America

Choose certainty.
Add value.

Report On

Radio Testing of the
Frymaster LLC
8076208

FCC Part 15 Subpart C §15.225
RSS-210 Issue 9, August 2016
RSS-GEN Issue 5, April 2018

Report No. TP72141853.102 **January 2019**

REPORT ON	EMC Evaluation of the Frymaster LLC 8076208
TEST REPORT NUMBER	TP72141853.101
REPORT DATE	20. September 2018
PREPARED FOR	Frymaster LLC 8700 Line Avenue Shreveport, LA 71106
CONTACT PERSON	Ralph Macy Director of Engineering II ralph.macy@welbilt.com
PREPARED BY	Steve Hoke Authorized Signatory Title: Senior EMC Engineer
APPROVED BY	Peter Walsh Authorized Signatory Title: Tampa Service Line Manager
DATED	20. September 2018

TÜV SÜD AMERICA INC 5610 West Sligh Ave., Suite 100, Tampa, FL 33634 Phone: 813 284 2715
Website: www.TUVamerica.com

Revision History

TP72141853.101 Frymaster LLC 8076208 RFID Reader Module					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
20. September 2018	Initial Release				P. Walsh
07. November 2018	TP72141853.100	TP72141853.101	Added model numbers	6	S. Hoke
19. January 2019	TP72141853.101	TP72141853.102	Revised model numbers & added Class A digital conducted emissions plots and added radiated emissions plots without cabinet	11 & 41-44	S. Hoke

TABLE OF CONTENTS

Section		Page No
1	**REPORT SUMMARY**	**5**
1.1	Introduction	6
1.2	Brief Summary of Results	7
1.3	Product Information	8
1.4	EUT Test configuration	10
1.5	Deviations from the Standard	11
1.6	Modification Record	11
1.7	Test Methodology	11
2	**TEST DETAILS**	**13**
2.1	Frequency Stability	14
2.2	20 dB Bandwidth	16
2.3	99% Bandwidth	18
2.4	Emission Mask	20
2.5	Spurious Radiated Emissions	23
2.6	Conducted Emissions	38
3	**TEST EQUIPMENT USED**	**48**
3.2	Measurement Uncertainty	50
4	**DIAGRAM OF TEST SETUP**	**51**
4.1	Test Setup Diagram (Emission Mask and Below 30 MHz)	52
4.2	Test Setup Diagram (30 MHz to 1 GHz)	53
4.3	Test Setup Diagram Above 1 GHz)	54
4.4	Test Setup Diagram (Conducted Emissions)	55
5	**ACCREDITATION, DISCLAIMERS AND COPYRIGHT**	**56**
5.1	Accreditation, Disclaimers and Copyright	57

TÜV SÜD AMERICA INC 5610 West Sligh Ave., Suite 100, Tampa, FL 33634 Phone: 813 284 2715
Website: www.TUVamerica.com

SECTION 1

REPORT SUMMARY

Radio Testing of the
Frymaster LLC
Model 8076208

TÜV SÜD AMERICA INC 5610 West Sligh Ave., Suite 100, Tampa, FL 33634 Phone: 813 284 2715
Website: www.TUVamerica.com

1.1 INTRODUCTION

The information contained in this report is intended to show compliance of the Frymaster LLC 8076208 to the requirements of FCC Part 15 Subpart C.

Objective	To perform Radio Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out.
Manufacturer	Frymaster LLC
Model Name	8076208
Model Number(s)	MHC22SNT1T, MHC22SNL1T, MHC24SNT2T, MHC52SNT1T, MHC54SNT1T
FCC ID Number	2AQ4D-RFIDREADER
IC Number	24291-RFIDREADER
Serial Number(s)	See 1.4.1
Number of Samples Tested	5
Test Specification/Issue/Date	FCC Part 15 Subpart C RSS-210 Issue 9 RSS-GEN Issue 5
Start of Test	28. August 2018
Finish of Test	04. September 2018
Name of Engineer(s)	David Foerstner, Steve Hoke
Related Document(s)	Supporting documents for EUT certification are separate exhibits.

TÜV SÜD AMERICA INC 5610 West Sligh Ave., Suite 100, Tampa, FL 33634 Phone: 813 284 2715
Website: www.TUVamerica.com

1.2 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out in accordance with Part 15 is shown below.

Section	FCC Part 15	§15.225 Spec Clause	RSS-210	RSS-Gen Clause	Test Description	Result	Comments/Base Standard
	§15.31(e)				Voltage Requirement	Compliant	§15.225(e)
	§15.203 and 204			6.8	Antenna Requirements	Compliant	See Test Note[1]
2.1		§15.225(e)	Annex B6 (d)	6.11	Frequency Tolerance	Compliant	
2.2	§15.215(c)				20dB Bandwidth	Compliant	
2.3				6.7	99% Bandwidth	Compliant	
2.4		§15.225(a)(b)(c)	Annex B6 (a)(b)(c)		Emission Mask	Compliant	
2.5	§15.209 and 109	§15.225(d)	Annex B6 (d)		Spurious Radiated Emissions	Compliant	
2.6	15.107	§15.207(a)		8.8	Conducted Emissions	Compliant	

Test Note[1] The antenna used is internal to the cabinet and not user accessible. This is considered sufficient evidence to comply with the provisions of this requirement.

.

TÜV SÜD AMERICA INC 5610 West Sligh Ave., Suite 100, Tampa, FL 33634 Phone: 813 284 2715
Website: www.TUVamerica.com

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was an Frymaster LLC Model 8076208 as shown in the photograph below.

RFID

Photo 1.3.1-1- Reader Board

Photo 1.3.1-2 - Antenna

TÜV SÜD AMERICA INC 5610 West Sligh Ave., Suite 100, Tampa, FL 33634 Phone: 813 284 2715
Website: www.TUVamerica.com

EUT General Description

EUT Description	Commercial Food Warmer
Model Name	
Model Number(s)	8076208
EUT Measured Field Strength	62.1 dBµV/m @ 3 meters
Frequency Range	13.56 MHz in the 13.110 to 14.0101 MHz band
Number of Operating Frequencies	1
Antenna Type	Custom (not user accessible)

TÜV SÜD AMERICA INC 5610 West Sligh Ave., Suite 100, Tampa, FL 33634 Phone: 813 284 2715
Website: www.TUVamerica.com

1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	*Description*	*Model / Serial Number*
A	Radiated Transmit Mode (no cabinet	8076208 / 1000302
B	EUT RFID PWB placed in temperature chamber with small loop antenna.	8076208 / 1000302
C	Radiated Transmit Mode (2 X 2) cabinet)	MHC22SNT1T / 1802ES0088 MHC22SNL1T
D	Radiated Transmit Mode (4 X 2) cabinet)	MHC24SNT2T / 1606150000313
E	Radiated Transmit Mode (5 X 2) cabinet)	MHC52SNT1T / 1803ES0126
F	Radiated Transmit Mode (5 X 4) cabinet)	MHC54SNT1T / 1512150000574

1.4.2 EUT Exercise Software

The EUT was exercised using proprietary software which set the RFID output power to (100%).

1.4.3 Support Equipment and I/O cables

Manufacturer	*Equipment/Cable*	*Description*

TÜV SÜD AMERICA INC 5610 West Sligh Ave., Suite 100, Tampa, FL 33634 Phone: 813 284 2715
Website: www.TUVamerica.com

1.5 DEVIATIONS FROM THE STANDARD

No deviations from the standard were exercised.

1.6 MODIFICATION RECORD

Description of Modification	Modification Fitted By	Date Modification Fitted
Serial Number:		
None		

The table above details modifications made to the EUT during the test programme. The modifications incorporated during each test (if relevant) are recorded on the appropriate test pages.

1.7 TEST METHODOLOGY

All measurements contained in this report were conducted with ANSI C63.10-2013. American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

For conducted and radiated emissions, the equipment under test (EUT) was configured to measure its highest possible emission level. This level was based on the maximized cable configuration from exploratory testing per ANSI C63.10-2013. The test modes were adapted according to the Operating Instructions provided by the manufacturer/client.

1.8 TEST FACILITY LOCATION

1.8.1 TÜV SÜD America Inc. (Tampa)

5610 W. Sligh Ave, Suite 100, Tampa, FL 33634

1.9 TEST FACILITY REGISTRATION

1.9.1 FCC – Site Registration: US1063

The TUV SUD America Inc. (Tampa), test facility has been registered with the Federal Communication Commission as an ISO/IEC 17025 accredited test laboratory and assigned the designation number US1063.

1.9.2 Innovation, Science and Economic Development Canada (IC) Registration No.: 2087A-2

The TUV SUD America Inc. (Tampa), test facility has been registered with Innovation, Science and Economic Development Canada and assigned the site number 2087A-2.

1.9.3 VCCI – Registration No. A-0293

The TUV SUD America Inc. (Tampa), test facility has been registered with the VCCI and assigned the registration number A-0293.

SECTION 2

TEST DETAILS

Radio Testing of the
Frymaster LLC
Model 8076208

TÜV SÜD AMERICA INC 5610 West Sligh Ave., Suite 100, Tampa, FL 33634 Phone: 813 284 2715
Website: www.TUVamerica.com

2.1 FREQUENCY STABILITY

2.1.1 Specification Reference

Part 15 Subpart C §15.225(e)
RSS-GEN § 6.11

2.1.2 Standard Applicable

(e) The frequency tolerance of the carrier signal shall be maintained within ±0.01% of the operating frequency over a temperature variation of −20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

2.1.3 Equipment Under Test and Modification State

Serial No: 1000302 / Test Configuration B

2.1.4 Date of Test/Initial of test personnel who performed the test

30. August 2018 / SH

2.1.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.1.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Tampa facility.

Ambient Temperature	24 °C
Relative Humidity	44 %

2.1.7 Additional Observations

- This is a radiated test. The test antenna output is directly connected to the spectrum analyzer input via a suitable external attenuator.
- Measurement was done using the spectrum analyser to measure the frequency variation of the EUT's RFID system.
- The RBW was set to 1 kHz for better resolution.
- The temperature was varied from -10°C to +55°C as requested by the manufacturer in 10 degree increments with voltage variation of 85% and 115% output @ 20°C.
- The EUT was powered off, then powered on once the temperature stabilized and the frequency was then measured.

TÜV SÜD AMERICA INC 5610 West Sligh Ave., Suite 100, Tampa, FL 33634 Phone: 813 284 2715
Website: www.TUVamerica.com

2.1.8 Test Results

Table 2.1.8-1 – RFID Reader Board Frequency Stability

RFID @ 13.56MHz - RFID Reader Board					
Voltage (%)	***Power (VDC)***	***Temp (°C)***	***Frequency (Hz)***	***Frequency Deviation (Hz)***	***Deviation (%)***
100	12.0	-20	13.562,520	+35	0.000258
		-10	13.562,520	+35	0.000258
		0	13.562,485	0	0
		+10	13.562,485	0	0
		+30	13.562,450	-35	0.000258
		+40	13.562,415	-70	0.000516
		+50	13.562,415	-70	0.000516
		+55	13.562,415	-70	0.000516
Voltage Variation (85% and 115%)	10.2	+20	13.562,485	0	0
	13.8	+20	13.562,485	0	0

Maximum Deviation = 0.000516% < 0.01% Limit **(Complies)**

TÜV SÜD AMERICA INC 5610 West Sligh Ave., Suite 100, Tampa, FL 33634 Phone: 813 284 2715
Website: www.TUVamerica.com

2.2 20 dB BANDWIDTH

2.2.1 Specification Reference

Part 15 Subpart C §15.215(c)

2.2.2 Standard Applicable

(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §15.217 through §15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

2.2.3 Equipment Under Test and Modification State

Serial No: 1000302 / Test Configuration A

2.2.4 Date of Test/Initial of test personnel who performed the test

28. August 2018 / DF

2.2.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.2.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Tampa facility.

Ambient Temperature	23 °C
Relative Humidity	44 %

2.2.7 Additional Observations

- This is a radiated test.
- Span is wide enough to capture the channel transmission.
- Since RBW wasn't specified, RBW was set to 9 kHz
- Sweep is auto.
- Detector is peak.
- The display line is set to -20 dBc. The spectrum analyser was used for this test.

