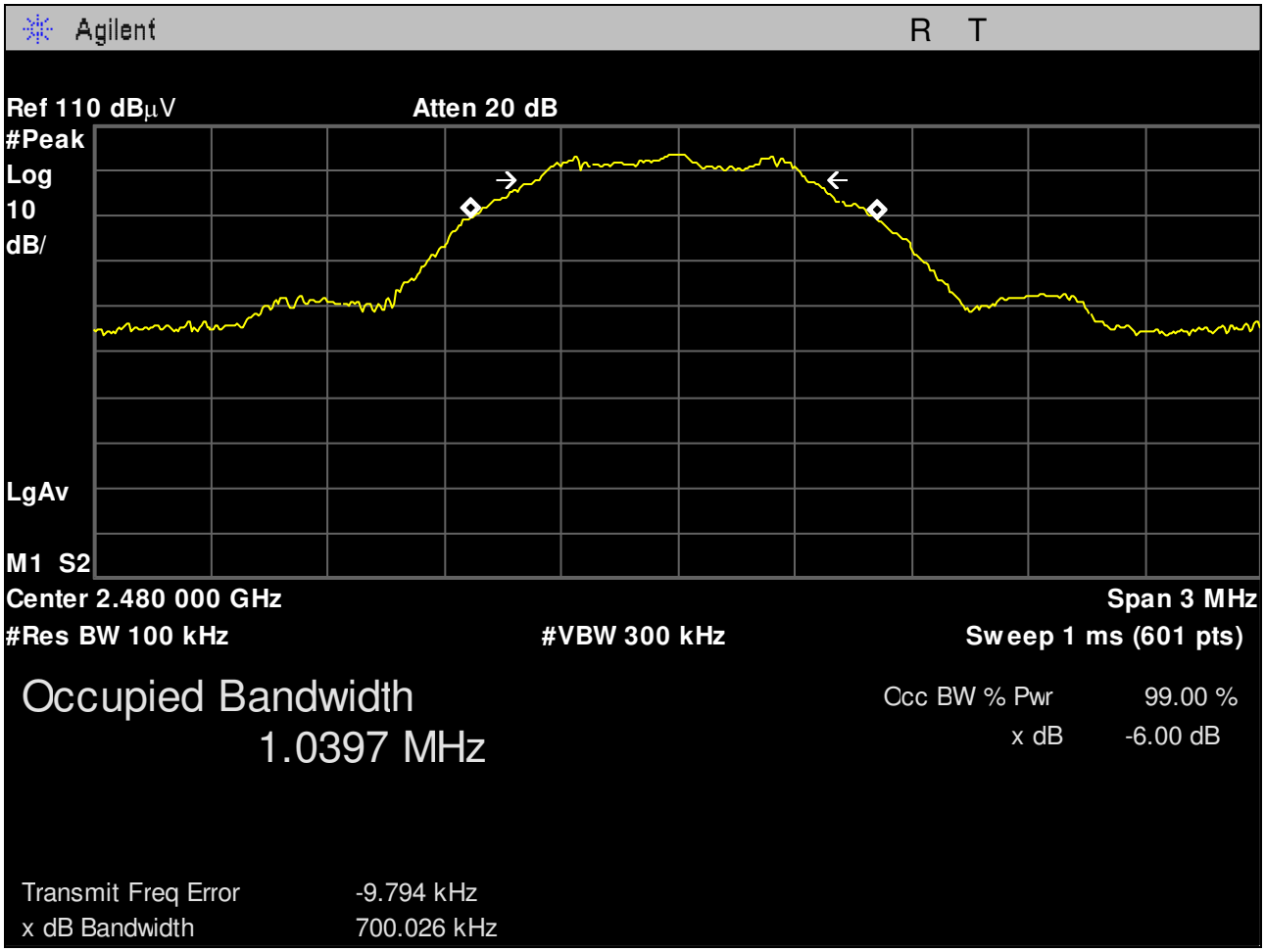
6 dB Occupied Bandwidth Test Results



Plot 3. 6 dB Occupied Bandwidth, Low Channel



Plot 4. 6 dB Occupied Bandwidth, Mid Channel



Plot 5. 6 dB Occupied Bandwidth, High Channel

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(b) Peak Power Output

Test Requirements: **§15.247(b):** The maximum peak output power of the intentional radiator shall not exceed the following:

Digital Transmission Systems (MHz)	Output Limit (Watts)
902-928	1.000
2400–2483.5	1.000
5725– 5850	1.000

Table 10. Output Power Requirements from §15.247(b)

§15.247(c): if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in the Table 10, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 2400 – 2483.5 MHz band and using a point to point application may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 5725 – 5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power.

Fixed, point-to-point operation excludes the use of point-to-multipoint systems, Omni-directional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.

Test Procedure: The transmitter was placed at 1m distance away from the horn antenna which was calibrated. The horn antenna was connected to the calibrated spectrum analyzer with attenuator. The EUT was measured at the low, mid and high channels of each band at the maximum power level.

Test Results: The EUT was compliant with the Peak Power Output limits of **§15.247(b)**. No anomalies detected.

Test Engineer(s): Deepak Giri

Test Date(s): July 13, 2016

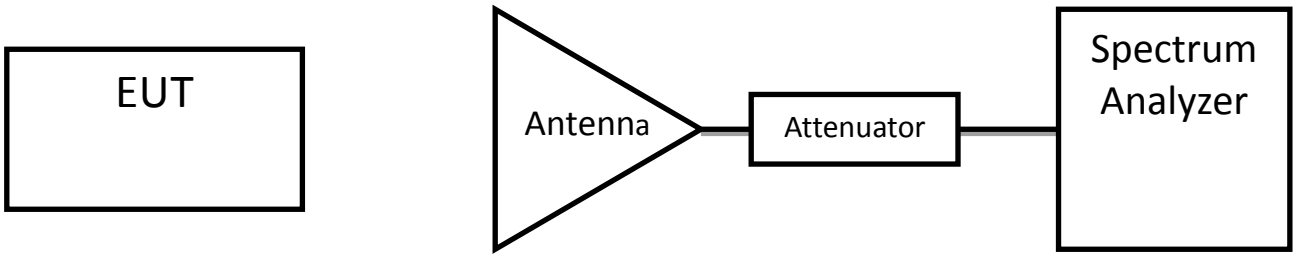


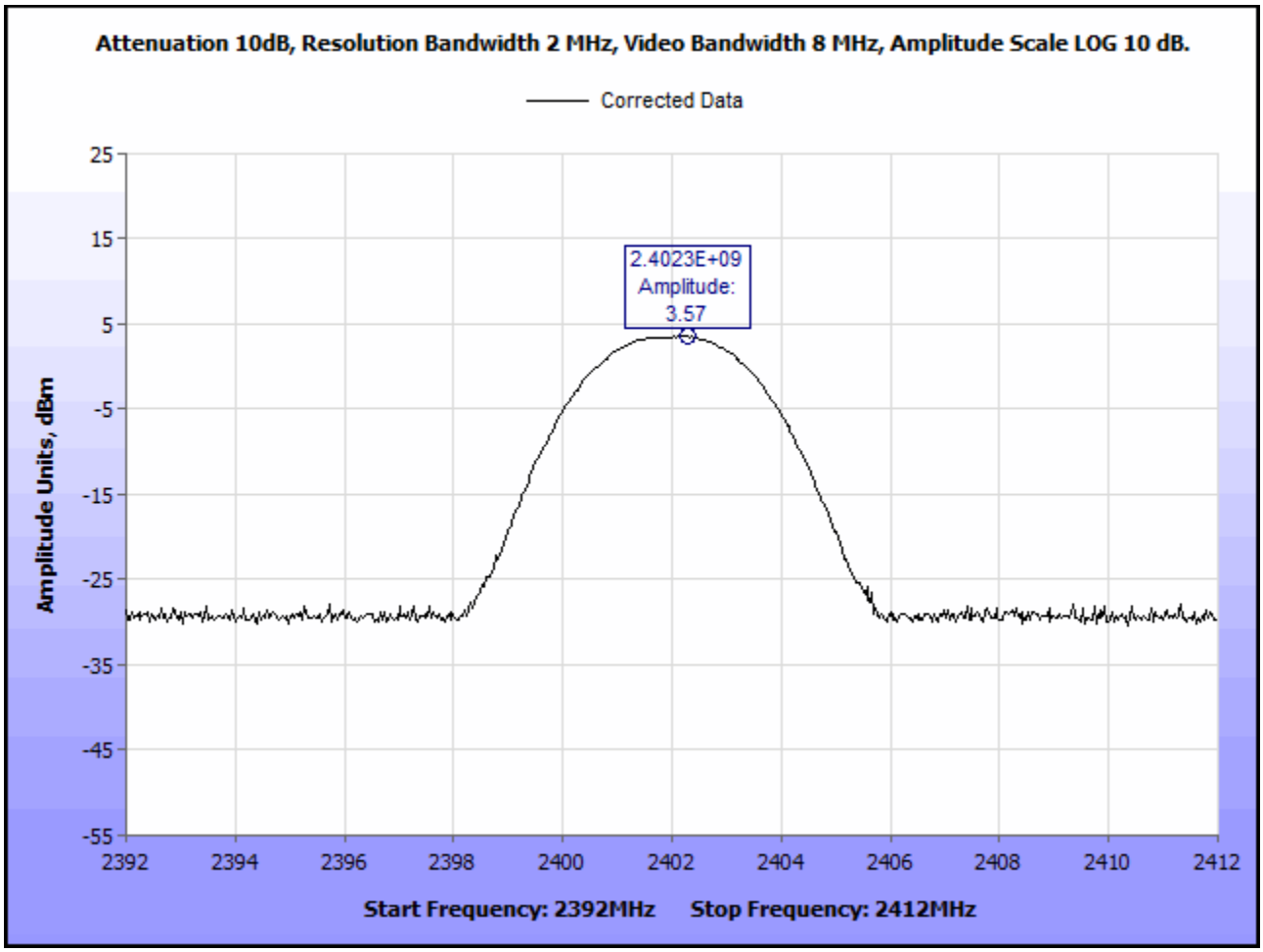
Figure 3. Peak Power Output Test Setup

Peak Power Output Test Results

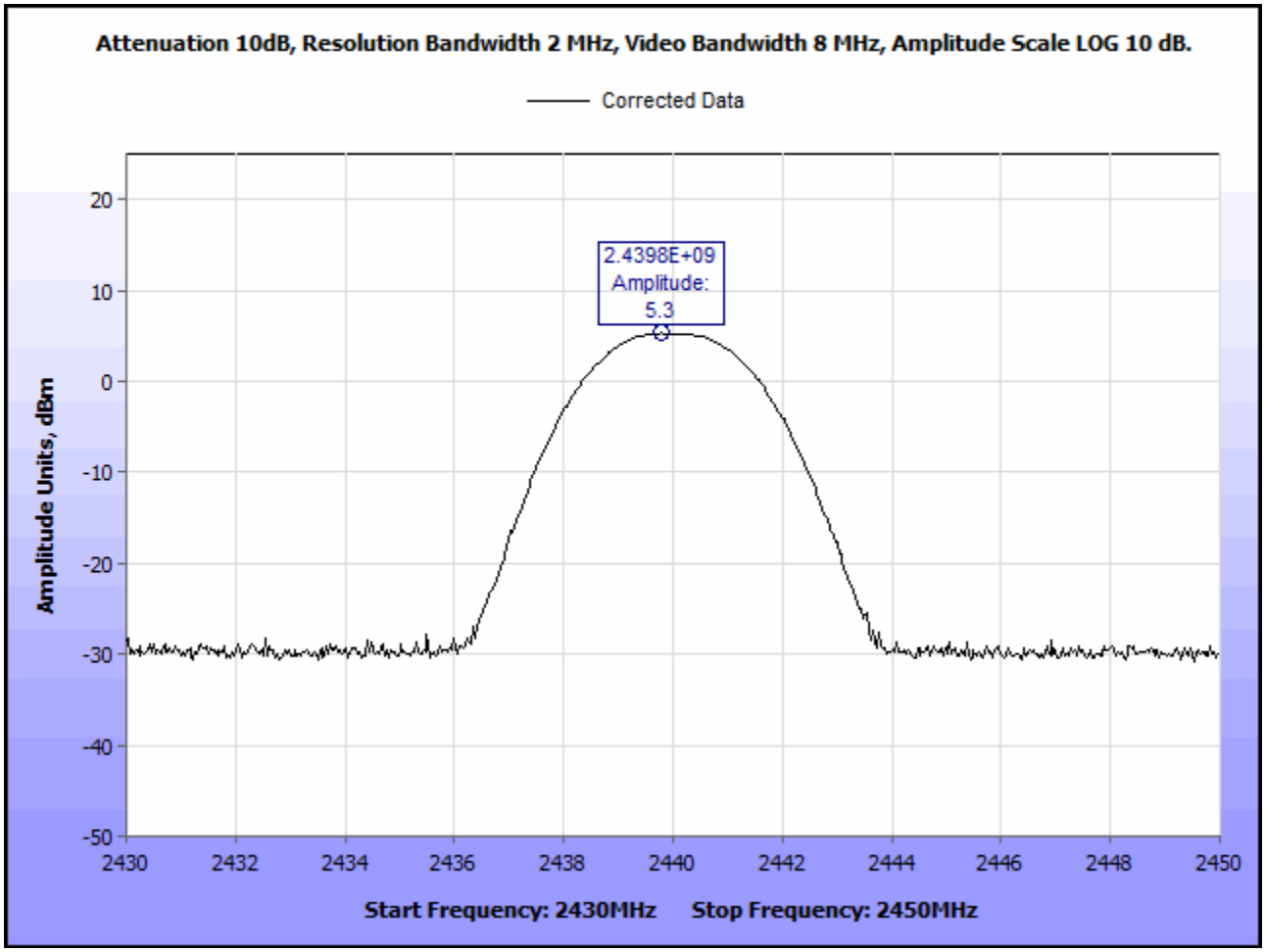
FCC-15.247 Conducted Power						
Frequency MHz	EIRP dBm	Antenna Gain dBi	Conducted Power dBm	Limit dBm	Margin dBm	Result
2402	3.57	1.00	2.57	30.00	26.43	Pass
2440	5.30	1.00	4.30	30.00	24.70	Pass
2480	5.36	1.00	4.36	30.00	24.64	Pass