2.2.8 Test Results

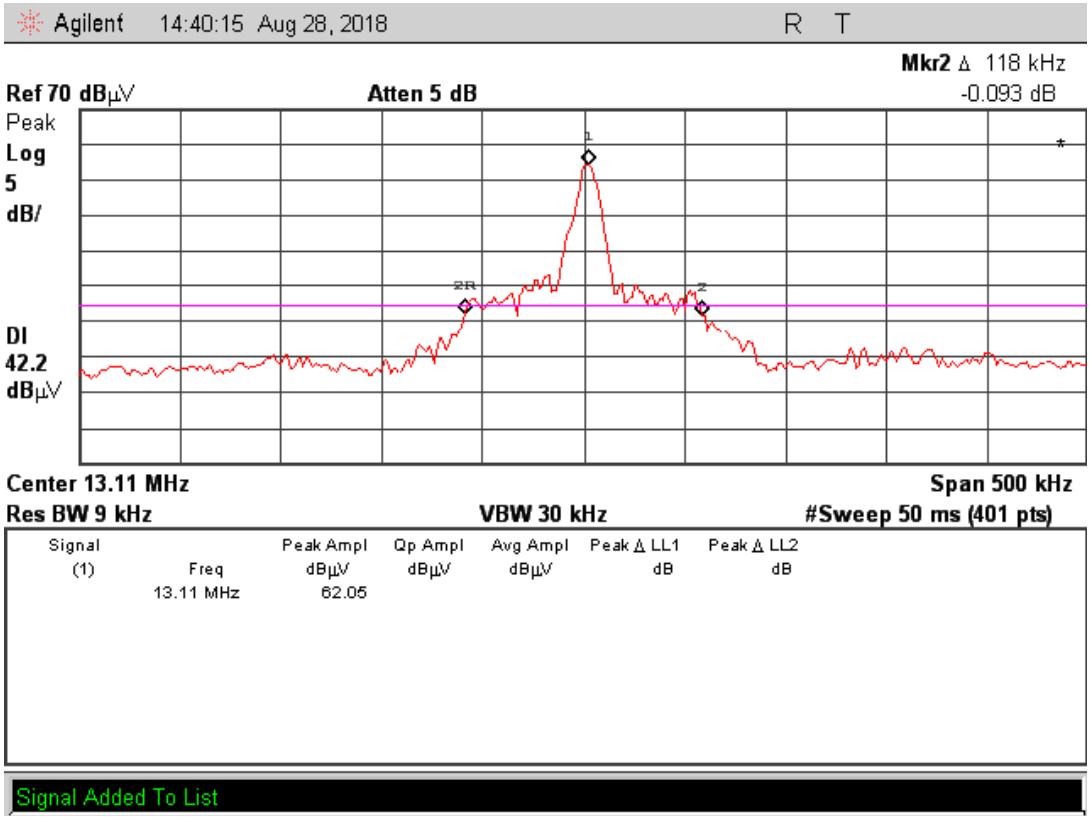


Figure 2.2.8-1 – Bandwidth Plot

Notes:

Measured 20dB Bandwidth: 118 kHz
Frequency Band: 13.110 to 14.010 MHz (900 kHz)

Table 2.2.8-1 – Bandwidth Data

Frequency	20dB bandwidth	20 dB bandwidth Limit	Verdict
13.56 MHz	118 kHz	900 kHz	Pass

2.3 99% BANDWIDTH

2.3.1 Specification Reference

RSS-GEN § 6.7

2.3.2 Standard Applicable

2.3.3 The occupied bandwidth or the "99% emission bandwidth" is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs. In some cases, the "x dB bandwidth" is required, which is defined as the frequency range between two points, one at the lowest frequency below and one at the highest frequency above the carrier frequency, at which the maximum power level of the transmitted emission is attenuated x dB below the maximum in-band power level of the modulated signal, where the two points are on the outskirts of the in-band emission.

2.3.4 Equipment Under Test and Modification State

Serial No: 1000302 / Test Configuration A

2.3.5 Date of Test/Initial of test personnel who performed the test

28. August 2018 / DF

2.3.6 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.3.7 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Tampa facility.

Ambient Temperature	23 °C
Relative Humidity	44 %

2.3.8 Additional Observations

- This is a radiated test.
- Span is wide enough to capture the channel transmission.
- The anticipated bandwidth was (1) MHz so the RBW was set to (9) kHz and VBW at (30) kHz
- Sweep is auto.
- Detector is peak.
- The display line is set to -23 dBc. The spectrum analyser was used for this test.

TÜV SÜD AMERICA INC 5610 West Sligh Ave., Suite 100, Tampa, FL 33634 Phone: 813 284 2715
Website: www.TUVamerica.com

2.3.9 Test Results

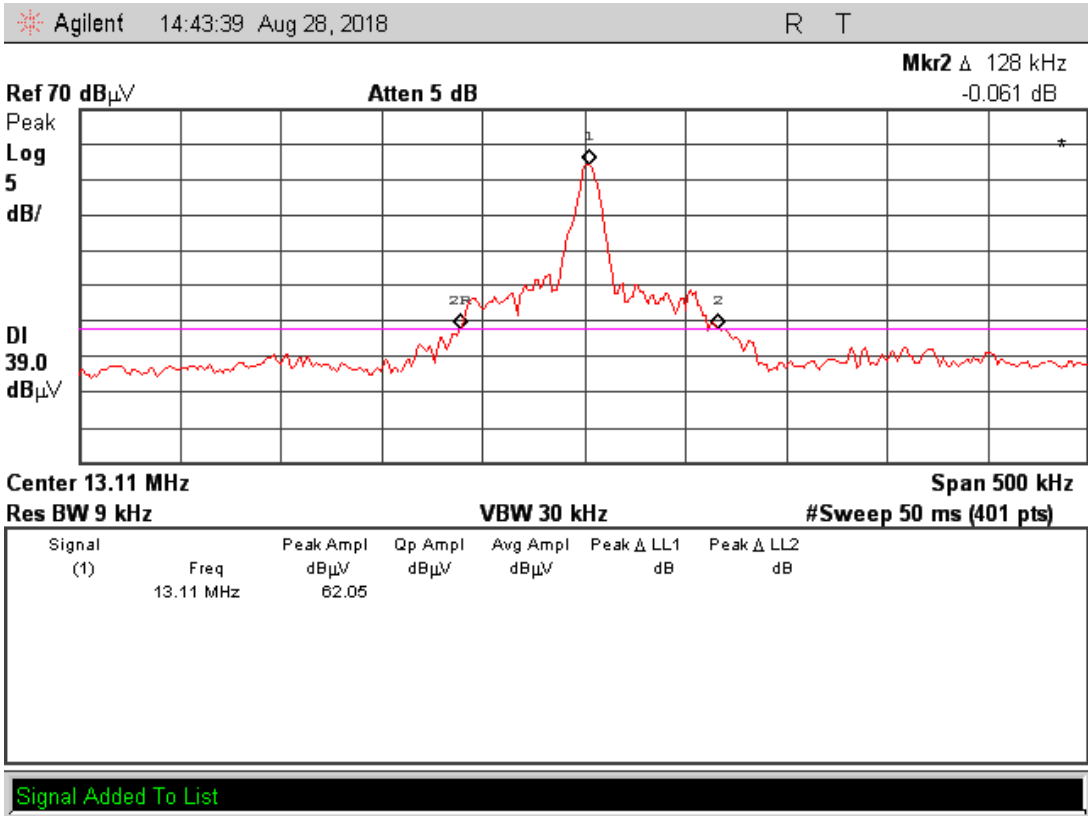


Figure 2.3.9-1 – Bandwidth Plot

Notes:

Measured 20dB Bandwidth: 128 kHz
Frequency Band: 13.110 to 14.010 MHz (900 kHz)

Table 2.3.9-1 – Bandwidth Data

Frequency	99% bandwidth	99% bandwidth Limit	Verdict
13.56 MHz	128 kHz	none	Pass

2.4 EMISSION MASK

2.4.1 Specification Reference

Part 15 Subpart C §15.225(a)(b)(c)
RSS-210 Annex B6(a)(b)(c)

2.4.2 Standard Applicable

(a) The field strength of any emissions within the band 13.553–13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.
(b) Within the bands 13.410–13.553 MHz and 13.567–13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.
(c) Within the bands 13.110–13.410 MHz and 13.710–14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

2.4.3 Equipment Under Test and Modification State

Serial No: 1000302 / Test Configuration A

2.4.4 Date of Test/Initial of test personnel who performed the test

28. August 2018 / DF

2.4.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.4.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Tampa facility.

Ambient Temperature	22 °C
Relative Humidity	38 %

2.4.7 Additional Observations

- This is a radiated test. The spectrum was searched from 13.110 MHz to 14.010 MHz.
- Limits were converted from 30 meters to 3 meters using 20 dB/decade extrapolation rules.
- Measurement was done using EMC32 V8.54automated software. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only. See Section 2.4.8 for sample computation.

2.4.8 Sample Computation (Radiated Emission)

Measuring equipment raw measurement (dBµV) @ 30 MHz			20.0
Correction Factor (dB)	Cable 2	0.24	18.94
	TEMC00011 (antenna)	18.70	
Reported QuasiPeak Final Measurement (dBµV/m) @ 30 MHz			**38.94**

2.4.9 Sample Computation (Limits)

Limit @ 13.553–13.567 MHz:	= 15,848 µV/m @30 meters
	= 20 log(15,848 µV/m)
	= 84 dB µV/m @30 meters
Using 20dB/decade extrapolation rule:	= 20 log (30m/3m)
Measuring distance correction factor:	= 20 dB
Calculated limit @ 3 meters:	= 84 dB µV/m + 20 dB
	= 104 dB µV/m

2.4.10 Test Results

Complies. See attached plots.

TÜV SÜD AMERICA INC 5610 West Sligh Ave., Suite 100, Tampa, FL 33634 Phone: 813 284 2715
Website: www.TUVamerica.com

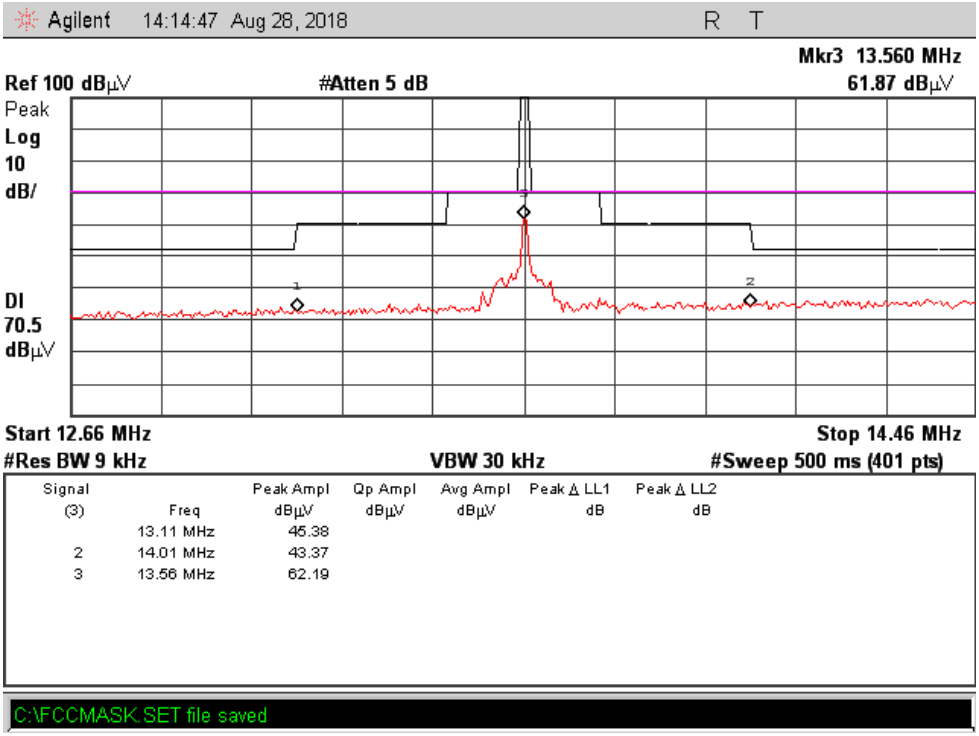


Figure 2.4.10-1 – Emissions within the 13.1 MHz to 14.01 MHz Band

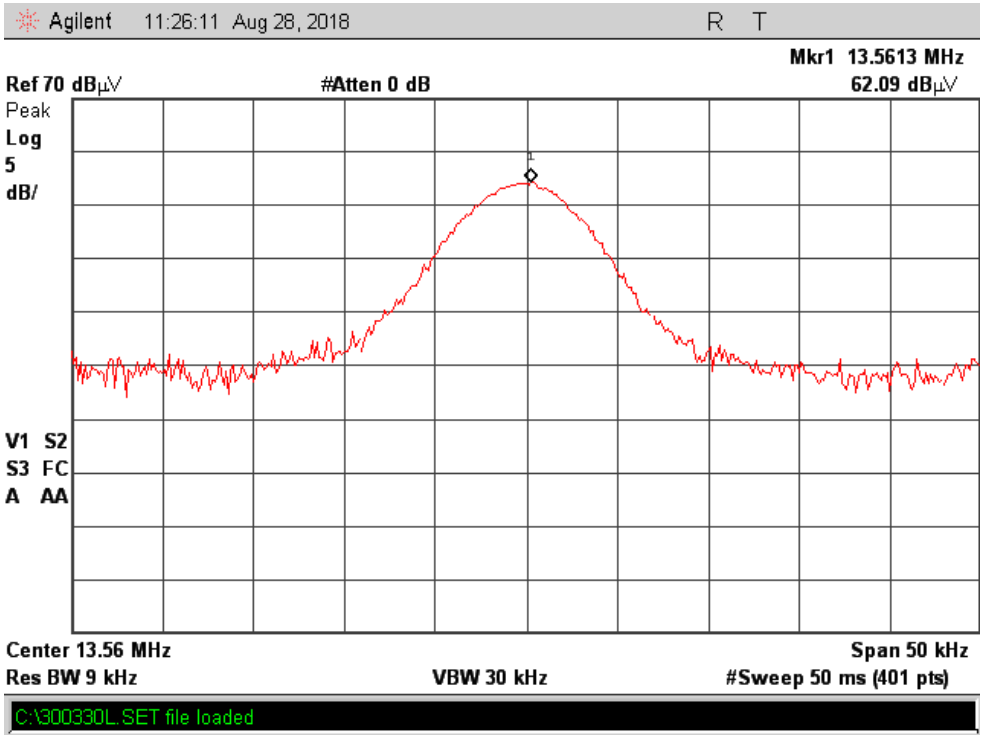


Figure 2.4.10-2 – Emissions within the 13.1 MHz to 14.01 MHz Band
Limit = (104) dBµV/m

2.5 SPURIOUS RADIATED EMISSIONS

2.5.1 Specification Reference

Part 15 Subpart C §15.225(d)
RSS-210 Annex B6(d)

2.5.2 Standard Applicable

(d) The field strength of any emissions appearing outside of the 13.110–14.010 MHz band shall not exceed the general radiated emission limits in §15.209.

2.5.3 Equipment Under Test and Modification State

Serial No: See configuration table / Test Configuration A,C,D,E & F

2.5.4 Date of Test/Initial of test personnel who performed the test

28. August – 04. September 2018 / DF

2.5.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.5.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Tampa facility.

Ambient Temperature	25 °C
Relative Humidity	48 %

2.5.7 Additional Observations

- This is a radiated test. The spectrum was searched from 9kHz to 15GHz
- There were no emissions found that do not comply with the restricted bands defined in FCC Part 15 Subpart C, 15.205.
- Measurement was done using EMC32 V8.54 automated software. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only. See Section 2.5.8 for sample computation.

2.5.8 Sample Computation (Radiated Emission)

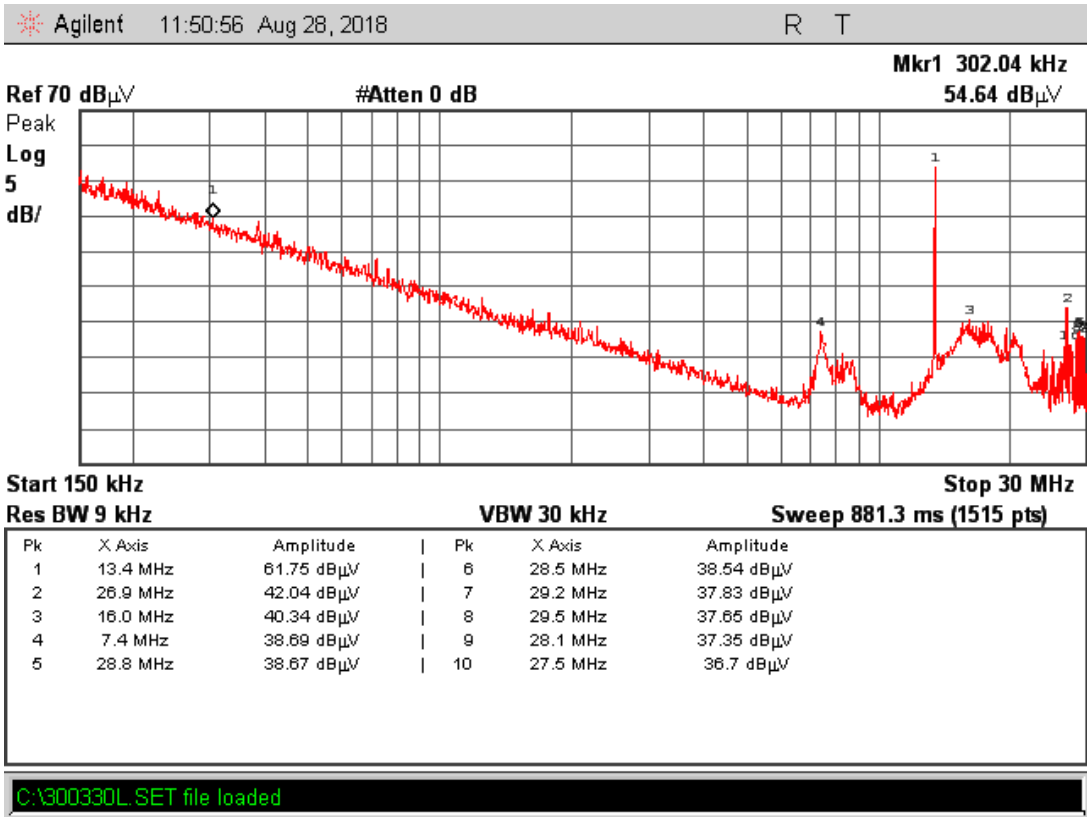
Measuring equipment raw measurement (dBµV) @ 30 MHz			20.0
Correction Factor (dB)	Cable 2	0.24	18.94
	TEMC00011 (antenna)	18.70	
Reported QuasiPeak Final Measurement (dBµV/m) @ 30MHz			**38.94**

2.5.9 Test Results

See attached plots.

TÜV SÜD AMERICA INC 5610 West Sligh Ave., Suite 100, Tampa, FL 33634 Phone: 813 284 2715
Website: www.TUVamerica.com

Test Results Below 30MHz (configuration A)



Pk	X Axis	Amplitude	Pk	X Axis	Amplitude
1	13.4 MHz	61.75 dBµV	6	28.5 MHz	38.54 dBµV
2	26.9 MHz	42.04 dBµV	7	29.2 MHz	37.83 dBµV
3	16.0 MHz	40.34 dBµV	8	29.5 MHz	37.65 dBµV
4	7.4 MHz	38.69 dBµV	9	28.1 MHz	37.35 dBµV
5	28.8 MHz	38.67 dBµV	10	27.5 MHz	36.7 dBµV

Figure 2.5.9-1 – Radiated Emissions Data 150 kHz – 30 MHz
Configuration A

Test Notes: Fundamental frequency ignored (13.56 MHz)

Test Results 30 MHz to 1GHz (configuration A)

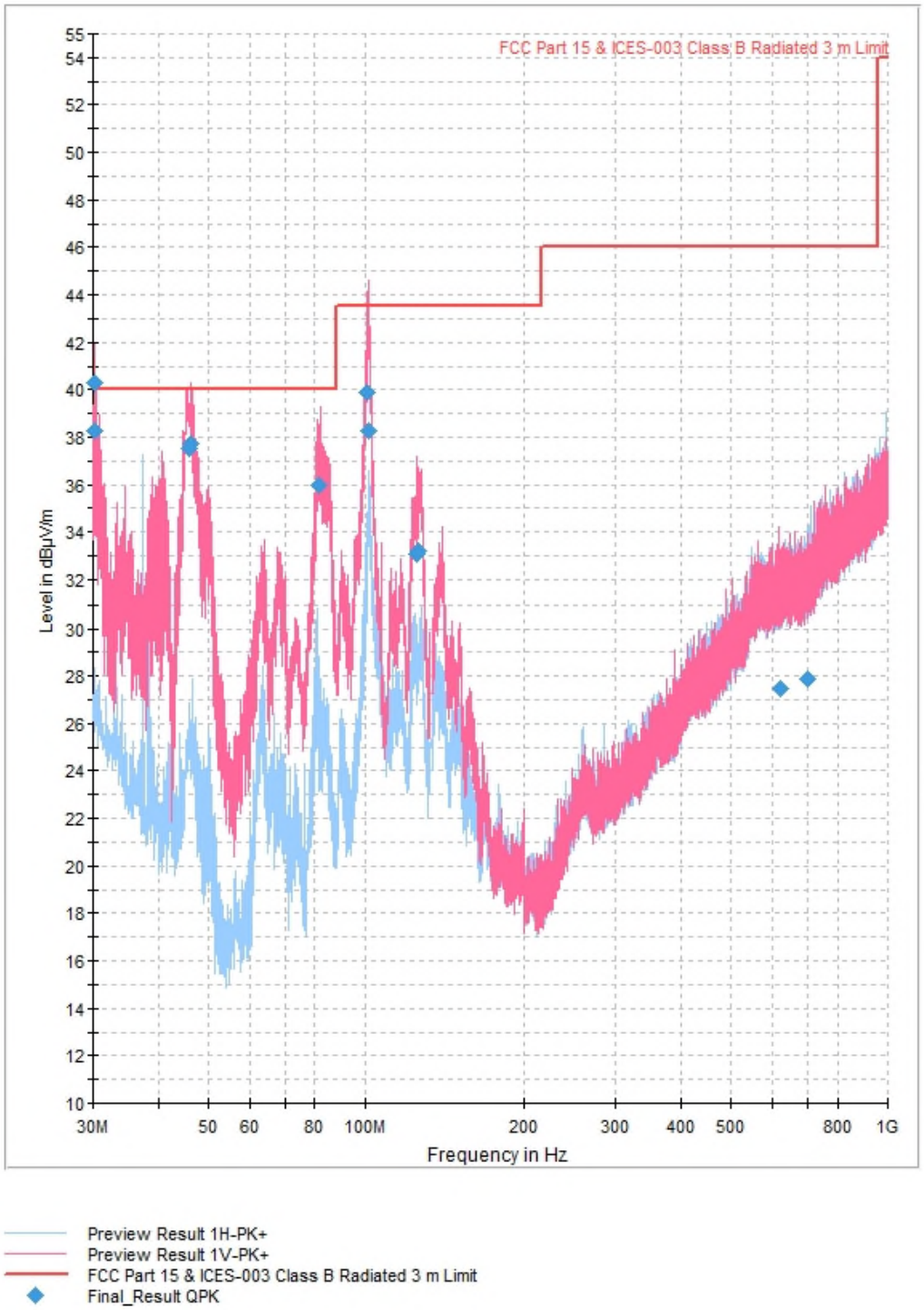


Figure 2.5.9-2 – Radiated Emissions 30 MHz to 1 GHz Plot

Table 2.5.9-1 - Quasi Peak Data (§15.209 Limits) 30 – 1000 MHz

Spurious Y/N	Frequency (MHz)	QuasiPeak (dBµV/m)	Height (cm)	Pol.	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
N	30.200	38.2	104.0	V	225.0	25.7	11.4	49.6
N	30.240	40.3	100.0	V	249.0	25.7	9.3	49.6
N	45.840	37.5	109.0	V	45.0	16.6	12.1	49.6
N	46.160	37.7	111.0	V	35.0	16.5	11.9	49.6
Y	81.320	36.0	150.0	V	135.0	14.3	4.0	40.0
N	101.000	39.9	111.0	V	141.0	18.3	14.1	54.0
N	101.240	38.3	100.0	V	144.0	18.3	15.7	54.0
N	125.600	33.1	116.0	V	289.0	19.9	20.9	54.0
N	126.440	33.2	104.0	V	293.0	19.9	20.8	54.0
N	620.320	27.5	400.0	V	48.0	28.1	29.5	57.0
N	701.480	27.9	386.0	V	64.0	28.5	29.1	57.0

Note: All non-spurious emissions are subject to Class A Digital limit.