Table 11. Peak Power Output, Test Results

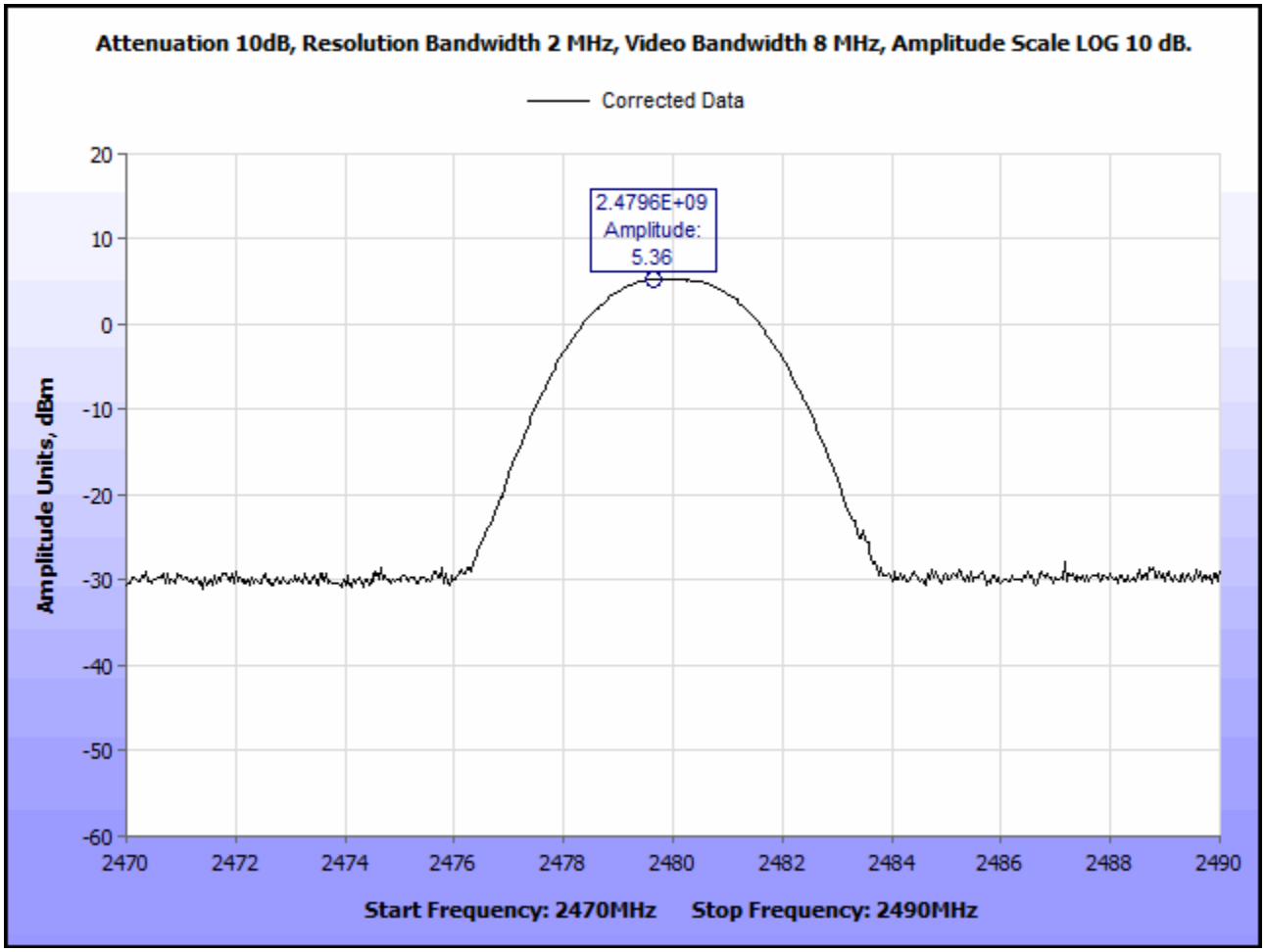
Peak Power Output Test Results



Plot 6. Peak Power Output, Low Channel



Plot 7. Peak Power Output, Mid Channel



Plot 8. Peak Power Output, High Channel

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(d) Radiated Spurious Emissions Requirements and Band Edge

Test Requirements: **§15.247(d); §15.205:** Emissions outside the frequency band.

§15.247(d): In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a).

§15.205(a): Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090–0.110----------	16.42–16.423	399.9–410	4.5–5.15
[1] 0.495–0.505----------	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905----------	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128----------	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775----------	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775----------	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218----------	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825----------	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225----------	123–138	2200–2300	14.47–14.5
8.291–8.294----------	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366----------	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675----------	156.7–156.9	2655–2900	22.01–23.12
8.41425–8.41475----------	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293----------	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025----------	240–285	3345.8–3358 36.	43–36.5
12.57675–12.57725----------	322–335.4	3600–4400	([2])

Table 12. Restricted Bands of Operation

[1] Until February 1, 1999, this restricted band shall be 0.490 – 0.510 MHz.
[2] Above 38.6

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 13.

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

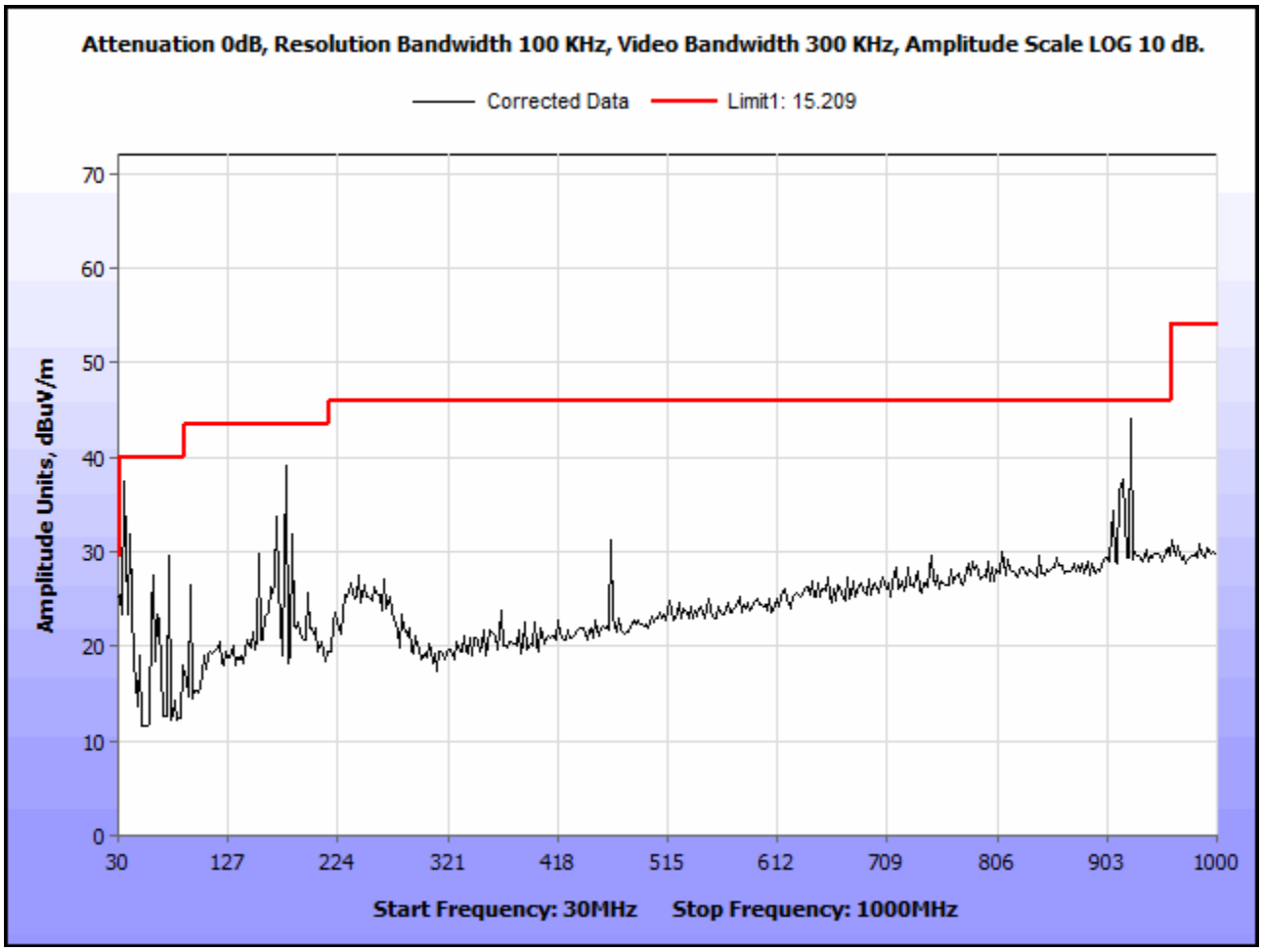
Test Procedures: The transmitter was turned on. Measurements were performed of the low, mid and high Channels. The EUT was rotated orthogonally through all three axes. Plots shown are corrected for both antenna correction factor and distance and compared to a 3 m limit line. Only noise floor was measured above 18 GHz.

Test Results: The EUT was compliant with the Radiated Spurious Emission limits of **§ 15.247(d)**. No anomalies detected.

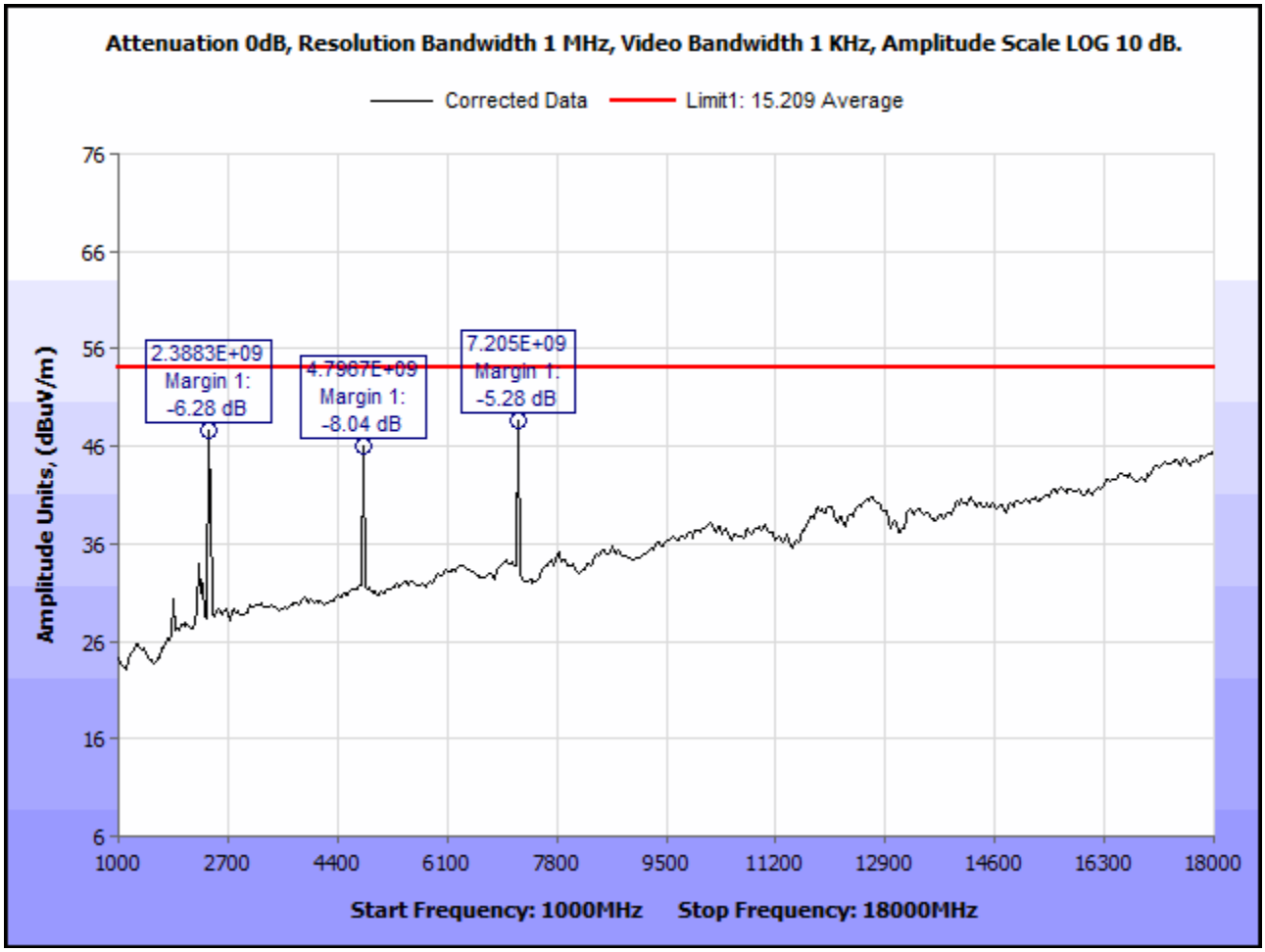
Test Engineer(s): Deepak Giri

Test Date(s): July 18, 2016

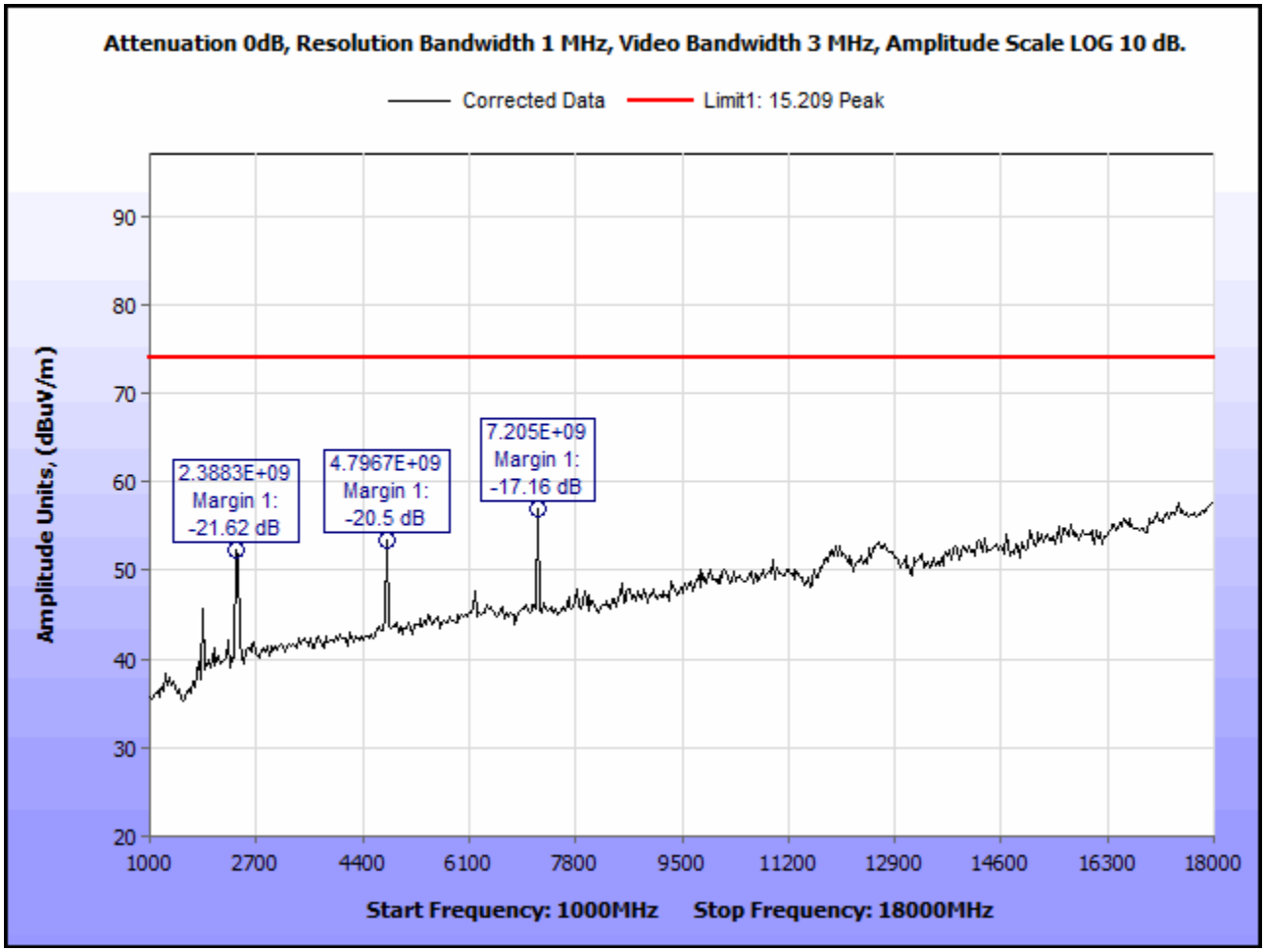
Radiated Spurious Emissions Test Results