TÜV SÜD AMERICA INC 5610 West Sligh Ave., Suite 100, Tampa, FL 33634 Phone: 813 284 2715
Website: www.TUVamerica.com

Test Results Below 30 MHz (configuration C)

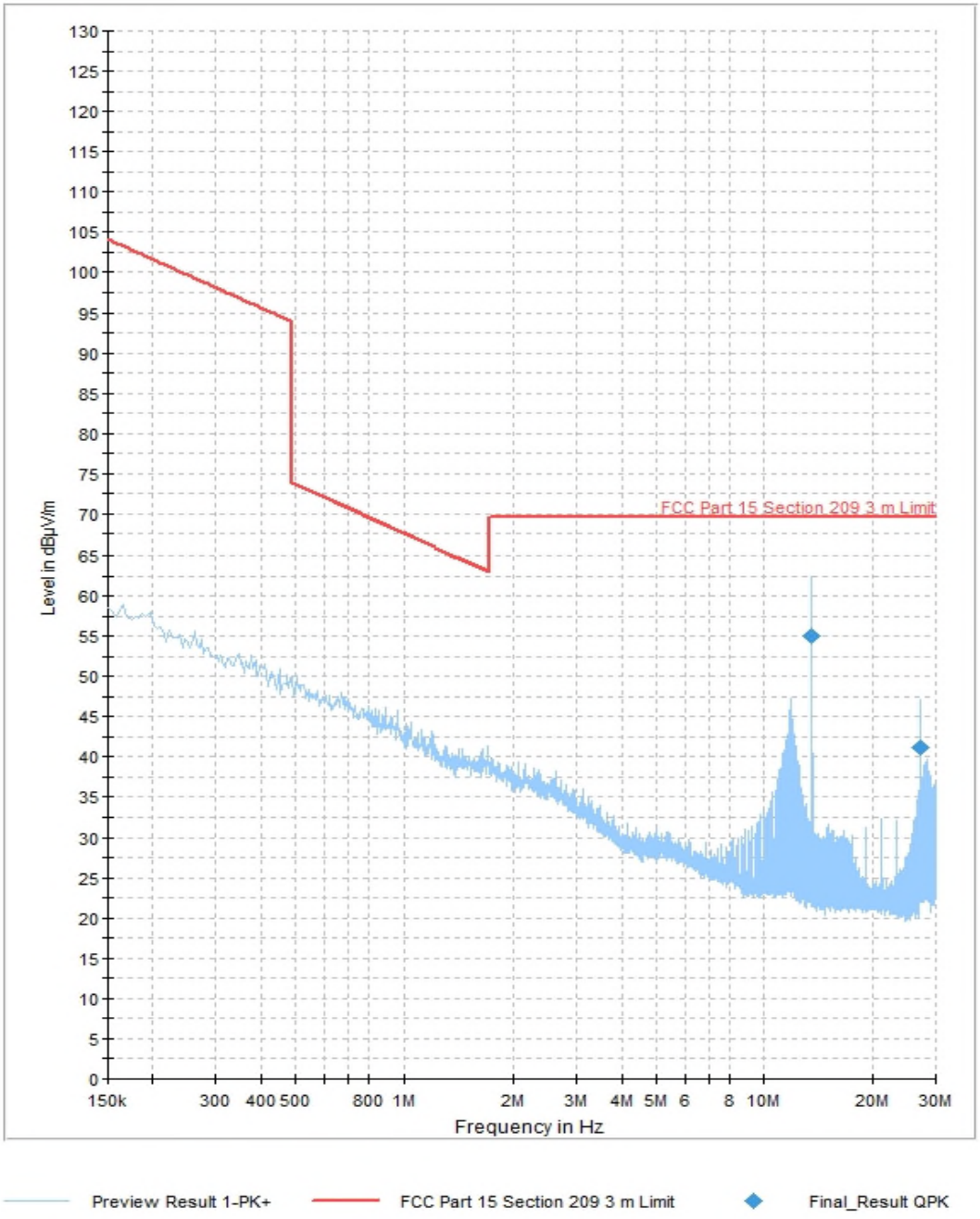


Figure 2.5.9-3 – Radiated Emissions Data 150 kHz – 30 MHz

Test Notes: Fundamental frequency ignored (13.56 MHz)

TÜV SÜD AMERICA INC 5610 West Sligh Ave., Suite 100, Tampa, FL 33634 Phone: 813 284 2715
Website: www.TUVamerica.com

Test Results 30 MHz to 1GHz (configuration C)

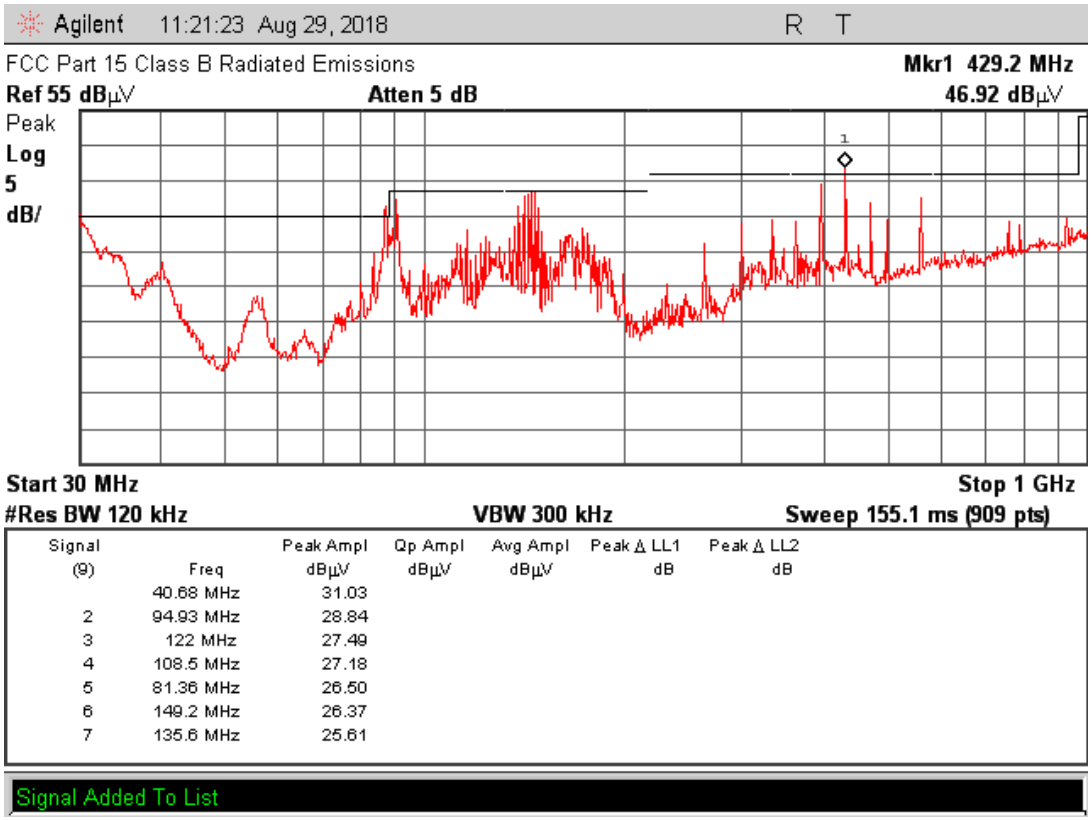


Figure 2.5.9-4 – Radiated Emissions 30 MHz to 1 GHz Plot

Table 2.5.9-2 - Quasi Peak Data (§15.209 Limits) 30 – 1000 MHz

Spurious Y/N	Frequency (MHz)	Peak (dBµV/m)	Margin (dB)	Limit (dBµV/m)
Y	40.68	31.0	9.0	40.0
Y	81.36	26.5	13.5	40.0
Y	94.93	28.8	14.7	43.5
Y	108.5	27.2	16.3	43.5
Y	122.0	27.5	16.0	43.5
Y	135.6	25.6	17.9	43.5
Y	149.2	26.4	17.1	43.5

Note: All non-spurious emissions are subject to Class A Digital limit.

Test Results Below 30 MHz (configuration D)

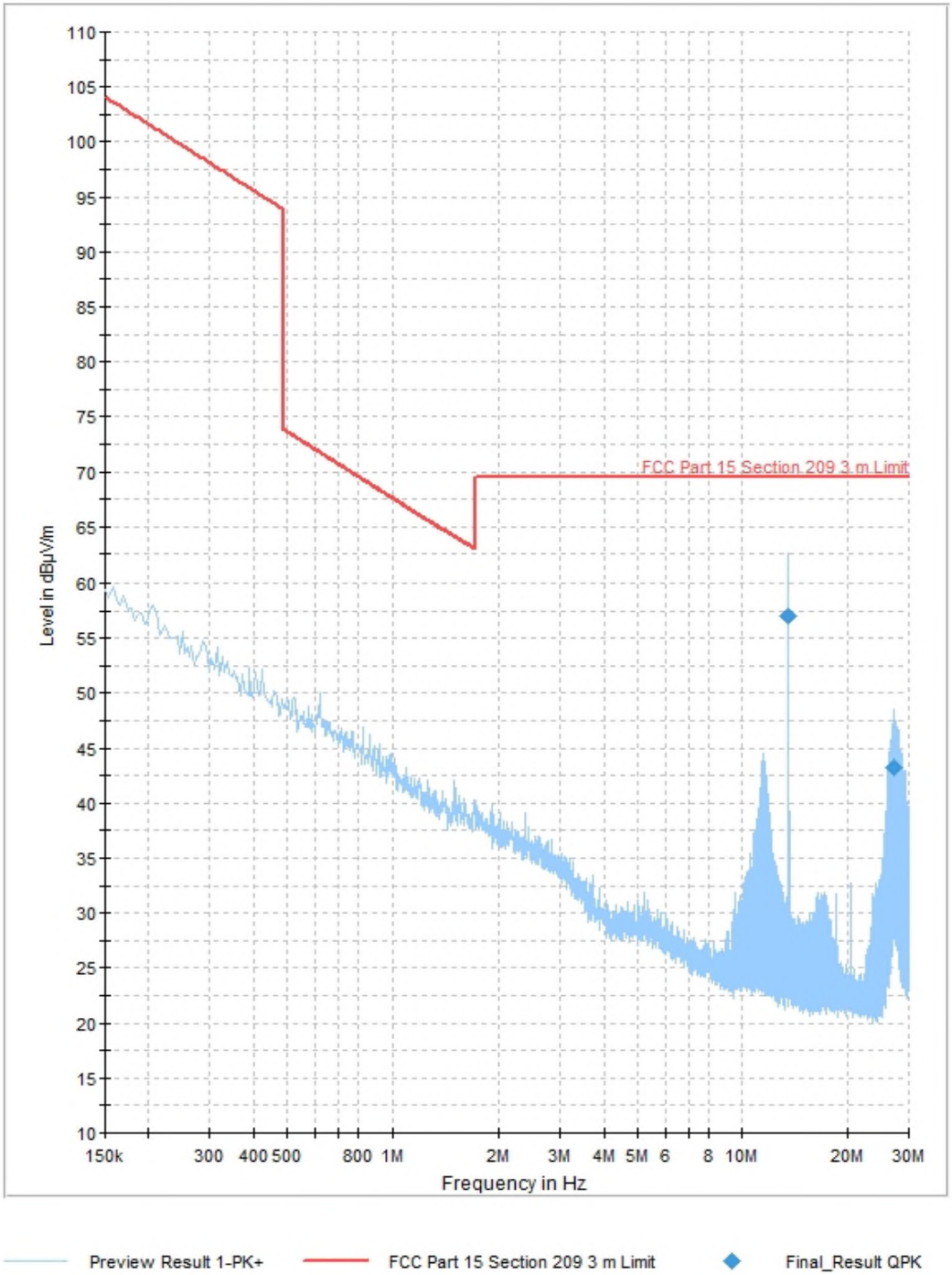


Figure 2.5.9-5 – Radiated Emissions Data 150 kHz – 30 MHz

Test Notes: Fundamental frequency ignored (13.56 MHz)