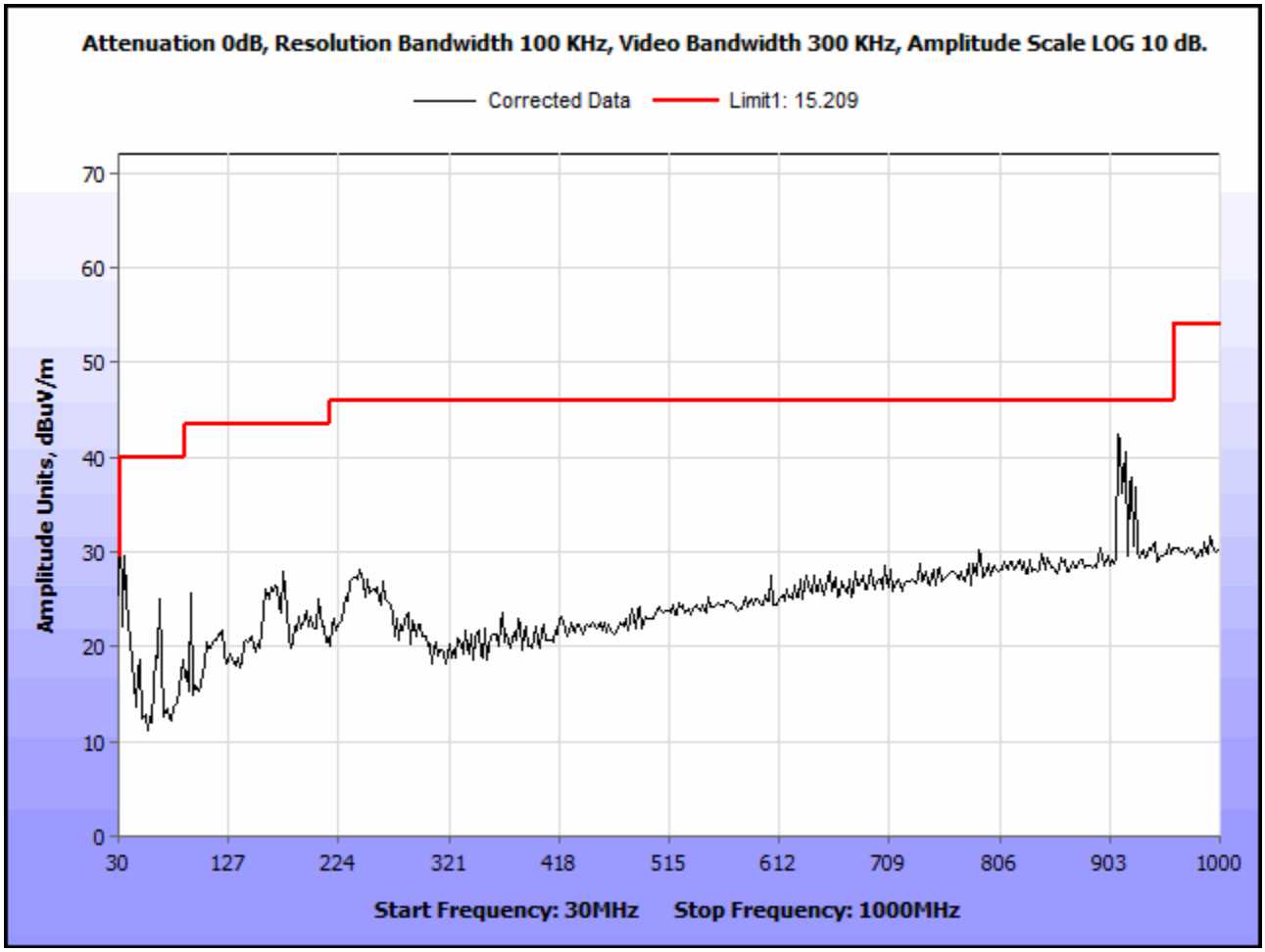
Plot 9. Radiated Spurious Emissions, Low Channel, 30 MHz – 1 GHz



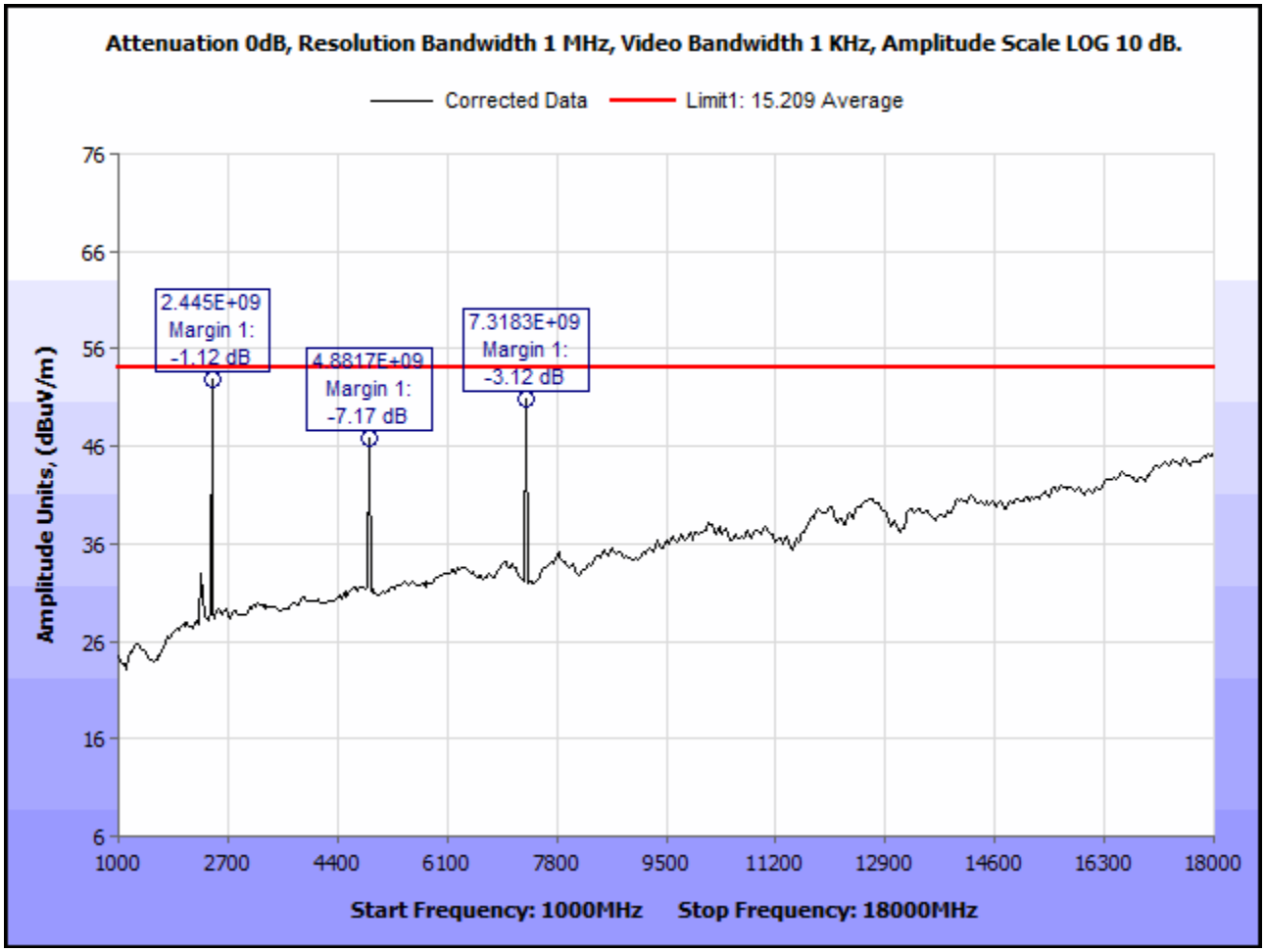
Plot 10. Radiated Spurious Emissions, Low Channel, 1 GHz – 18 GHz (AVG)



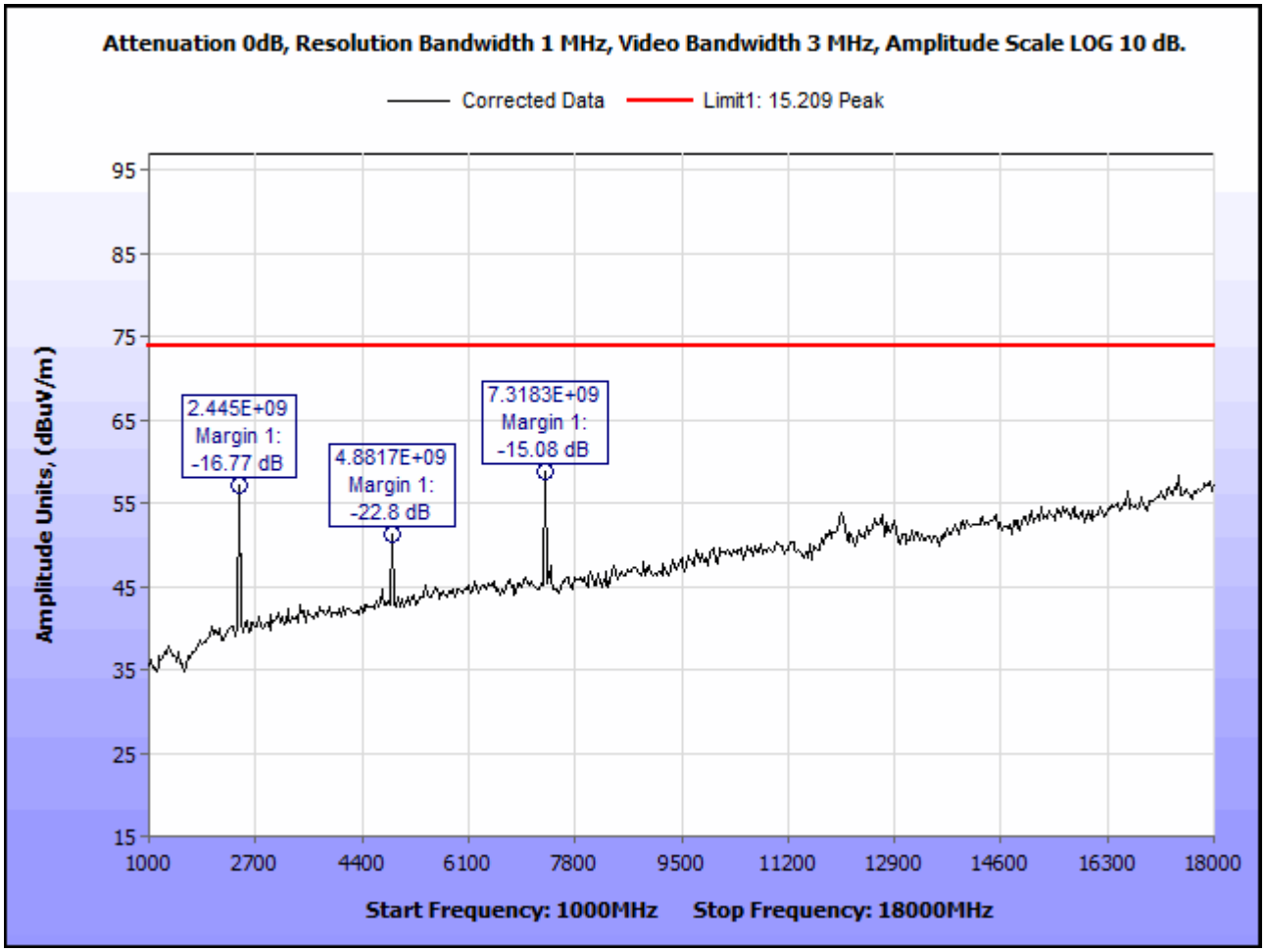
Plot 11. Radiated Spurious Emissions, Low Channel, 1 GHz – 18 GHz (Peak)