Test Results 30MHz to 1GHz (configuration D)

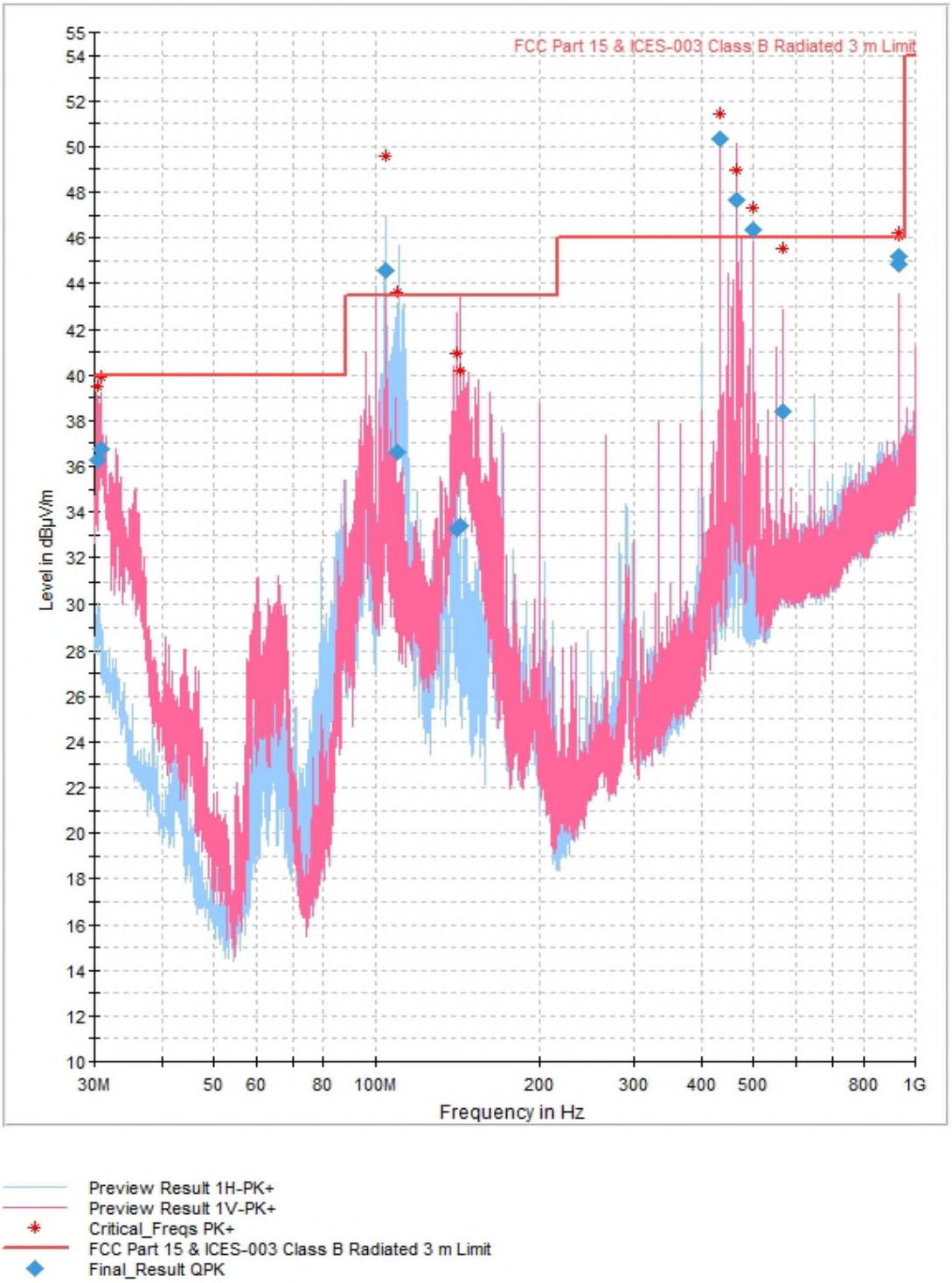


Figure 2.5.9-6 – Radiated Emissions 30 MHz to 1 GHz Plot

Table 2.5.9-3 - Quasi Peak Data (§15.209 Limits) 30 – 1000 MHz

Spurious Y/N	Frequency (MHz)	QuasiPeak (dBµV/m)	Height (cm)	Pol.	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
N	30.520000	36.3	109.0	V	45.0	25.5	13.3	49.6
N	30.760000	36.8	126.0	V	13.0	25.4	12.8	49.6
N	104.120000	44.5	168.0	H	308.0	18.7	9.5	54.0
N	109.800000	36.6	184.0	H	326.0	19.5	17.4	54.0
N	140.720000	33.3	104.0	V	180.0	18.9	20.7	54.0
N	142.680000	33.4	100.0	V	180.0	18.7	23.6	57.0
N	433.320000	50.3	103.0	V	172.0	25.3	6.7	57.0
N	466.680000	47.7	109.0	V	18.0	25.8	9.3	57.0
N	500.000000	46.4	107.0	V	35.0	26.2	10.6	57.0
N	566.680000	38.4	103.0	V	18.0	27.9	18.6	57.0
N	933.320000	45.2	106.0	V	43.0	30.8	11.8	57.0
N	933.360000	44.9	104.0	V	48.0	30.8	12.1	57.0

All non-spurious emissions are subject to Class A Digital limit

TÜV SÜD AMERICA INC 5610 West Sligh Ave., Suite 100, Tampa, FL 33634 Phone: 813 284 2715
Website: www.TUVamerica.com

Test Results Below 30MHz (configuration E)

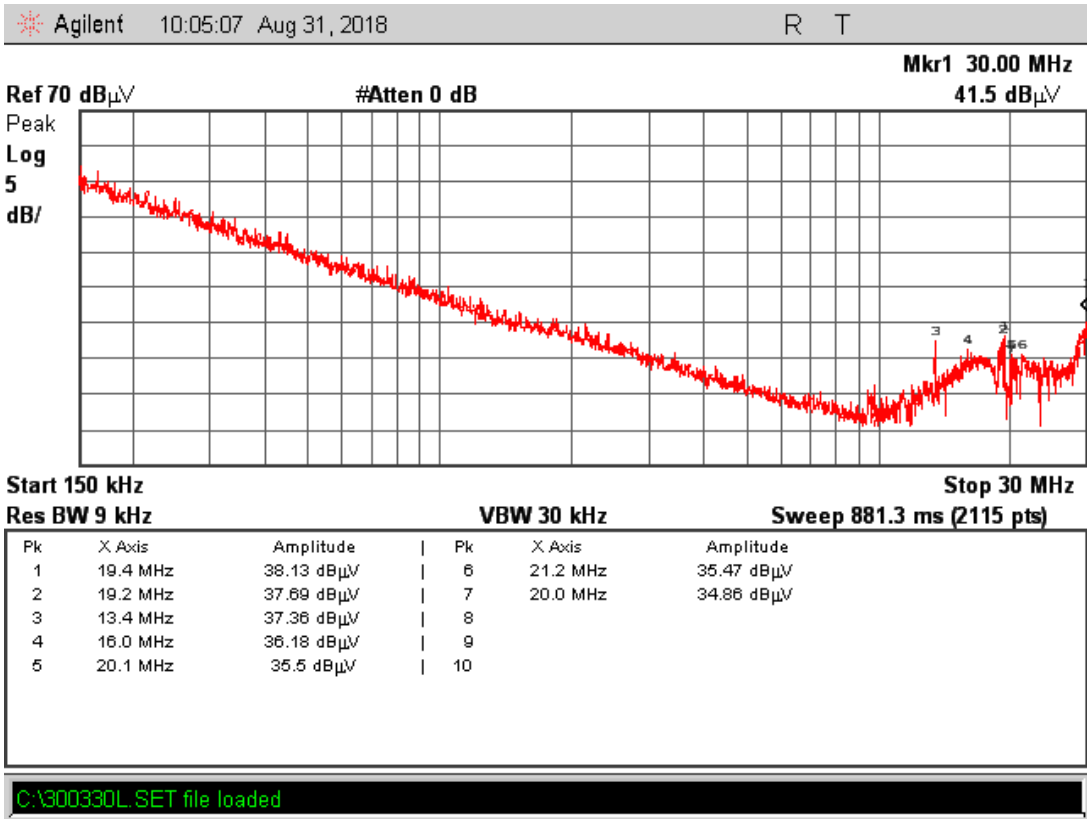


Figure 2.5.9-7 – Radiated Emissions Data 150 kHz – 30 MHz

Test Notes: Fundamental frequency ignored (13.56 MHz)

Test Results 30MHz to 1GHz (configuration E)

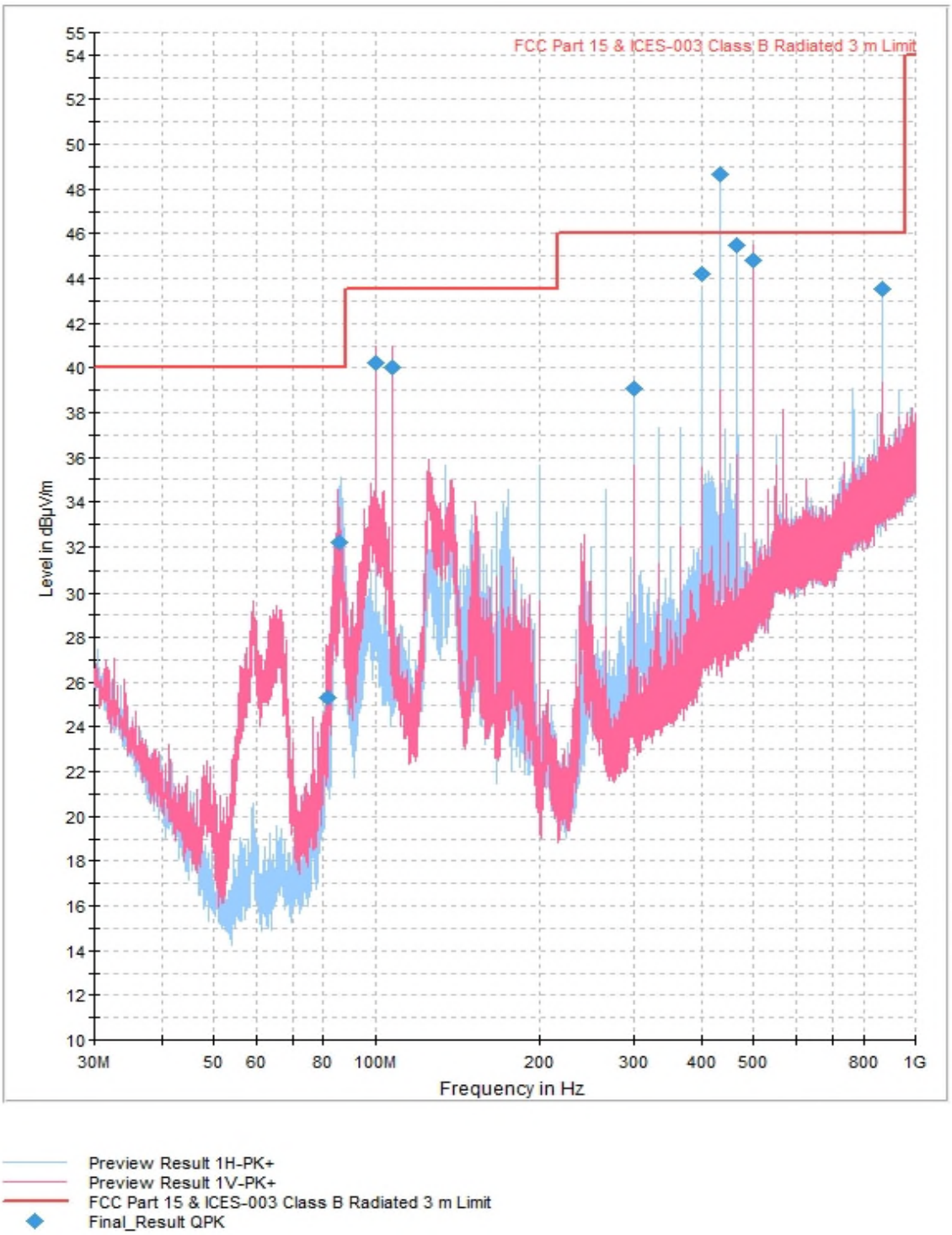


Figure 2.5.9-8 – Radiated Emissions 30 MHz to 1 GHz Plot

Table 2.5.9-4 - Quasi Peak Data (§15.209 Limits) 30 – 1000 MHz

Spurious Y/N	Frequency (MHz)	QuasiPeak (dBµV/m)	Height (cm)	Pol.	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
Y	81.364	25.3	396.0	H	279.0	14.3	14.7	40.0
N	85.300	32.2	132.0	V	50.0	15.0	17.4	49.6
N	100.000	40.2	124.0	V	0.0	18.1	13.8	54.0
N	107.360	40.0	400.0	V	24.0	19.2	14.0	54.0
N	300.000	39.1	113.0	H	100.0	21.3	17.9	57.0
N	400.000	44.2	106.0	H	131.0	24.2	12.8	57.0
N	433.360	48.7	100.0	H	34.0	25.3	8.3	57.0
N	466.680	45.5	104.0	H	56.0	25.8	11.5	57.0
N	500.000	44.8	119.0	V	23.0	26.2	12.2	57.0
N	866.680	43.5	119.0	H	354.0	30.3	13.5	57.0

Note: All non-spurious emissions are subject to Class A Digital limit.