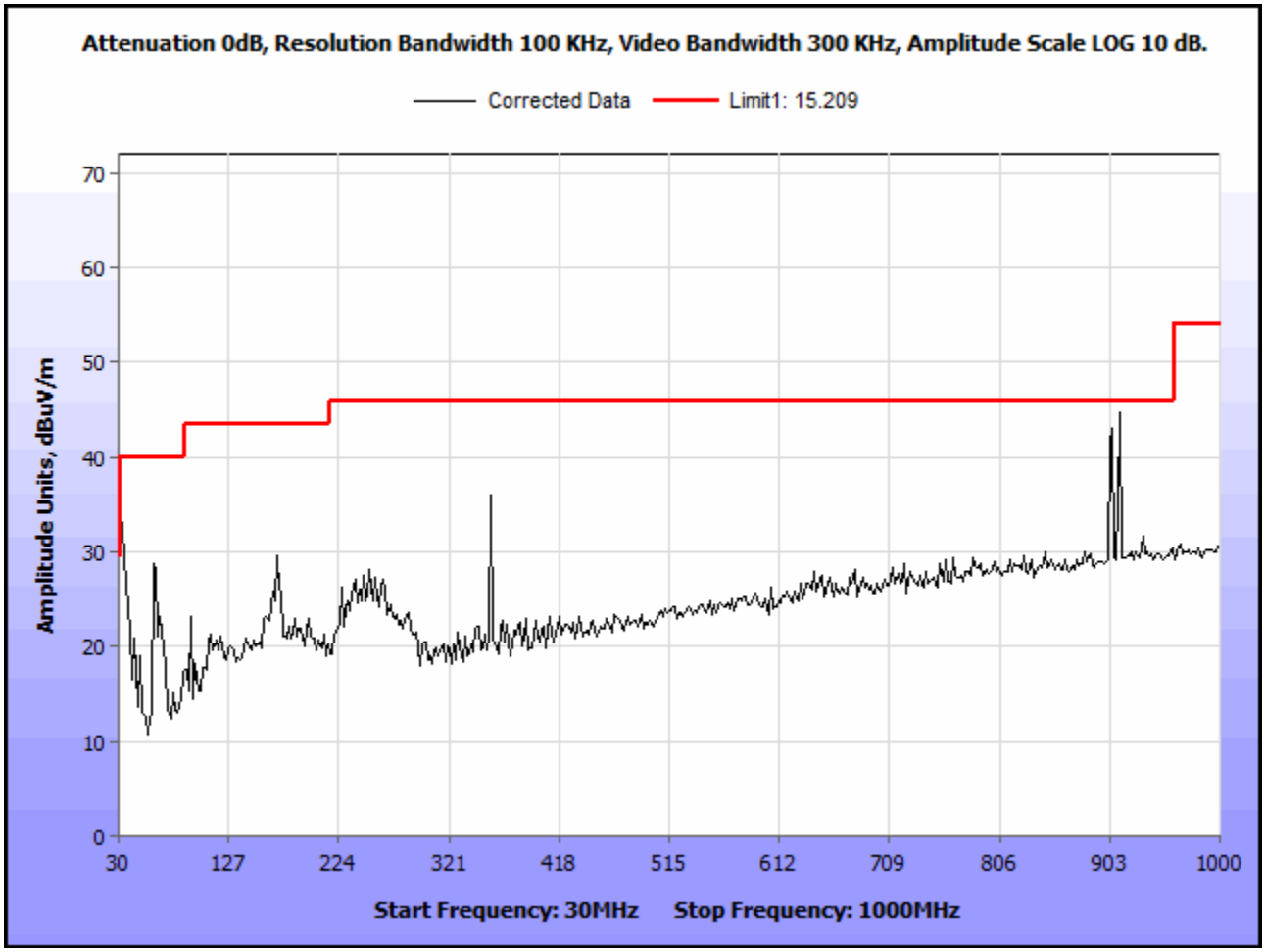
Plot 12. Radiated Spurious Emissions, Mid Channel, 30 MHz – 1 GHz



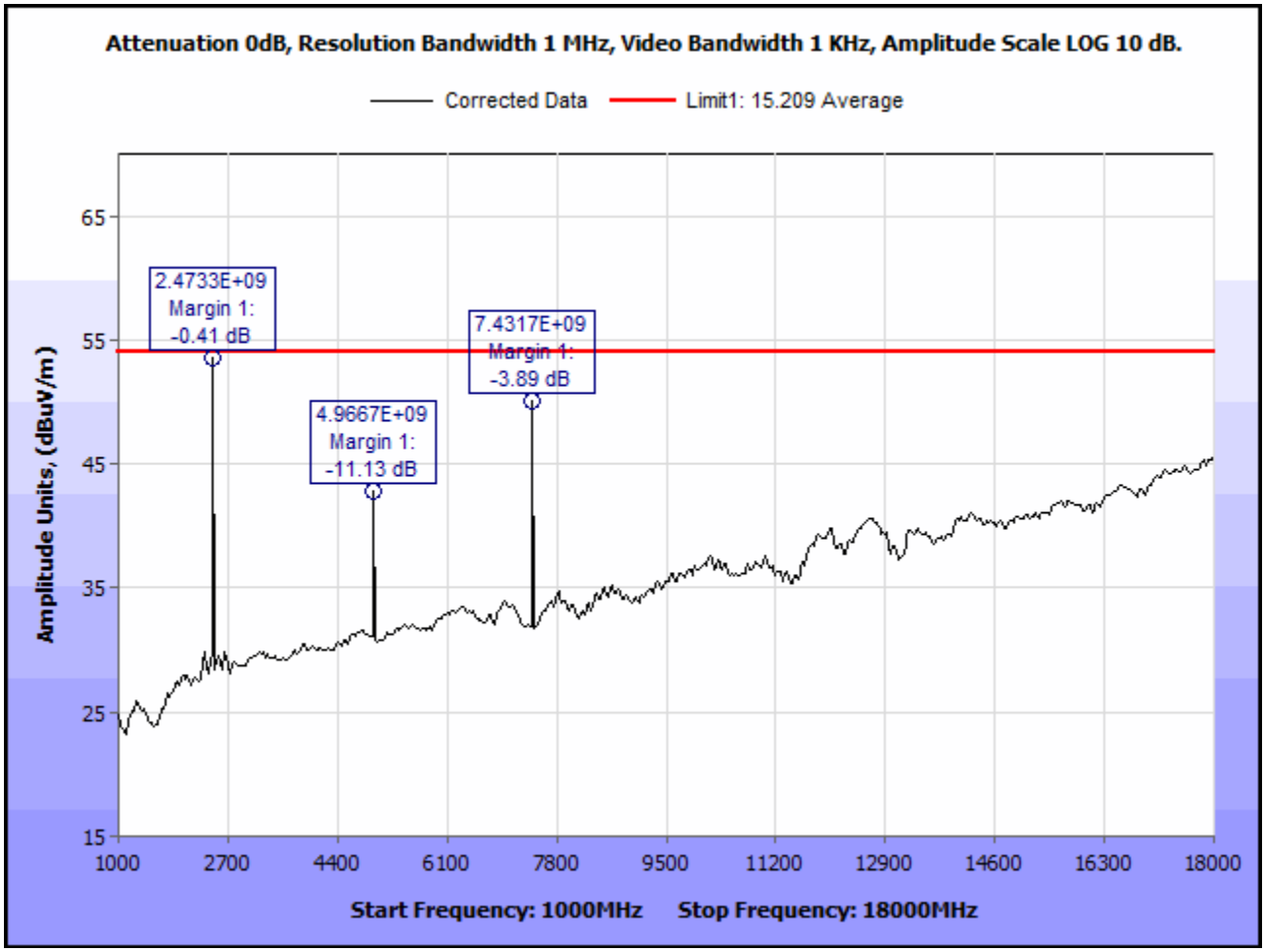
Plot 13. Radiated Spurious Emissions, Mid Channel, 1 GHz – 18 GHz (AVG)



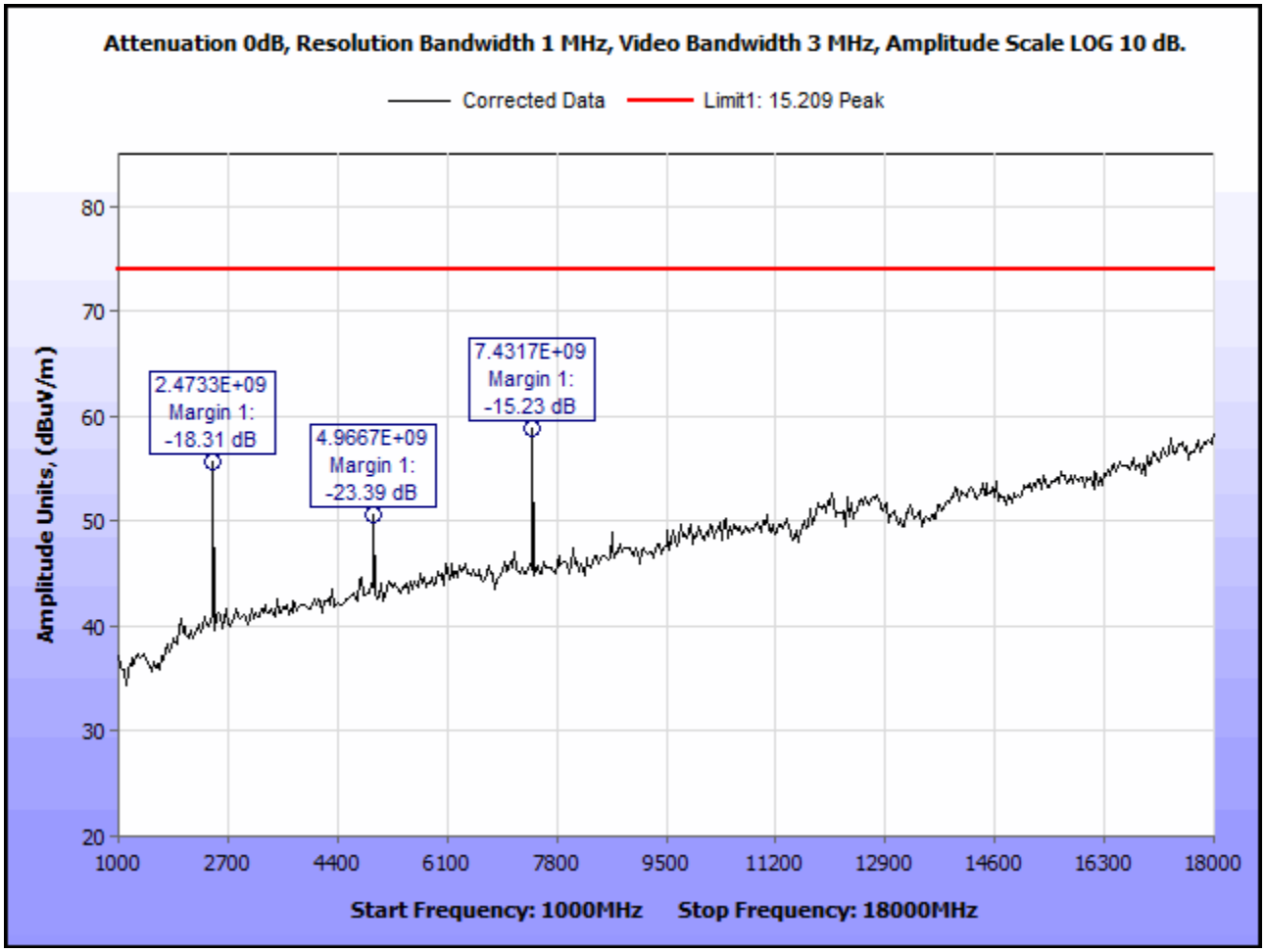
Plot 14. Radiated Spurious Emissions, Mid Channel, 1 GHz – 18 GHz (Peak)



Plot 15. Radiated Spurious Emissions, High Channel, 30 MHz – 1 GHz



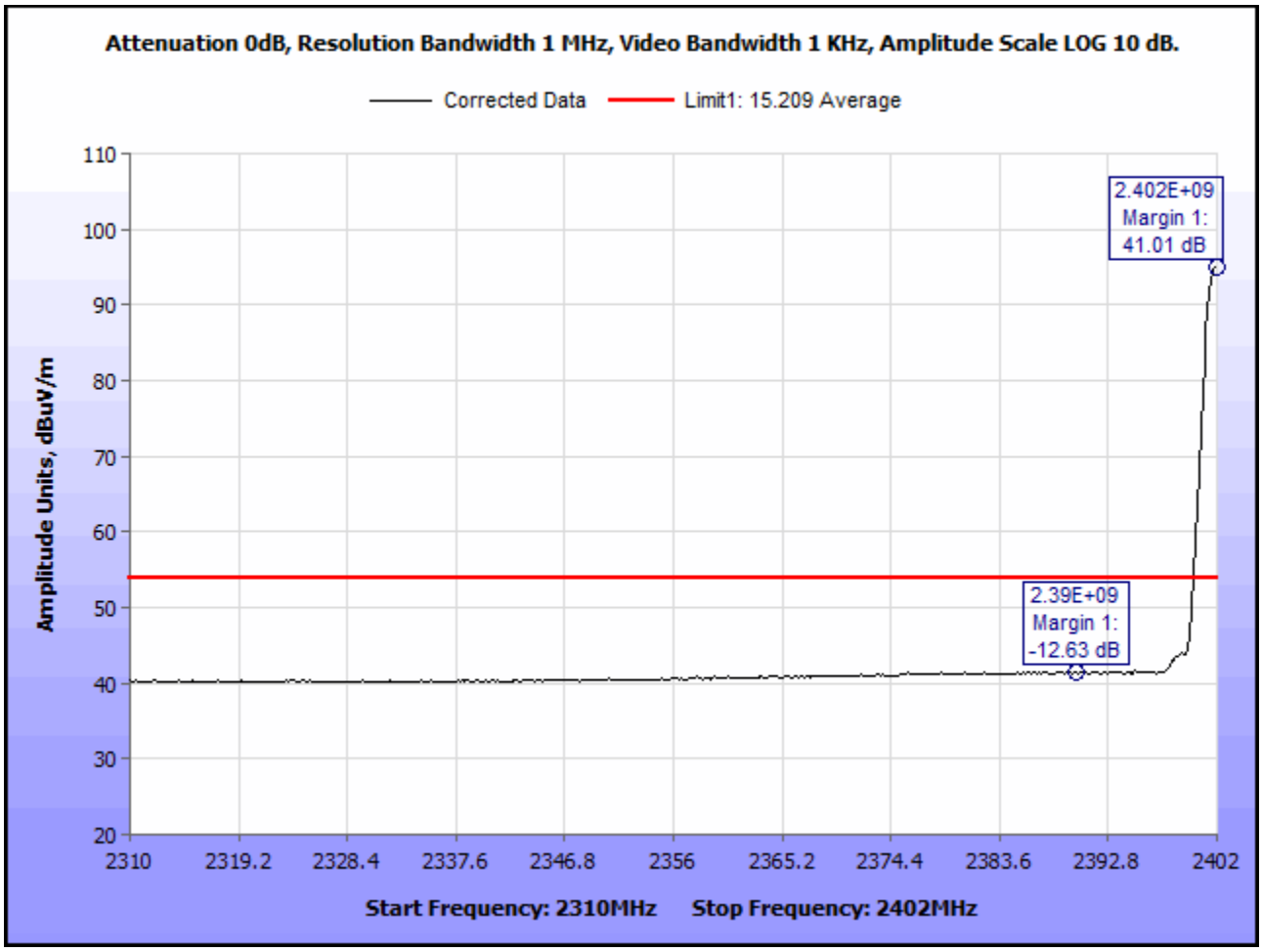
Plot 16. Radiated Spurious Emissions, High Channel, 1 GHz – 18 GHz (AVG)