TÜV SÜD AMERICA INC 5610 West Sligh Ave., Suite 100, Tampa, FL 33634 Phone: 813 284 2715
Website: www.TUVamerica.com

Test Results Below 30 MHz (configuration F)

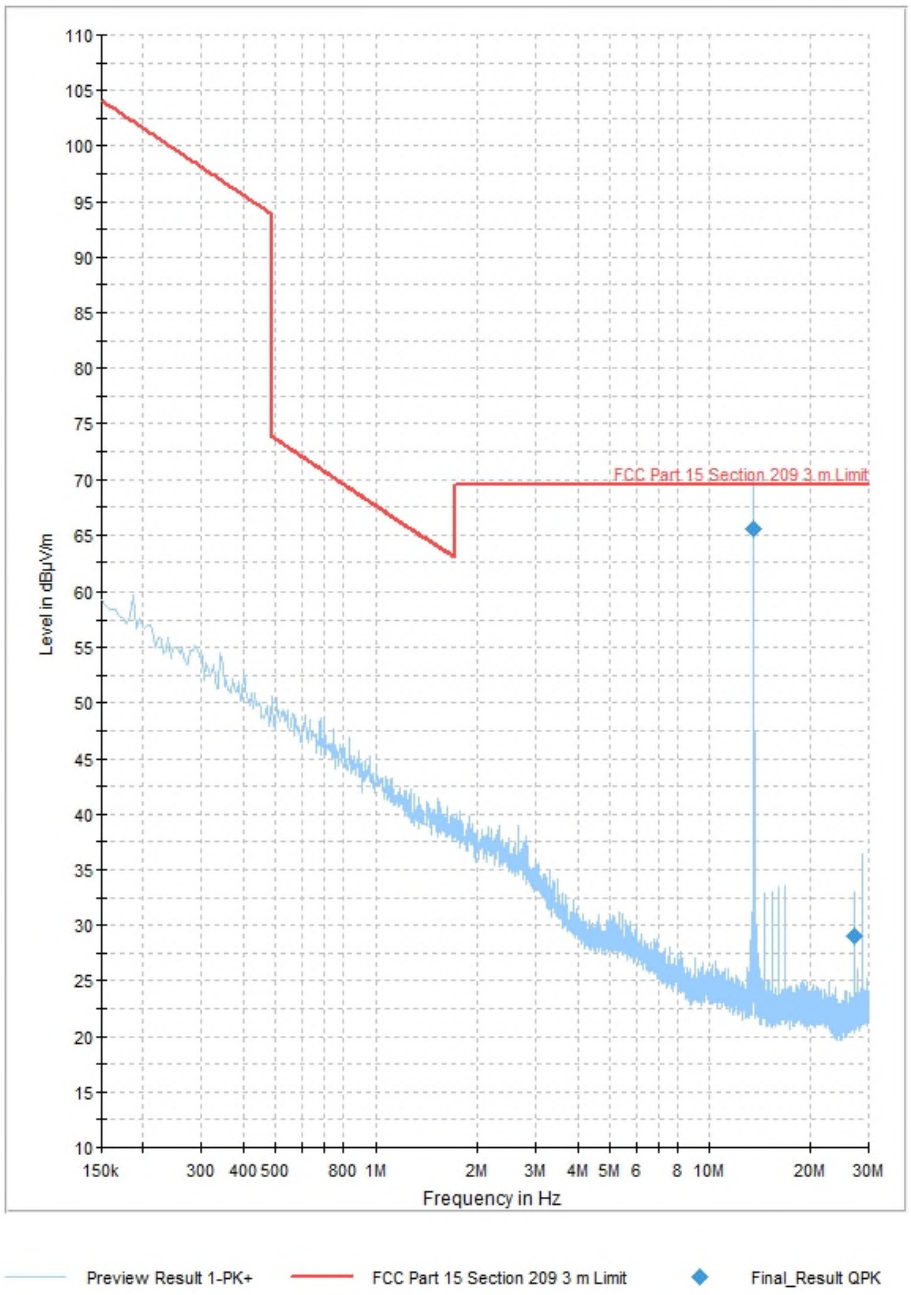


Figure 2.5.9-9 – Radiated Emissions Data 150 kHz – 30 MHz

Test Notes: Fundamental frequency ignored (13.56 MHz)

TÜV SÜD AMERICA INC 5610 West Sligh Ave., Suite 100, Tampa, FL 33634 Phone: 813 284 2715
Website: www.TUVamerica.com

Test Results 30 MHz to 1GHz (configuration F)

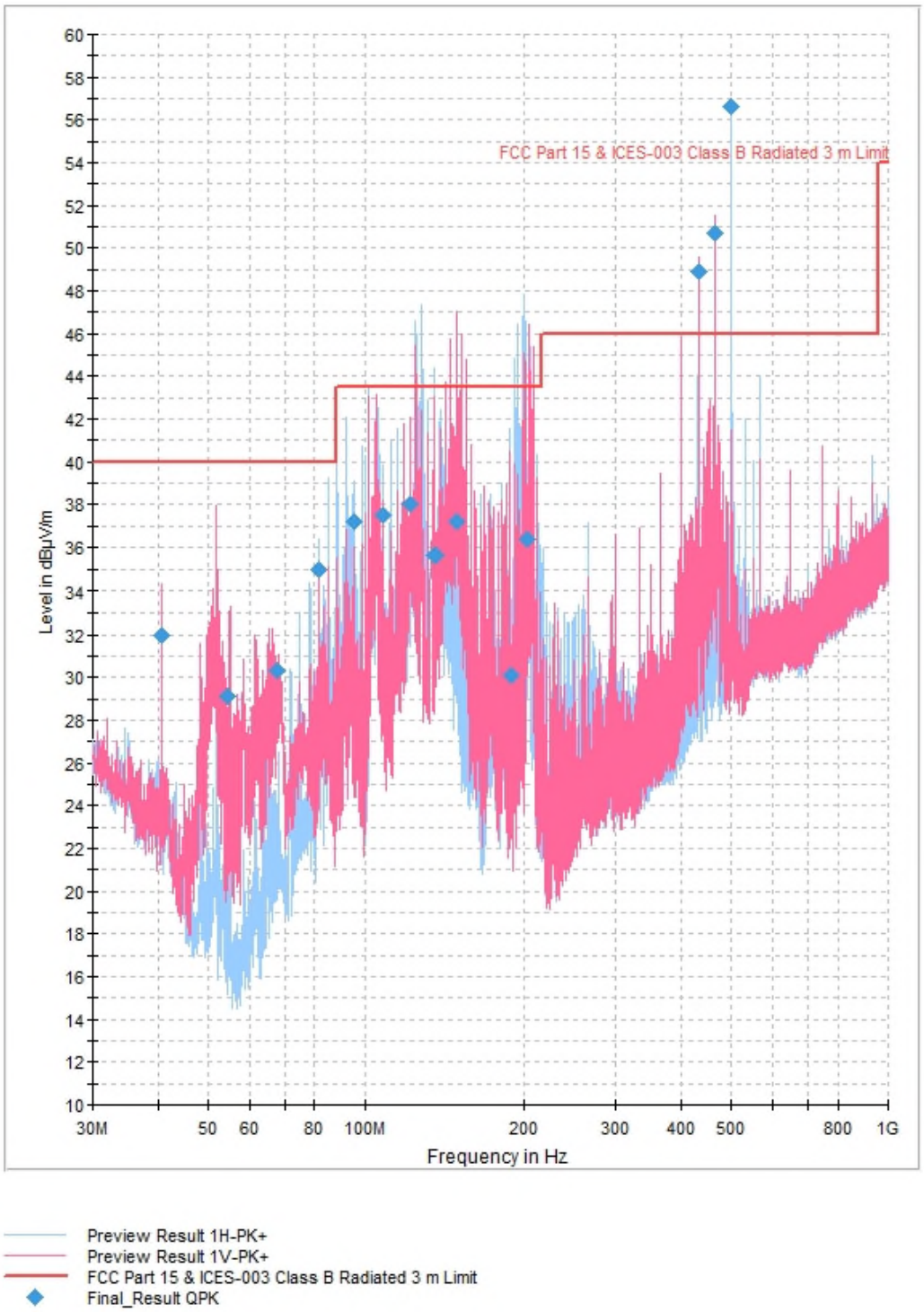


Figure 2.5.9-10 – Radiated Emissions 30 MHz to 1 GHz Plot

Table 2.5.9-5 - Quasi Peak Data (§15.209 Limits) 30 – 1000 MHz

Spurious Y/N	Frequency (MHz)	QuasiPeak (dBµV/m)	Height (cm)	Pol.	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
Y	40.682	32.0	100.0	V	135.0	19.4	8.0	40.0
Y	54.240	29.1	108.0	V	22.0	13.7	10.1	40.0
Y	67.800	30.3	125.0	V	260.0	13.3	9.7	40.0
Y	81.365	35.0	159.0	H	254.0	14.3	5.0	40.0
Y	94.920	37.2	159.0	H	42.0	17.1	6.3	43.5
Y	108.480	37.5	199.0	H	62.0	19.3	6.0	43.5
Y	122.041	38.0	167.0	V	188.0	20.0	5.5	43.5
Y	135.601	35.6	104.0	H	265.0	19.3	7.9	43.5
Y	149.168	37.2	104.0	V	269.0	18.2	6.3	43.5
Y	189.850	30.1	120.0	V	225.0	16.9	13.4	43.5
Y	203.410	36.4	140.0	H	180.0	17.4	7.1	43.5
N	433.320	48.9	100.0	V	18.0	25.3	8.1	57.0
N	466.680	50.7	144.0	H	42.0	25.8	6.3	57.0
N	500.000	56.7	123.0	H	16.0	26.2	0.3	57.0

Note: All non-spurious emissions are subject to Class A Digital limit.

TÜV SÜD AMERICA INC 5610 West Sligh Ave., Suite 100, Tampa, FL 33634 Phone: 813 284 2715
Website: www.TUVamerica.com

2.6 CONDUCTED EMISSIONS

2.6.1 Specification Reference

Part 15 Subpart C §15.207(a)
RSS-GEN § 8.8

2.6.2 Standard Applicable

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 30 MHz, shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN).

Frequency of emission (MHz)	Conducted limit (dBµV)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

**Decreases with the logarithm of the frequency.*

2.6.3 Equipment Under Test and Modification State

Serial No: 1802ES0088 /Test Configuration C

2.6.4 Date of Test/Initial of test personnel who performed the test

30. August 2018 / DF

2.6.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.6.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Tampa facility.

Ambient Temperature	22 °C
Relative Humidity	40 %

TÜV SÜD AMERICA INC 5610 West Sligh Ave., Suite 100, Tampa, FL 33634 Phone: 813 284 2715
Website: www.TUVamerica.com

2.6.7 Additional Observations

- The EUT contains two different RFID readers and this test is to show compliance to the general limits of §15.207(a).
- The host device is a class A digital device. The following plots demonstrate compliance as a class A device and compliance with 15.207(a) for the intentional radiator portion of the emissions.