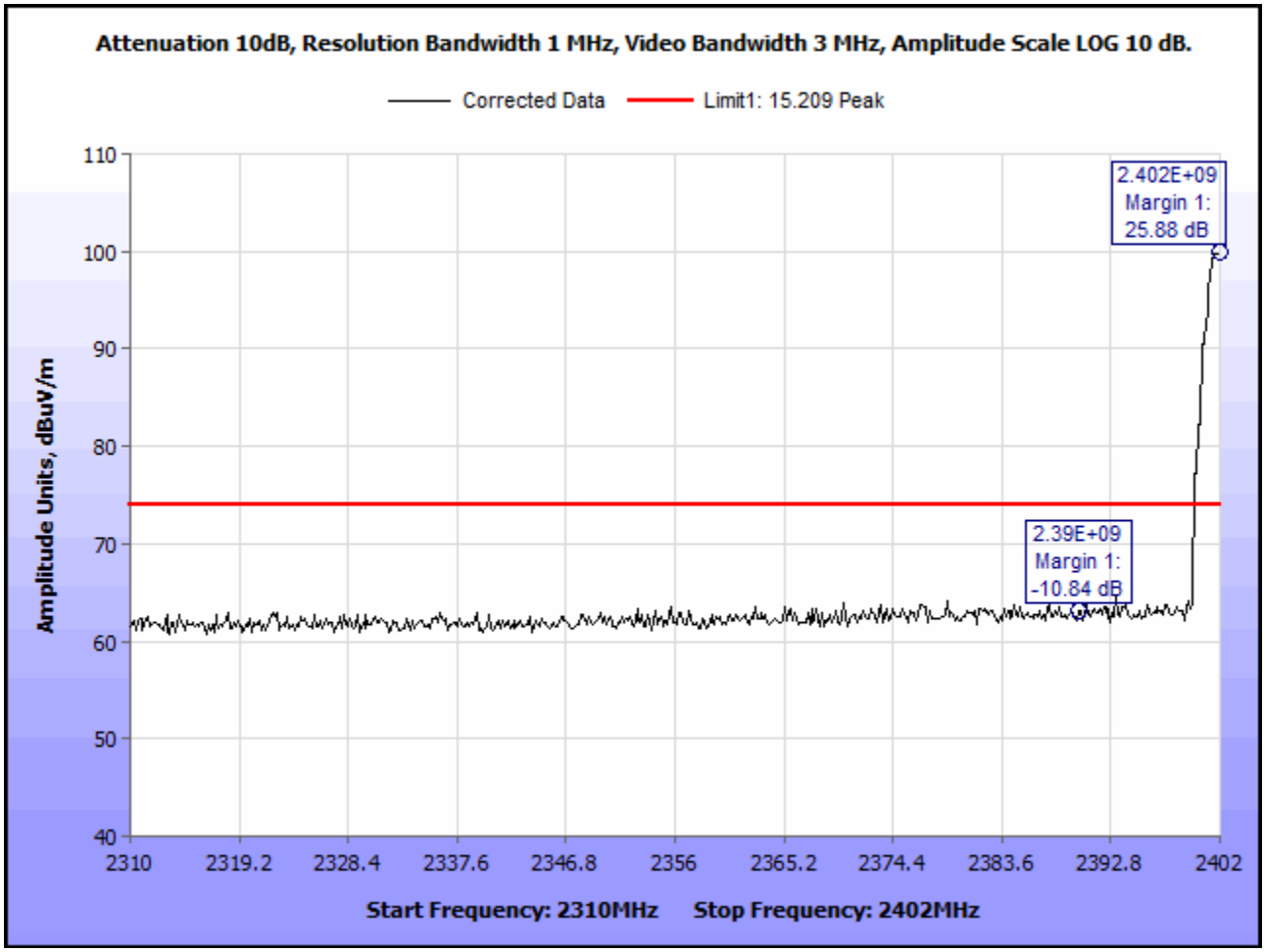
Plot 17. Radiated Spurious Emissions, High Channel, 1 GHz – 18 GHz (Peak)

Radiated Band Edge Measurements

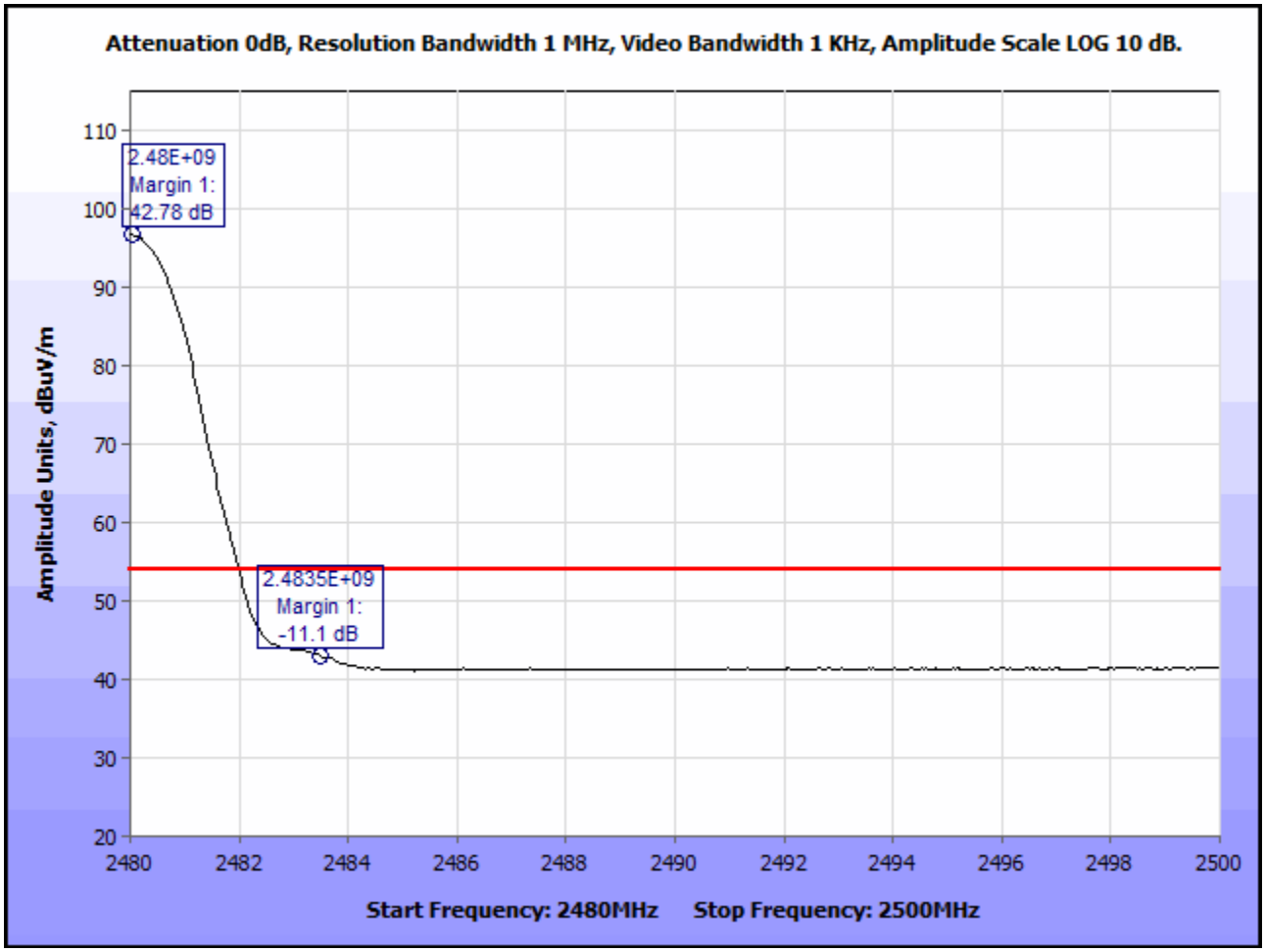
Test Procedures: The transmitter was turned on. Measurements were performed of the low, mid and high Channels. The EUT was rotated orthogonally through all three axes. Plots shown are corrected for both antenna correction factor and distance and compared to a 3 m limit line.



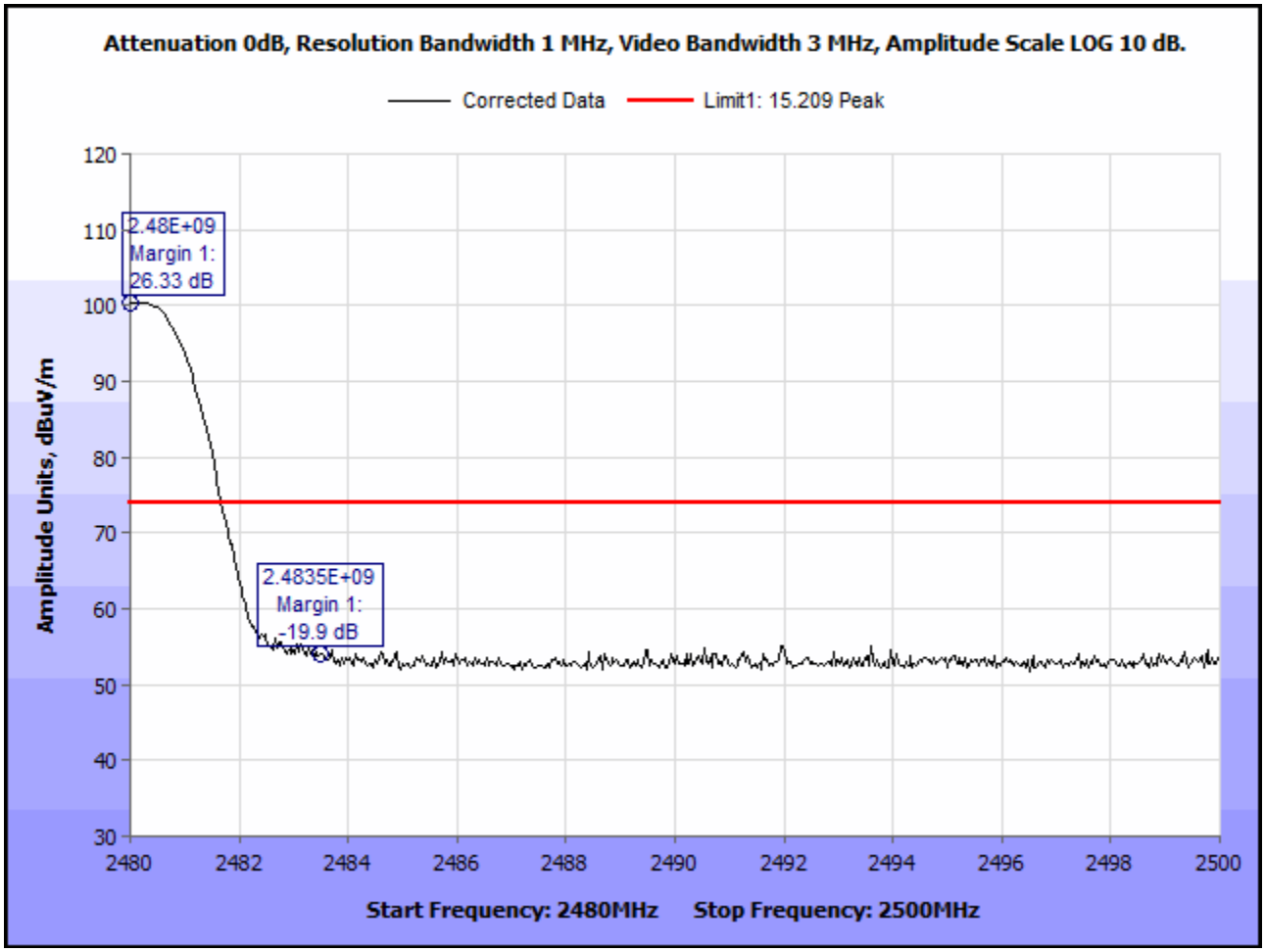
Plot 18. Radiated Restricted Band Edge, Low Channel AVG



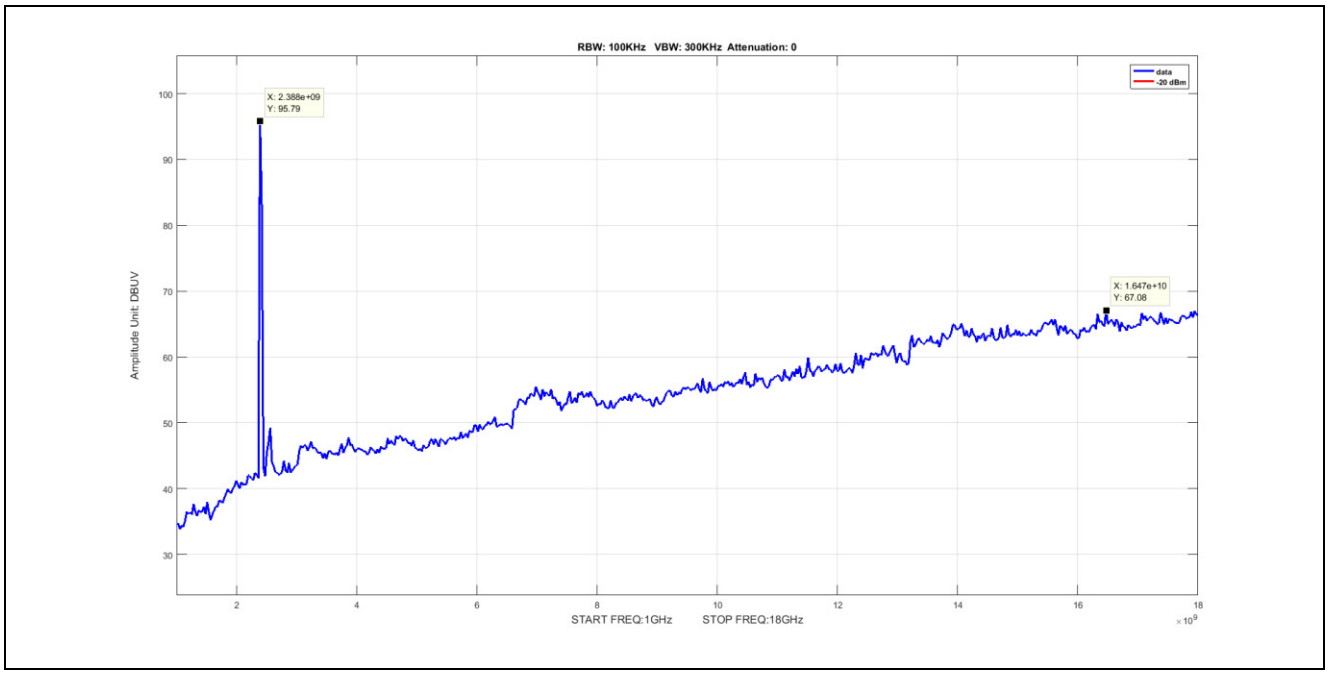
Plot 19. Radiated Restricted Band Edge, Low Channel Peak



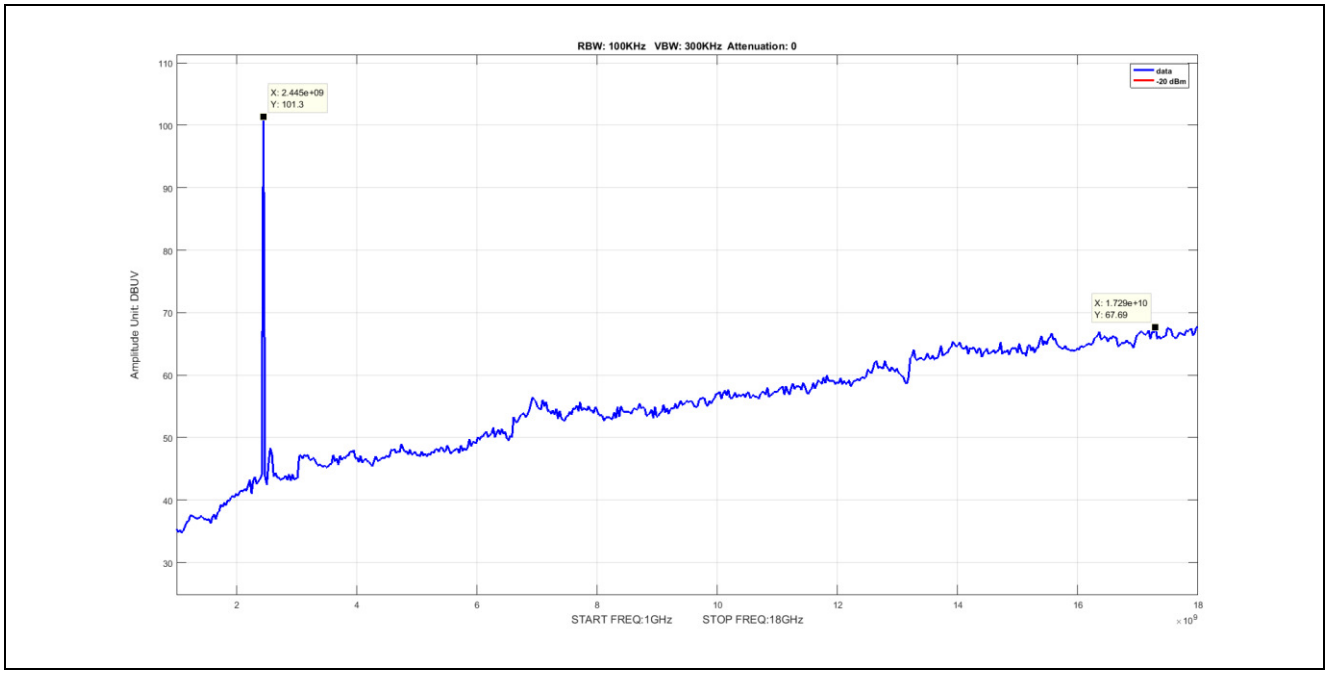
Plot 20. Radiated Restricted Band Edge, High Channel AVG



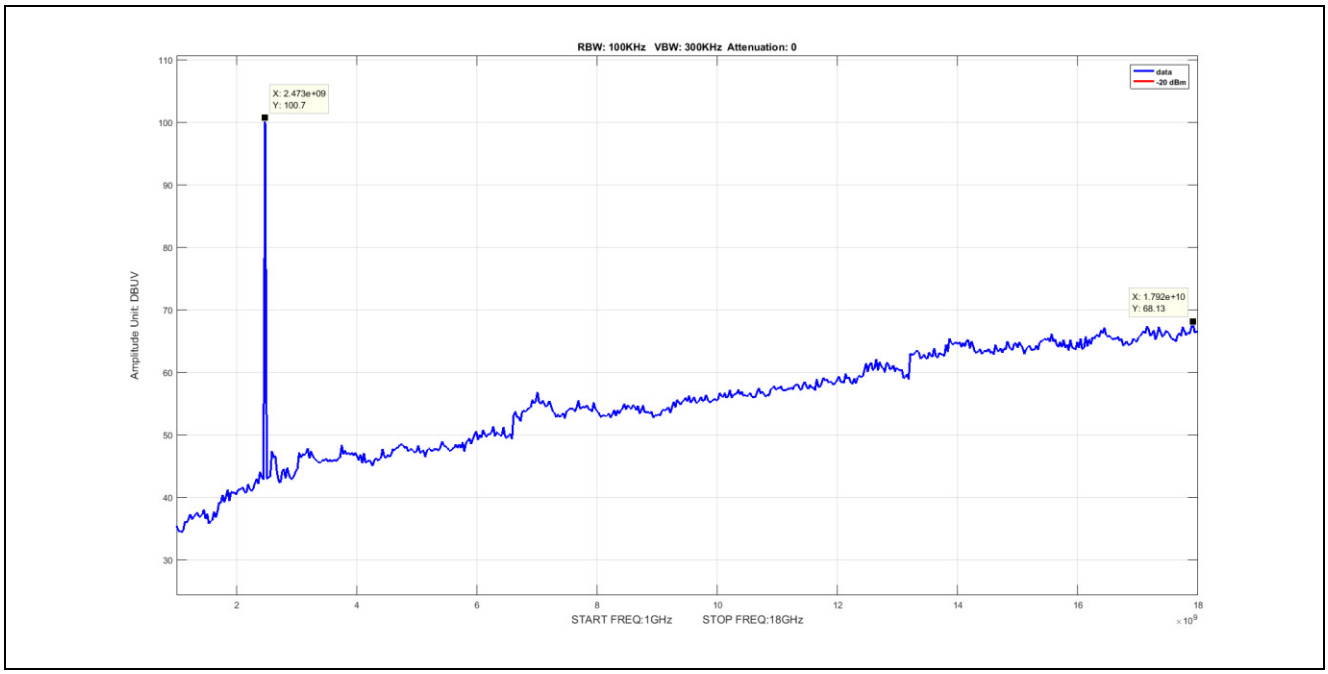
Plot 21. Radiated Restricted Band Edge, High Channel Peak



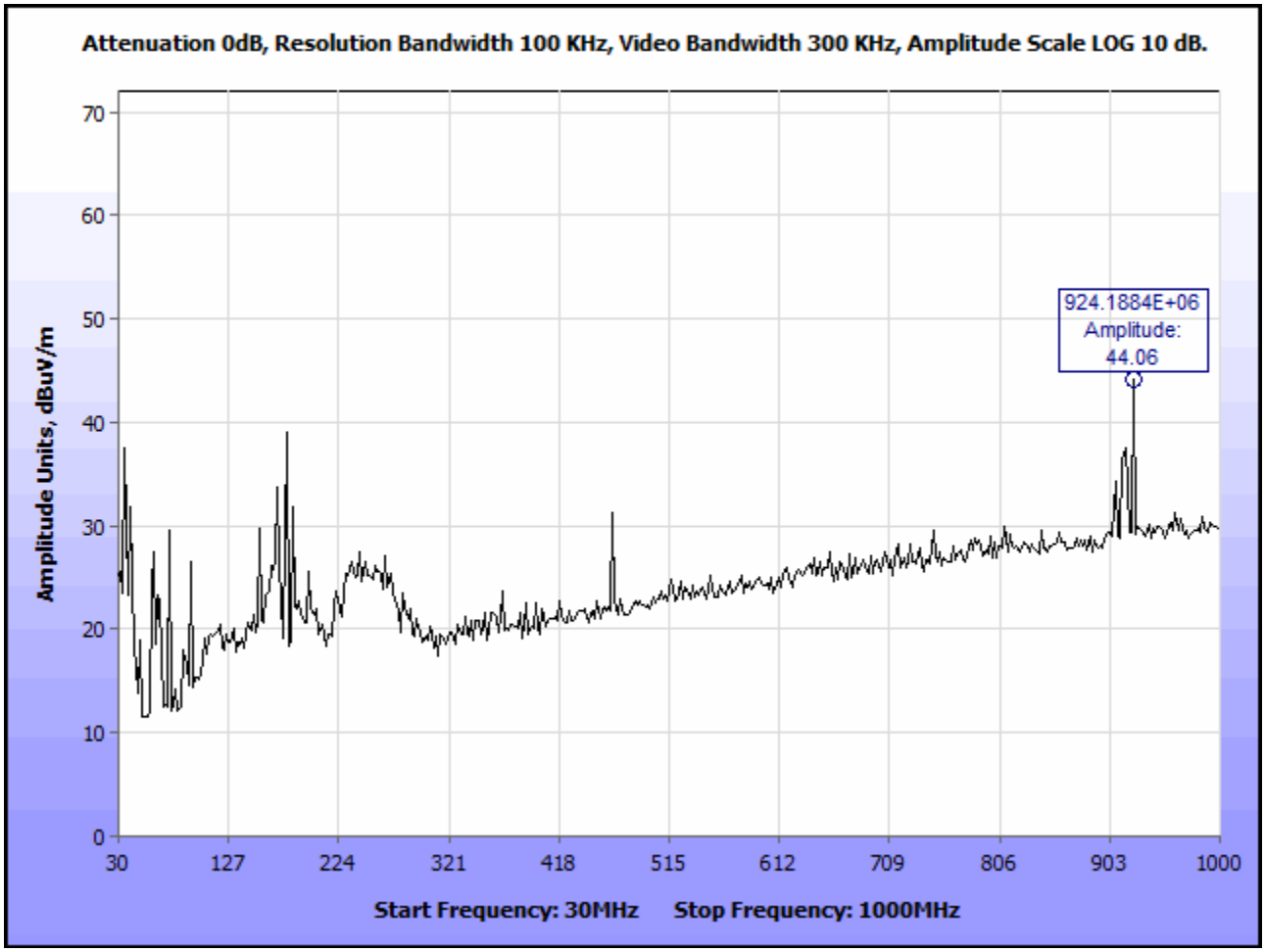
Plot 22. Radiated Spurious, 20dBc-100K, 1 GHz – 18 GHz, Low Channel



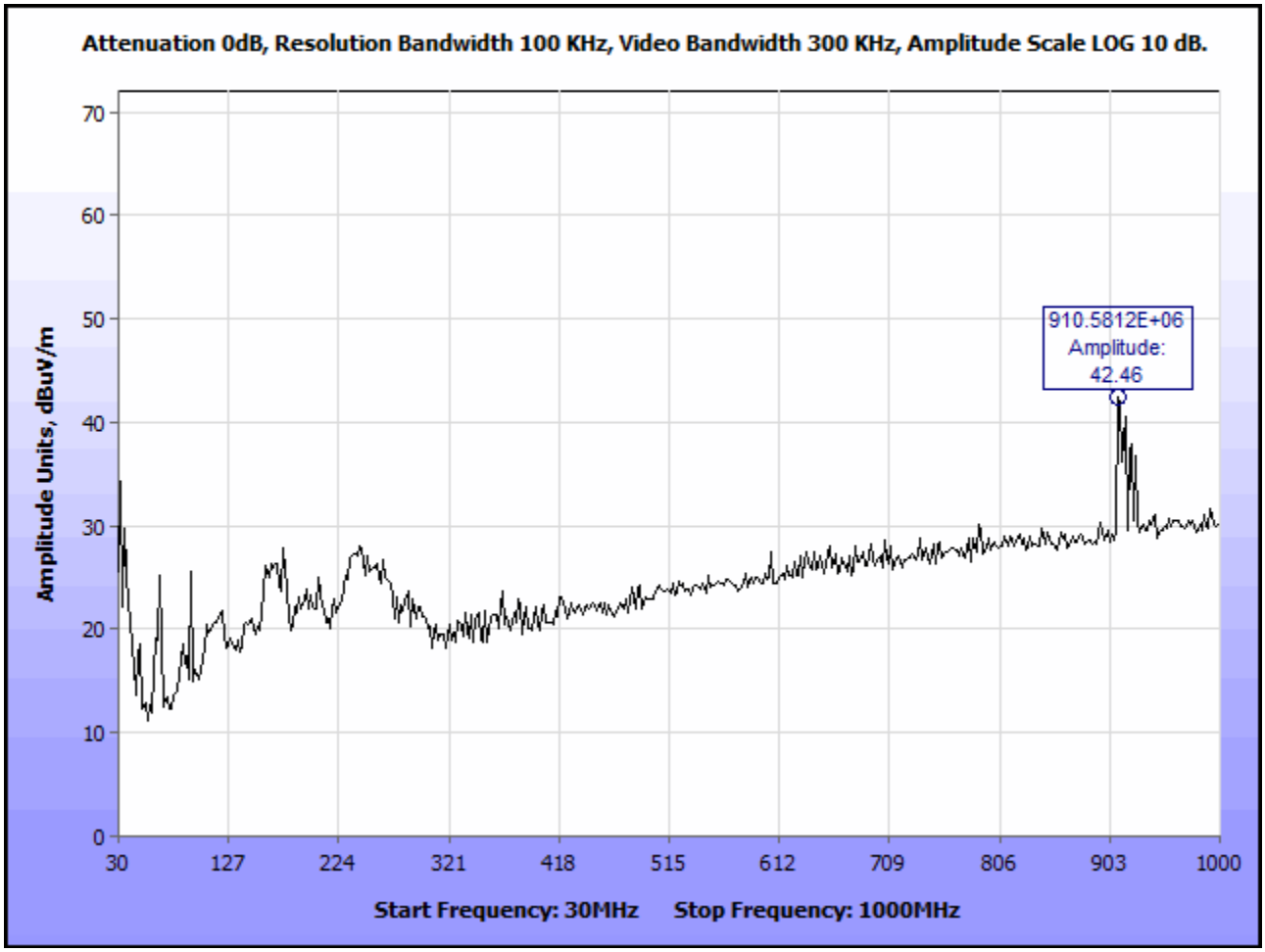
Plot 23. Radiated Spurious, 20dBc-100K, 1 GHz – 18 GHz, Mid Channel