2.6.8 Sample Computation (Conducted Emission – Quasi Peak)

Measuring equipment raw measurement (dBµV) @ 150kHz			30.0
Correction Factor (dB)	TEMC00002 – LISN	0.03	0.11
	Cable 1	0.08	
Reported QuasiPeak Final Measurement (dBµV) @ 150kHz			**30.11**

2.6.9 Test Results

Compliant. See attached plots and tables.

120 VAC 60Hz (Line 1) – Class A Digital device compliance

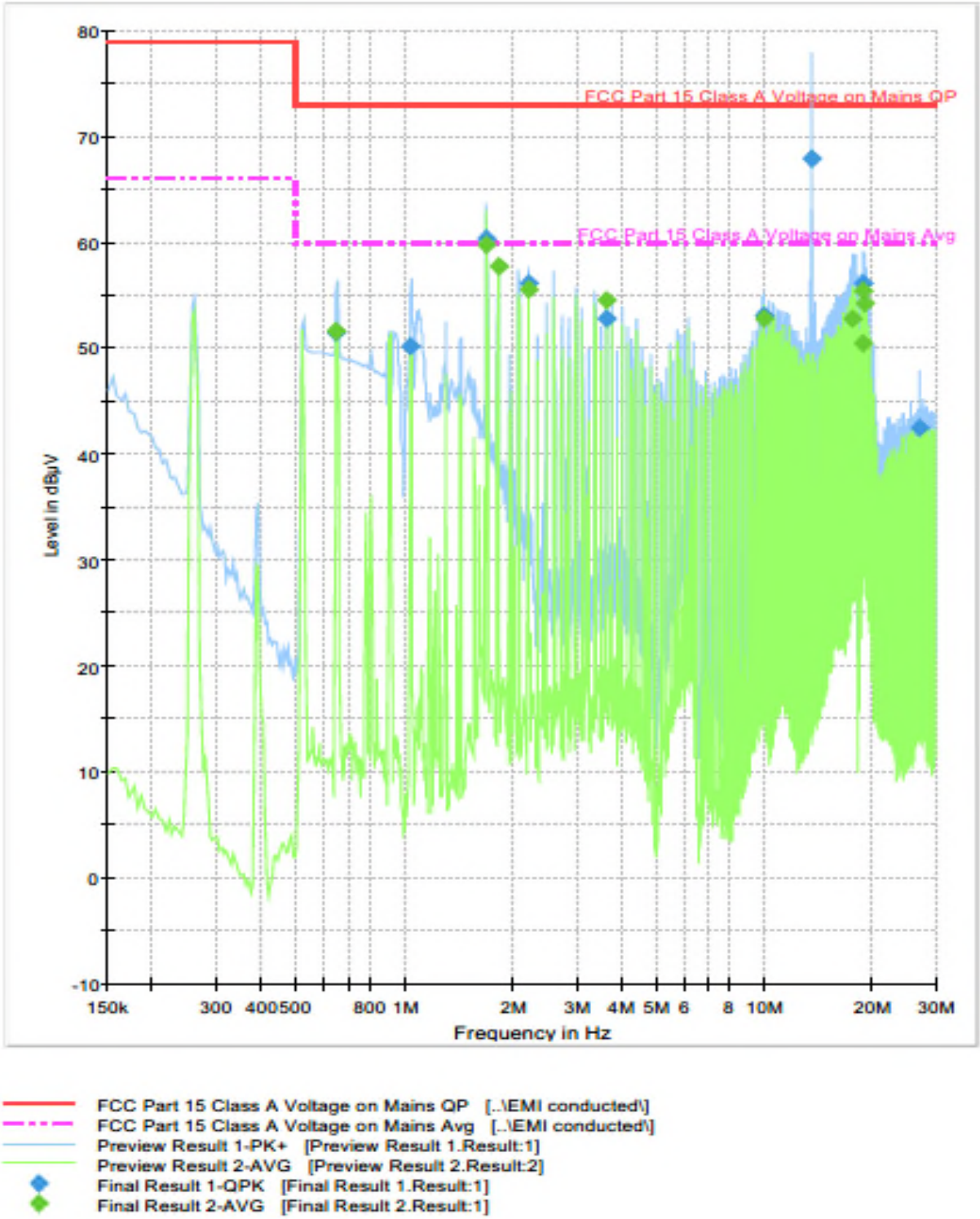


Figure 2.6.9-1 – Conducted Emissions Plot

Table 2.6.9-1 - Quasi Peak Detector Data

Frequency (MHz)	Quasi-peak (dBµV)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.649500	51.5	L1	10.1	21.5	73.0
1.041000	50.2	L1	10.1	22.8	73.0
1.693500	60.4	L1	10.2	12.6	73.0
2.215500	56.2	L1	10.3	16.8	73.0
3.651000	52.8	L1	10.4	20.2	73.0
10.041000	53.1	L1	10.9	19.9	73.0
*13.555500	67.9	L1	11.3		
18.906000	56.1	L1	11.8	16.9	73.0
**27.120000	42.5	L1	12.2		

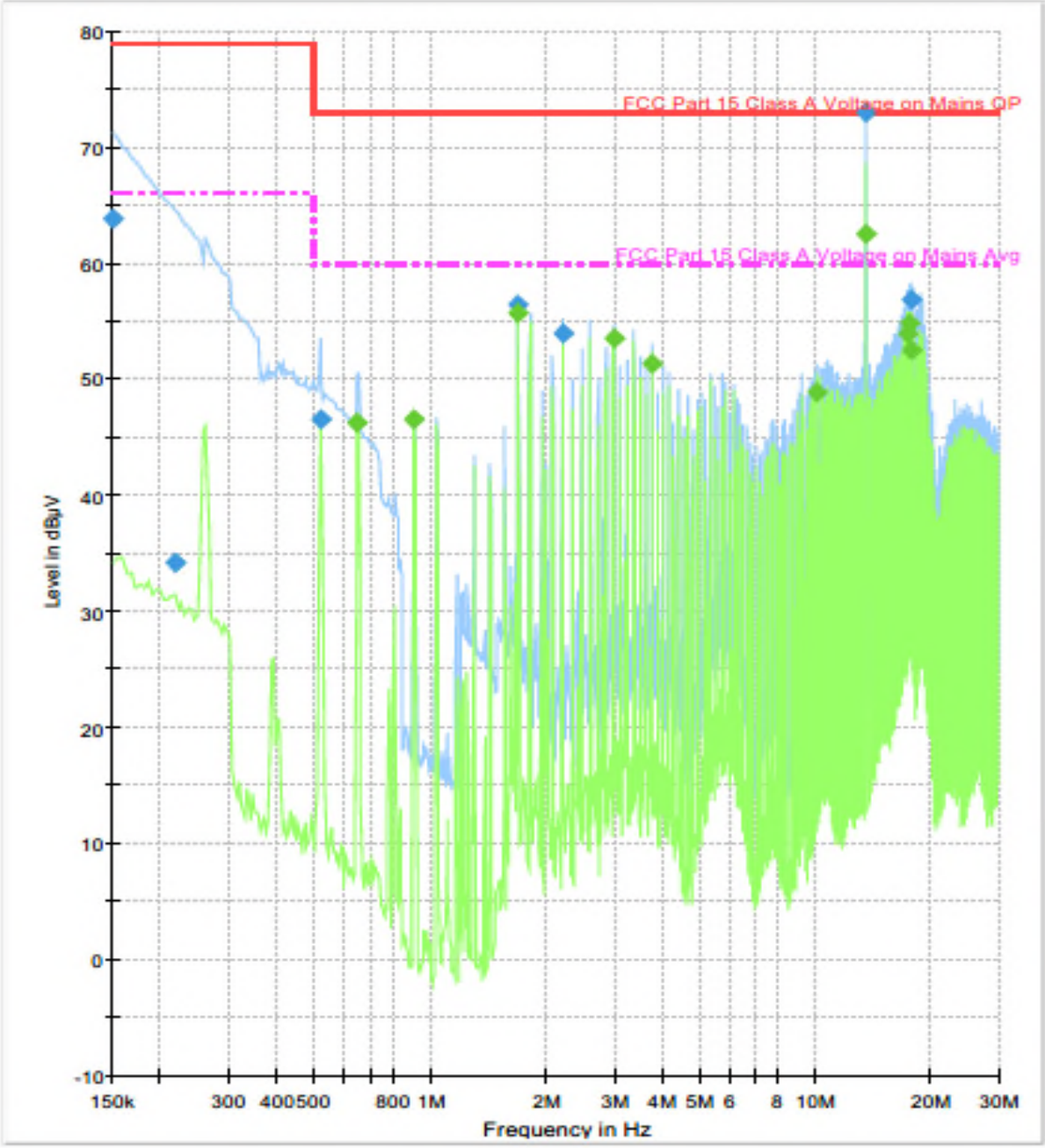
*fundamental **2nd harmonic

Table 2.6.9-2 – Average Detector Data

Frequency (MHz)	Average (dBµV)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.649500	51.7	N	10.1	8.3	60.0
1.693500	59.7	L1	10.2	0.3	60.0
1.824000	57.8	L1	10.2	2.2	60.0
2.215500	55.6	L1	10.2	4.4	60.0
3.651000	54.6	N	10.4	5.4	60.0
10.041000	52.8	L1	11.0	7.2	60.0
17.605500	52.8	N	11.6	7.2	60.0
18.775500	55.4	L1	11.7	4.6	60.0
18.910500	50.5	N	11.7	9.5	60.0
19.036500	54.3	L1	11.8	5.7	60.0

TÜV SÜD AMERICA INC 5610 West Sligh Ave., Suite 100, Tampa, FL 33634 Phone: 813 284 2715
Website: www.TUVamerica.com

120 VAC 60Hz (Line 2) – Class A Digital device compliance



FCC Part 15 Class A Voltage on Mains QP [..\EMI conducted\]
FCC Part 15 Class A Voltage on Mains Avg [..\EMI conducted\]
Preview Result 1-PK+ [Preview Result 1.Result:1]
Preview Result 2-AVG [Preview Result 2.Result:2]
Final Result 1-QPK [Final Result 1.Result:1]
Final Result 2-AVG [Final Result 2.Result:1]

Figure 2.6.9-2 – Conducted Emissions Plot

Table 2.6.9-3 - Quasi Peak Detector Data

Frequency (MHz)	Quasi-peak (dBµV)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	63.9	N	10.1	15.1	79.0
0.217500	34.1	N	10.0	44.9	79.0
0.519000	46.6	N	10.1	26.4	73.0
1.693500	56.5	N	10.2	16.5	73.0
2.215500	53.9	N	10.2	19.1	73.0
*13.560000	73.1	N	11.3		
17.727000	56.9	N	11.6	16.1	73.0