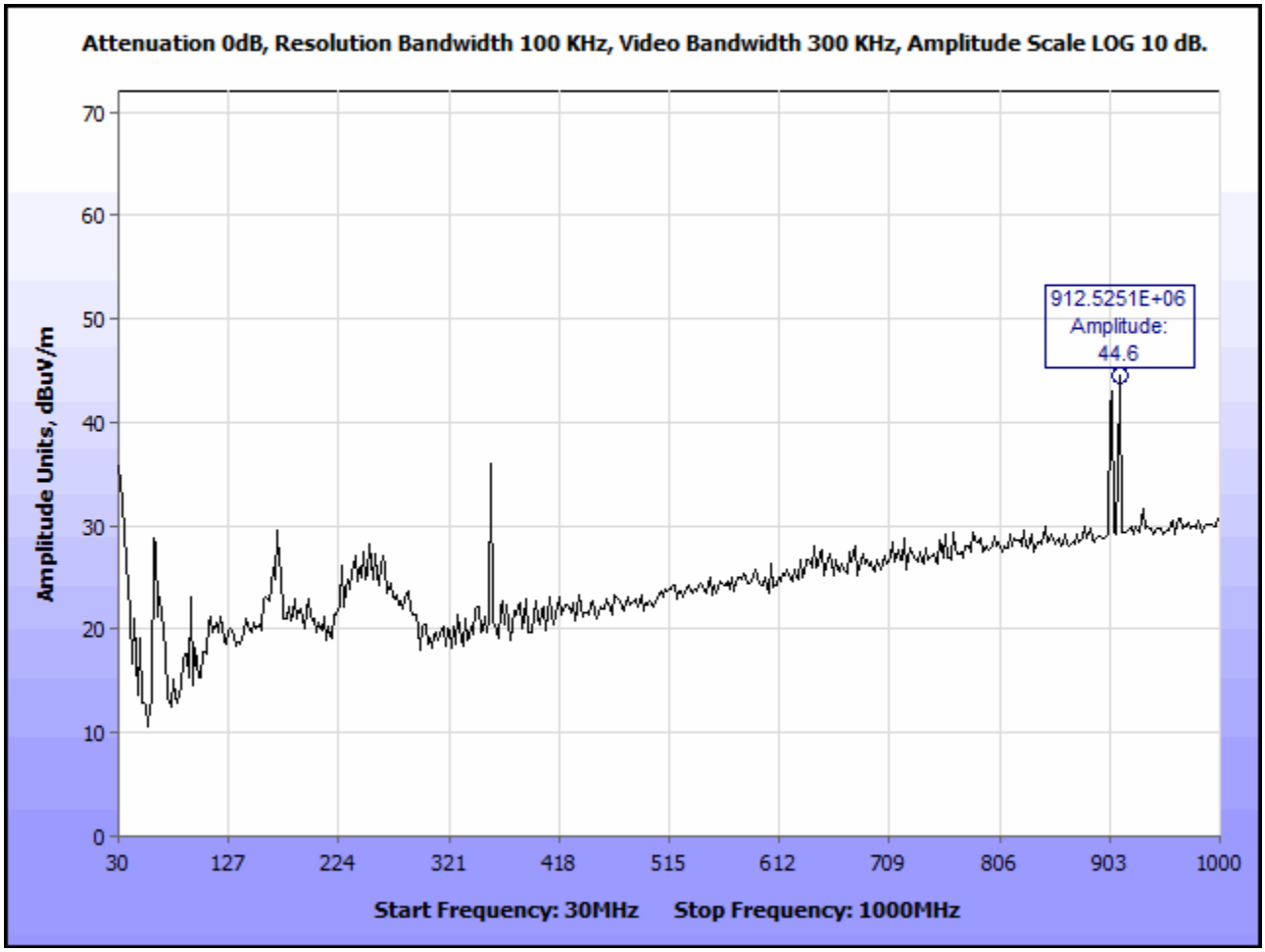
Plot 24. Radiated Spurious, 20dBc-100K, 1 GHz – 18 GHz, High Channel



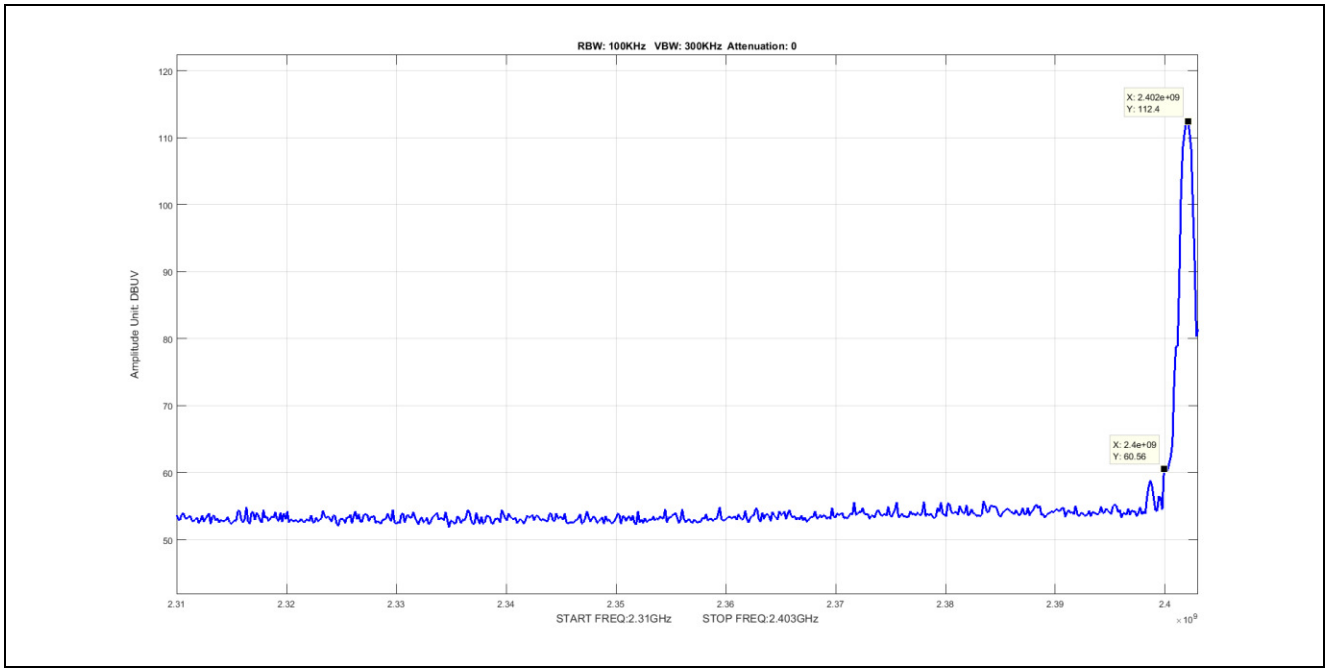
Plot 25. Radiated Spurious, 20 dBc, Low Channel, Below 1 GHz



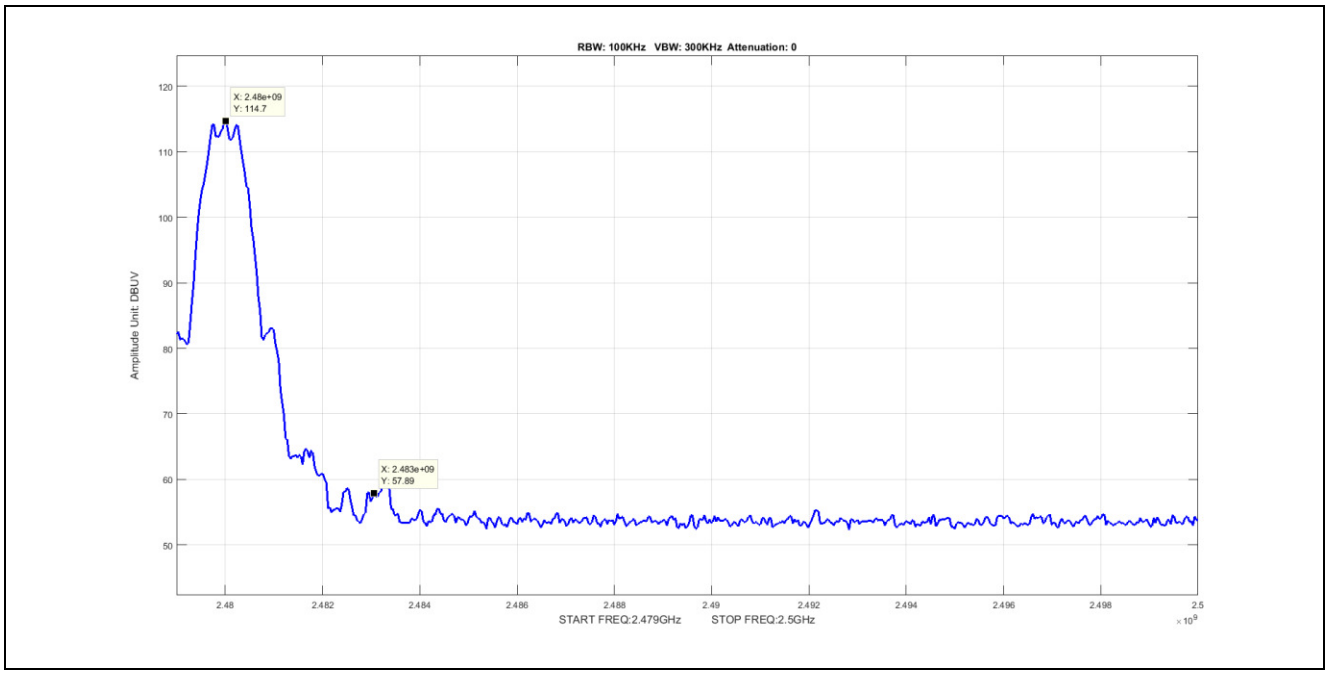
Plot 26. Radiated Spurious, 20 dBc, Mid Channel, Below 1 GHz



Plot 27. Radiated Spurious, 20 dBc, High Channel, Below 1 GHz



Plot 28. 20 dBc Lower Band Edge, 100K



Plot 29. 20 dBc Upper Band Edge, 100K

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(d) RF Conducted Spurious Emissions Requirements and Band Edge

Test Requirement: **15.247(d)** In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

Test Results: Conducted sample was not available.

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(e) Peak Power Spectral Density

Test Requirements: **§15.247(e):** For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission.

Test Procedure: The transmitter was placed at 1 meter distance away from calibrated horn antenna. The horn antenna was connected to the calibrated spectrum analyzer with attenuator. Measurements were carried out at the low, mid and high channels.

Test Results: The EUT was compliant with the peak power spectral density limits of **§ 15.247 (e)**. No anomalies detected.

The peak power spectral density was determined from plots on the following page(s).

Test Engineer: Deepak Giri

Test Date: July 13, 2016

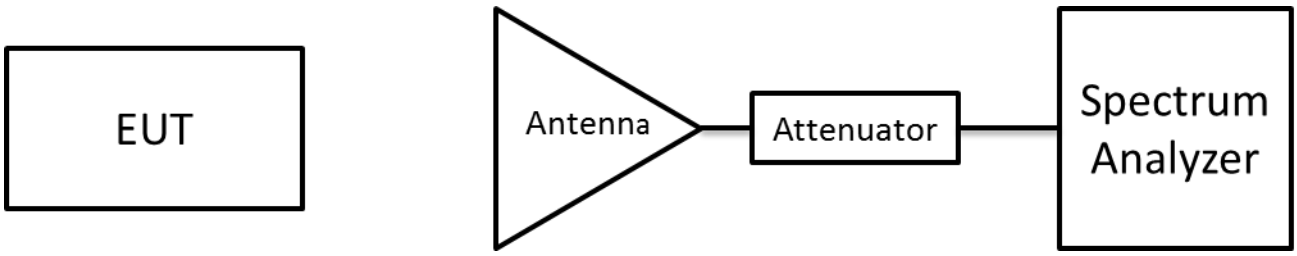


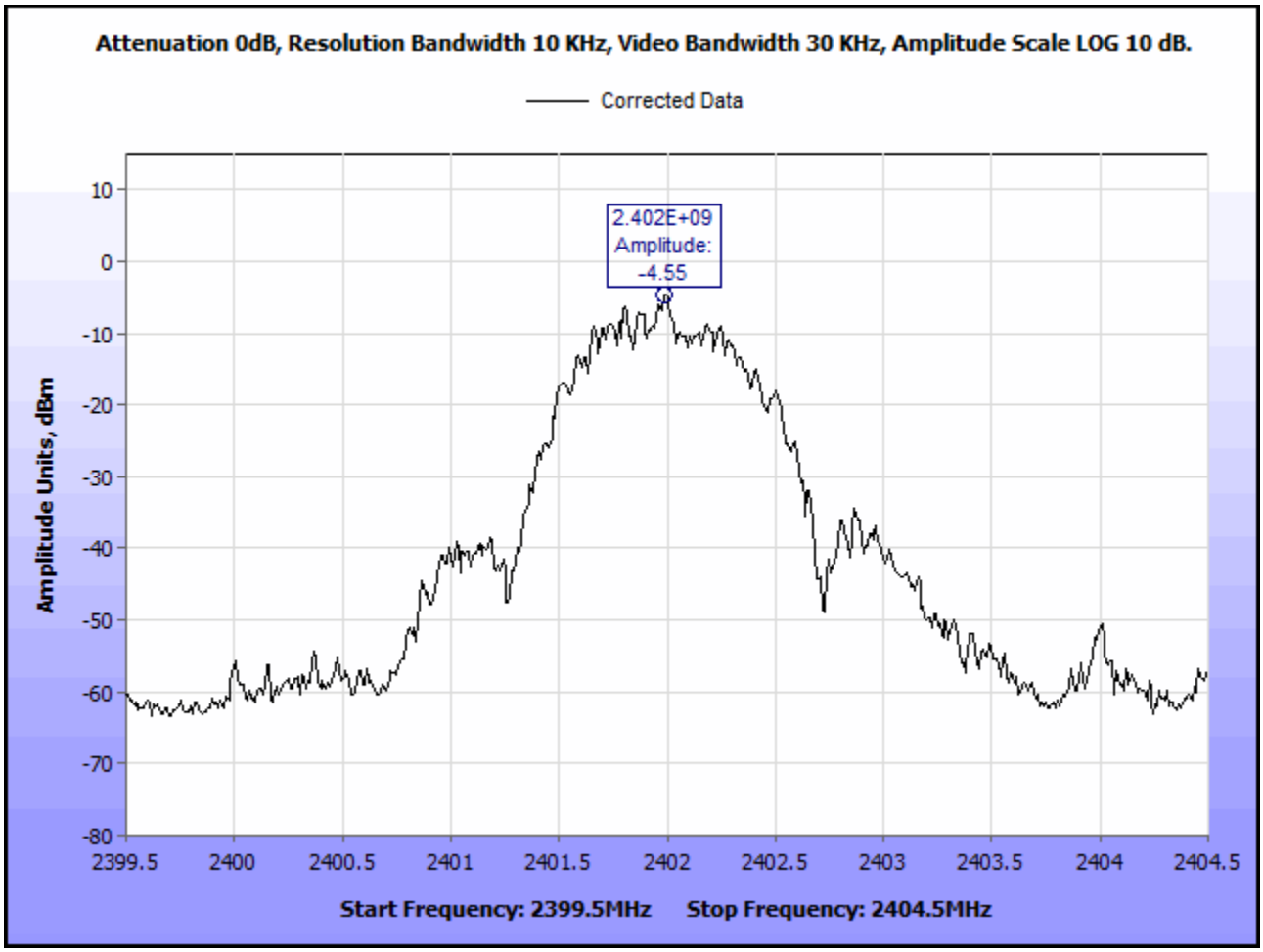
Figure 4. Block Diagram, Peak Power Spectral Density Test Setup

Peak Power Spectral Density Test Results

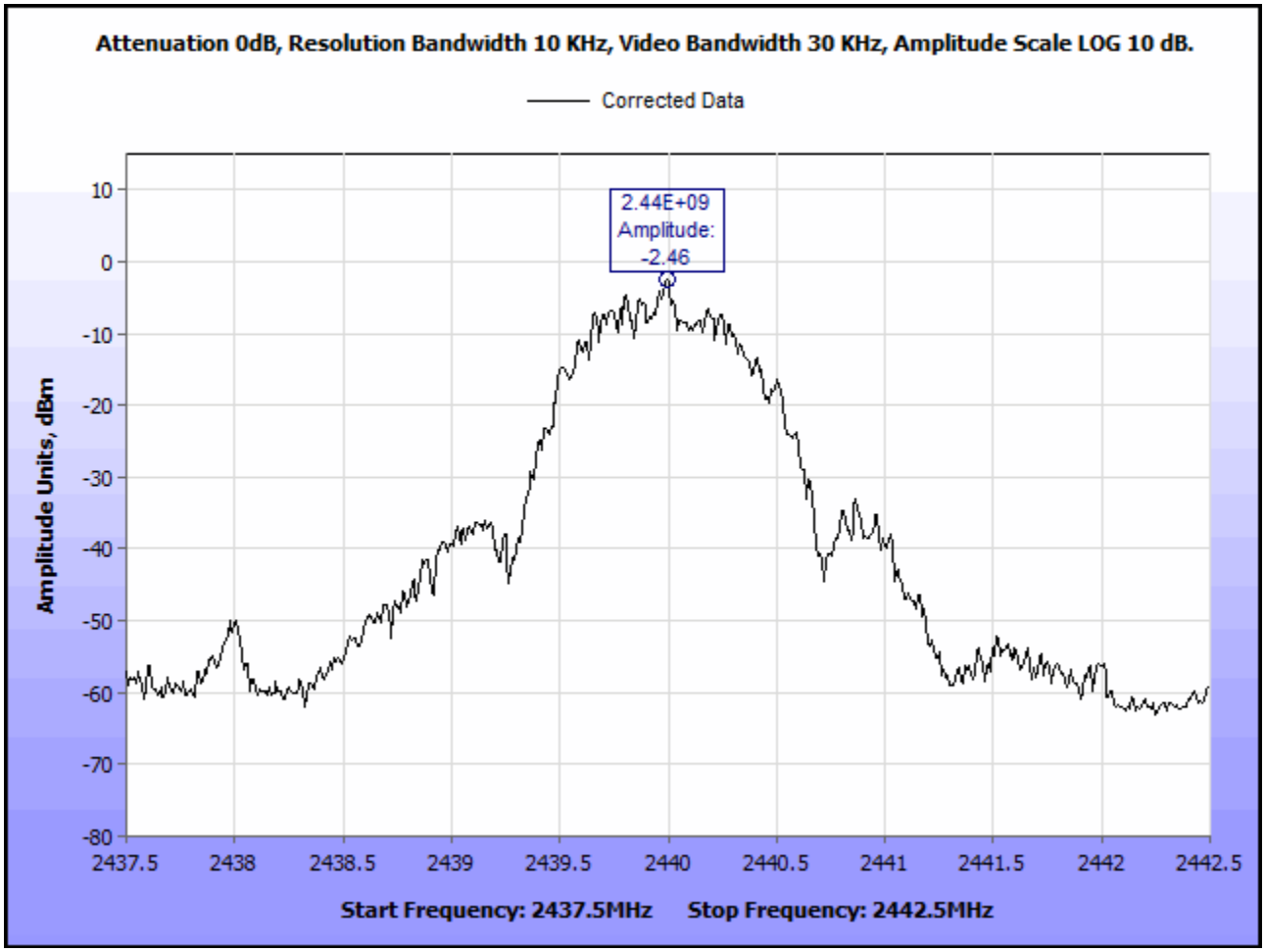
15.247 Power Spectral Density			
Frequency MHz	PSD dBm	Limits dBm	Results
2402	-4.55	8 dBm	Pass
2440	-2.46	8 dBm	Pass
2480	-2.63	8 dBm	Pass

Table 14. Peak Power Spectral Density, Test Results

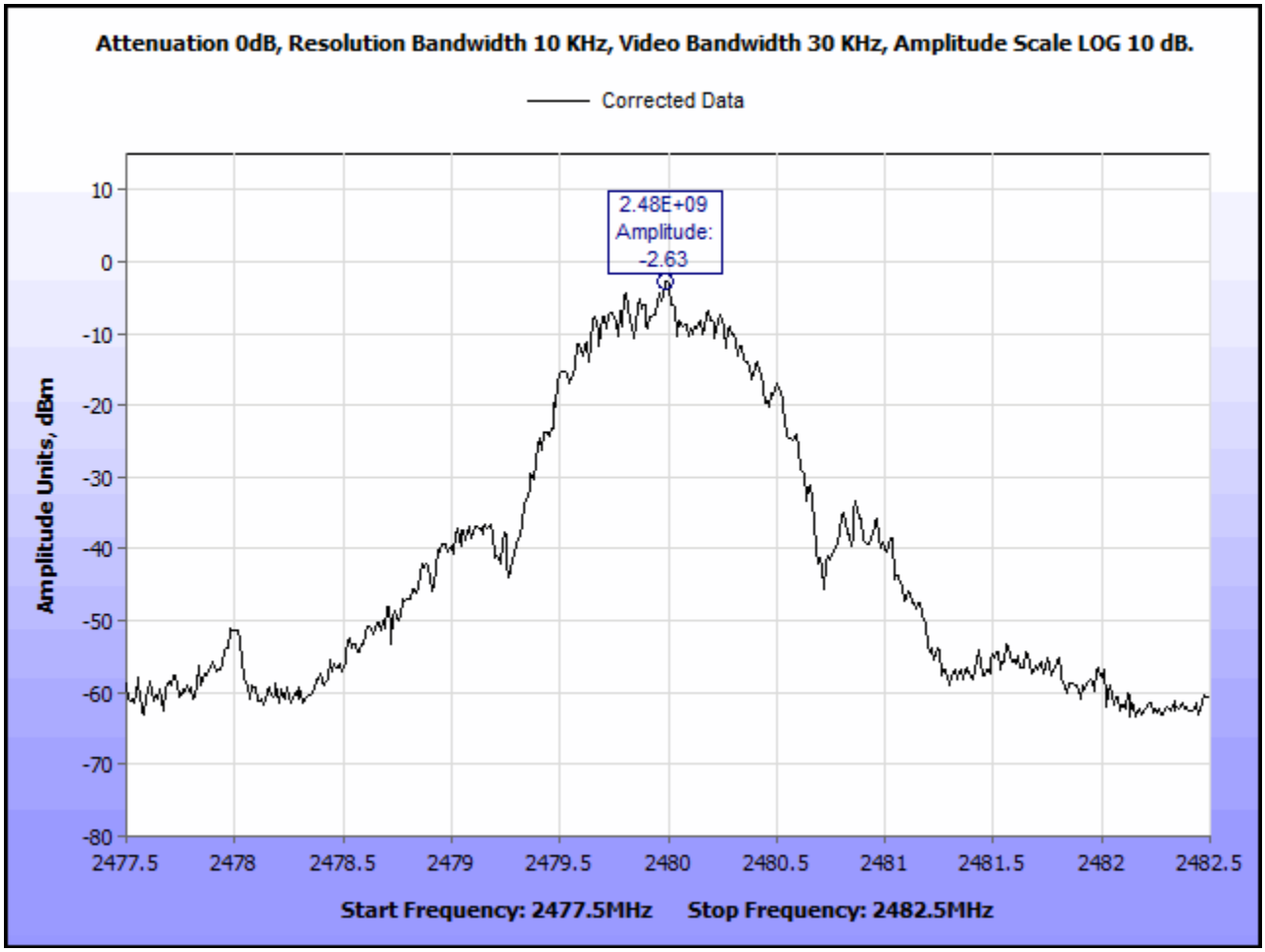
Peak Power Spectral Density



Plot 30. Peak Power Spectral Density, Low Channel



Plot 31. Peak Power Spectral Density, Mid Channel



Plot 32. Peak Power Spectral Density, High Channel

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(i) Maximum Permissible Exposure

SAR Exclusion Calculation:

For 100 MHz to 6 GHz and test separation distances ≤ 50 mm, the 1-g and 10-g SAR test exclusion thresholds are determined by the following: [(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR, and ≤ 7.5 for 10-g extremity SAR, 30 where

- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation31
- The result is rounded to one decimal place for comparison
- The values 3.0 and 7.5 are referred to as numeric thresholds in step b) below

For 100 MHz to 6 GHz and test separation distances > 50 mm, the 1-g and 10-g SAR test exclusion thresholds are determined by the following:

{[Power allowed at numeric threshold for 50 mm in step a)] + [(test separation distance – 50 mm)·10]} mW, for > 1500 MHz and ≤ 6 GHz

Frequency (GHz)	Output Power (dBm)	Tune Up (dBm)	Tune Up (dBm)	Tune up (mW)	Distance (mm)	SAR	Limit	Result
2.402	2.79	2.79±1	5.4	3.467368505	50	0.107477238	≤ 3.0 for 1-g SAR, and ≤ 7.5 for 10-g extremity SAR	Exempt
2.44	4.3	4.3±1	5.4	3.467368505	50	0.108324055	≤ 3.0 for 1-g SAR, and ≤ 7.5 for 10-g extremity SAR	Exempt
2.48	4.36	4.36±1	5.4	3.467368505	50	0.109208348	≤ 3.0 for 1-g SAR, and ≤ 7.5 for 10-g extremity SAR	Exempt

Conclusion: No SAR is required.

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
Test Name: Conducted Emissions 15.207					
1T8818	SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4407B	12/16/2015	12/16/2016
1T4504	SHIELDED ROOM	UNIVERSAL SHIELDING CORP	N/A	NOT REQUIRED	
1T4563	LISN (10 AMP)	SOLAR ELECTRONICS COMPANY	9322-50-R-10-BNC	8/27/2015	2/27/2017
1T4859	DIGITAL BAROMETER, HYGROMETER, THERMOMETER	CONTROL COMPANY	15-078-198, FB70423, 245CD	2/10/2016	2/10/2018
Test Name: Occupied Bandwidth					
1T4442	PRE-AMPLIFIER, MICROWAVE	MITEQ	AFS42-01001800-30-10P	SEE NOTE	
1T4483	ANTENNA; HORN	ETS-LINDGREN	3117	10/08/2015	04/08/2017
1T4771	PSA SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4446A	01/25/2015	07/25/2016
1T4149	HIGH-FREQUENCY ANECHOIC CHAMBER	RAY PROOF	81	NOT REQUIRED	
1T4300	SEMI-ANECHOIC CHAMBER # 1 (NSA)	EMC TEST SYSTEMS	NONE	02/06/2015	02/06/2018
1T4751	ANTENNA - BILOG	SUNOL SCIENCES	JB6	02/26/2016	08/26/2017
1T4409	EMI RECEIVER	ROHDE & SCHWARZ	ESIB7	10/29/2014	10/29/2016
1T4859	DIGITAL BAROMETER, HYGROMETER, THERMOMETER	CONTROL COMPANY	15-078-198, FB70423, 245CD	02/10/2016	02/10/2018
Test: Peak Power Output					
1T4442	PRE-AMPLIFIER, MICROWAVE	MITEQ	AFS42-01001800-30-10P	SEE NOTE	
1T4483	ANTENNA; HORN	ETS-LINDGREN	3117	10/08/2015	04/08/2017
1T4771	PSA SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4446A	01/25/2015	07/25/2016
1T4149	HIGH-FREQUENCY ANECHOIC CHAMBER	RAY PROOF	81	NOT REQUIRED	
1T4300	SEMI-ANECHOIC CHAMBER # 1 (NSA)	EMC TEST SYSTEMS	NONE	02/06/2015	02/06/2018
1T4751	ANTENNA - BILOG	SUNOL SCIENCES	JB6	02/26/2016	08/26/2017
1T4409	EMI RECEIVER	ROHDE & SCHWARZ	ESIB7	10/29/2014	10/29/2016
1T4859	DIGITAL BAROMETER, HYGROMETER, THERMOMETER	CONTROL COMPANY	15-078-198, FB70423, 245CD	02/10/2016	02/10/2018
Test Name: Radiated Spurious Emissions					

1T4442	PRE-AMPLIFIER, MICROWAVE	MITEQ	AFS42-01001800-30-10P	SEE NOTE	
1T4483	ANTENNA; HORN	ETS-LINDGREN	3117	10/08/2015	04/08/2017
1T4771	PSA SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4446A	01/25/2015	07/25/2016
1T4149	HIGH-FREQUENCY ANECHOIC CHAMBER	RAY PROOF	81	NOT REQUIRED	
1T4300	SEMI-ANECHOIC CHAMBER # 1 (NSA)	EMC TEST SYSTEMS	NONE	02/06/2015	02/06/2018
1T4751	ANTENNA - BILOG	SUNOL SCIENCES	JB6	02/26/2016	08/26/2017
1T4409	EMI RECEIVER	ROHDE & SCHWARZ	ESIB7	10/29/2014	10/29/2016
1T4859	DIGITAL BAROMETER, HYGROMETER, THERMOMETER	CONTROL COMPANY	15-078-198, FB70423, 245CD	02/10/2016	02/10/2018
Test Name: Power Spectral Density					
1T4442	PRE-AMPLIFIER, MICROWAVE	MITEQ	AFS42-01001800-30-10P	SEE NOTE	
1T4483	ANTENNA; HORN	ETS-LINDGREN	3117	10/08/2015	04/08/2017
1T4771	PSA SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4446A	01/25/2015	07/25/2016
1T4149	HIGH-FREQUENCY ANECHOIC CHAMBER	RAY PROOF	81	NOT REQUIRED	
1T4300	SEMI-ANECHOIC CHAMBER # 1 (NSA)	EMC TEST SYSTEMS	NONE	02/06/2015	02/06/2018
1T4751	ANTENNA - BILOG	SUNOL SCIENCES	JB6	02/26/2016	08/26/2017
1T4409	EMI RECEIVER	ROHDE & SCHWARZ	ESIB7	10/29/2014	10/29/2016
1T4859	DIGITAL BAROMETER, HYGROMETER, THERMOMETER	CONTROL COMPANY	15-078-198, FB70423, 245CD	02/10/2016	02/10/2018

Table 15. 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