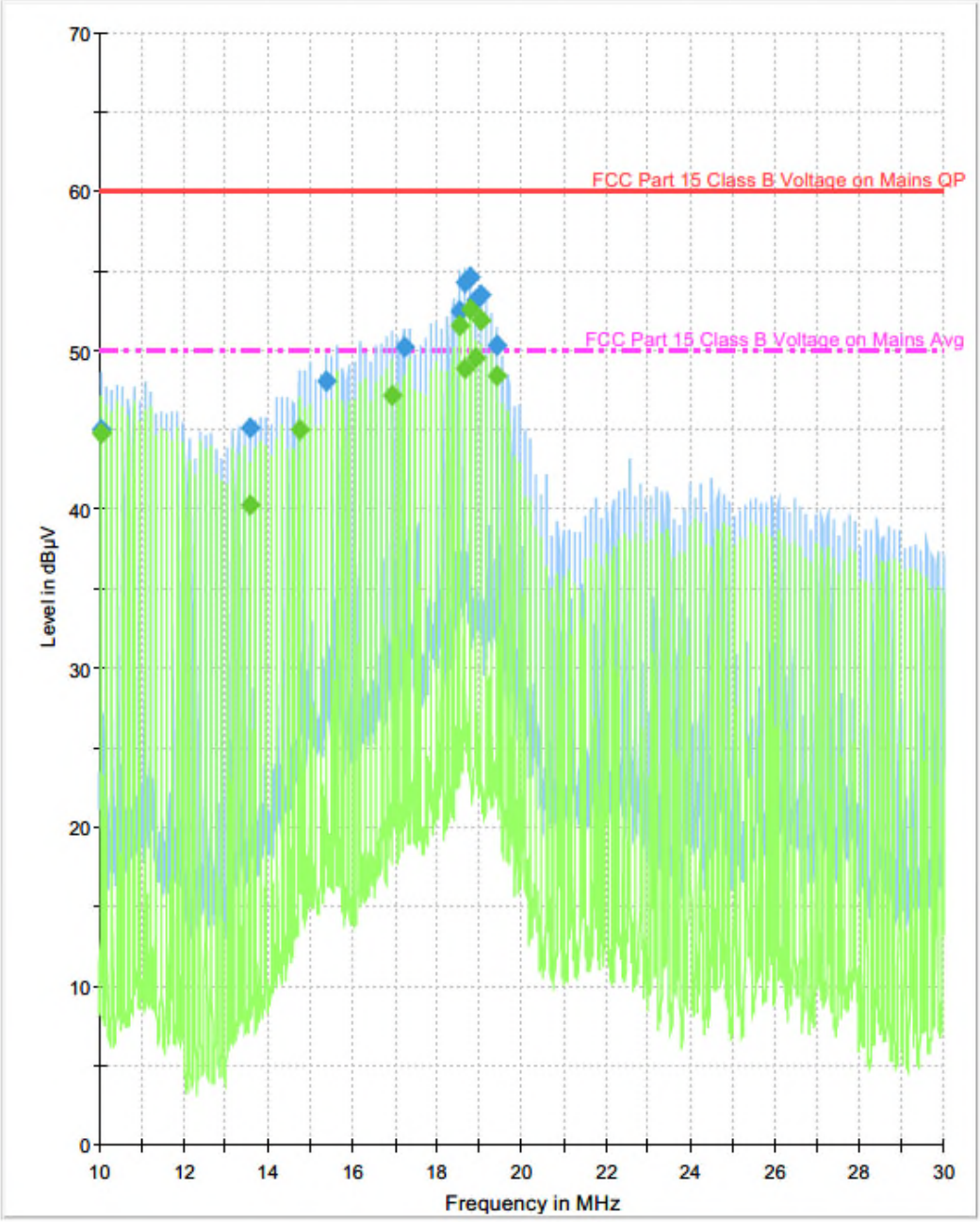
*fundamental

Table 2.6.9-4 – Average Detector Data

Frequency (MHz)	Average (dBµV)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.649500	46.2	N	10.1	13.8	60.0
0.910500	46.5	N	10.1	13.5	60.0
1.693500	55.7	N	10.2	4.3	60.0
2.998500	53.5	N	10.3	6.5	60.0
3.777000	51.3	N	10.4	8.7	60.0
10.167000	49.0	N	11.0	11.0	60.0
13.555500	62.5	N	11.3	-2.5	60.0
17.466000	54.0	N	11.6	6.0	60.0
17.596500	54.9	N	11.6	5.1	60.0
17.722500	52.6	N	11.6	7.4	60.0

TÜV SÜD AMERICA INC 5610 West Sligh Ave., Suite 100, Tampa, FL 33634 Phone: 813 284 2715
Website: www.TUVamerica.com

120 VAC 60Hz (Line 1) (intentional radiator)



FCC Part 15 Class B Voltage on Mains QP [..\EMI conducted\]
FCC Part 15 Class B Voltage on Mains Avg [..\EMI conducted\]
Preview Result 1-PK+ [Preview Result 1.Result:1]
Preview Result 2-AVG [Preview Result 2.Result:2]
Final Result 1-QPK [Final Result 1.Result:1]
Final Result 2-AVG [Final Result 2.Result:1]

Figure 2.6.9-3 – Conducted Emissions Plot

Table 2.6.9-5 - Quasi Peak Detector Data

Frequency (MHz)	Quasi-peak (dBµV)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
*10.041000	45.0	L1	10.9	15.0	60.0
13.561000	45.1	L1	11.3	14.9	60.0
*15.387000	48.1	L1	11.4	11.9	60.0
*17.209500	50.2	L1	11.6	9.8	60.0
*18.514500	52.5	L1	11.7	7.5	60.0
*18.645000	54.3	L1	11.7	5.7	60.0
*18.775500	54.6	L1	11.7	5.4	60.0
*18.906000	53.2	L1	11.8	6.8	60.0
*19.036500	53.5	L1	11.8	6.5	60.0
*19.428000	50.3	L1	11.7	9.7	60.0

*from class A digital device

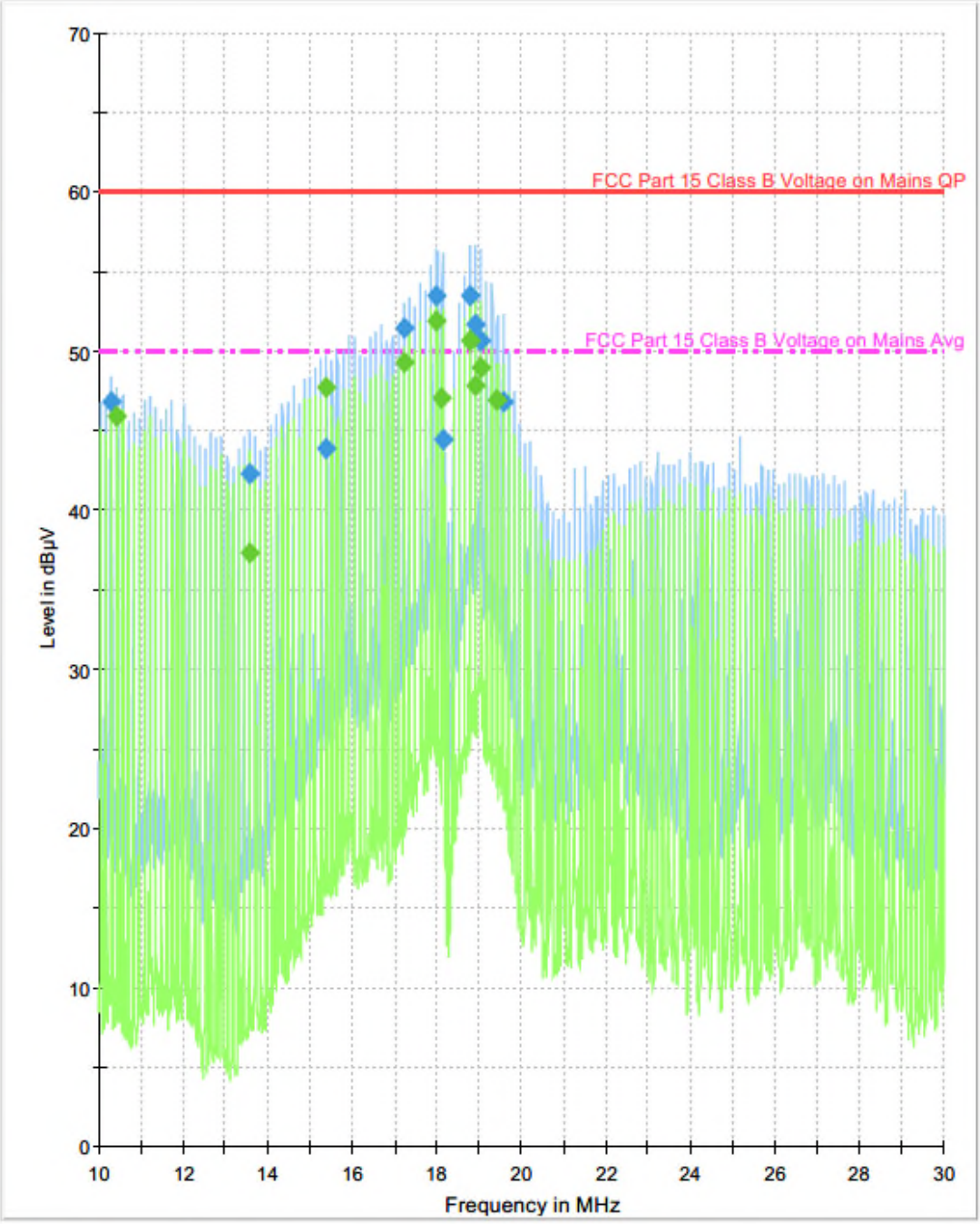
Table 2.6.9-6 – Average Detector Data

Frequency (MHz)	Average (dBµV)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
*10.041000	44.8	L1	10.9	5.2	50.0
13.561100	40.3	L1	11.3	9.7	50.0
*14.734500	45.0	L1	11.4	5.0	50.0
*16.948500	47.2	L1	11.5	2.8	50.0
*18.514500	51.6	L1	11.7	-1.6	50.0
*18.640500	48.8	L1	11.7	1.2	50.0
*18.775500	52.6	L1	11.7	-2.6	50.0
*18.901500	49.5	L1	11.7	0.5	50.0
*19.036500	52.0	L1	11.7	-2.0	50.0
*19.428000	48.5	L1	11.8	1.5	50.0

*from class A digital device

TÜV SÜD AMERICA INC 5610 West Sligh Ave., Suite 100, Tampa, FL 33634 Phone: 813 284 2715
Website: www.TUVamerica.com

120 VAC 60Hz (Line 2) (Intentional radiator)



FCC Part 15 Class B Voltage on Mains QP [..\EMI conducted\]
FCC Part 15 Class B Voltage on Mains Avg [..\EMI conducted\]
Preview Result 1-PK+ [Preview Result 1.Result:1]
Preview Result 2-AVG [Preview Result 2.Result:2]
Final Result 1-QPK [Final Result 1.Result:1]
Final Result 2-AVG [Final Result 2.Result:1]

Figure 2.6.9-4 – Conducted Emissions Plot

Table 2.6.9-7 - Quasi Peak Detector Data

Frequency (MHz)	Quasi-peak (dBµV)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
*10.432500	45.9	N	11.0	4.1	50.0
13.561000	37.3	N	11.3	12.7	50.0
*15.387000	47.8	N	11.4	2.2	50.0
*17.209500	49.3	N	11.6	0.7	50.0
*17.997000	51.9	N	11.6	-1.9	50.0
*18.127500	47.0	N	11.7	3.0	50.0
*18.780000	50.7	N	11.7	-0.7	50.0
*18.910500	47.9	N	11.8	2.1	50.0
*19.041000	49.0	N	11.7	1.0	50.0
*19.428000	47.0	N	11.8	3.0	50.0

*from class A digital device

Table 2.6.9-8 – Average Detector Data

Frequency (MHz)	Average (dBµV)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
*10.302000	46.8	N	11.0	13.2	60.0
13.561000	42.3	N	11.3	17.7	60.0
*15.391500	43.9	N	11.4	16.1	60.0
*17.214000	51.5	N	11.6	8.5	60.0
*17.997000	53.5	N	11.6	6.5	60.0
*18.132000	44.4	N	11.6	15.6	60.0
*18.780000	53.5	N	11.7	6.5	60.0
*18.910500	51.7	N	11.8	8.3	60.0
*19.041000	50.7	N	11.8	9.3	60.0
*19.563000	46.8	N	11.8	13.2	60.0

*from class A digital device

TÜV SÜD AMERICA INC 5610 West Sligh Ave., Suite 100, Tampa, FL 33634 Phone: 813 284 2715
Website: www.TUVamerica.com

SECTION 3

TEST EQUIPMENT USED

TÜV SÜD AMERICA INC 5610 West Sligh Ave., Suite 100, Tampa, FL 33634 Phone: 813 284 2715
Website: www.TUVamerica.com

3.1 TEST EQUIPMENT USED

List of absolute measuring and other principal items of test equipment.

ID Number	Test Equipment	Type	Serial Number	Manufacturer	SW/FW Rev	Cal Due Date
Conducted Emissions						
TEMC00003	LISN	FCC-LISN-50/250-25-2-01	03009	FCC	N/A	8/16/2019
TEMC00011	EMI Test Receiver	ESCS30	825788/002	Rhode & Schwarz	2.3002.0102.36	11/17/2019
Radiated Emission						
TEMC00025	Loop Antenna	AL-130	121033	Com-Power	N/A	11/07/2019
TEMC00005	Bilog Antenna	6112B	2579	Chase EMC	N/A	12/19/2019
TEMC00061	Double-ridged waveguide horn antenna	3117	00109296	ETS Lindgren	N/A	2/13/2020
TEMC00128	EMI Test Receiver	ESIB 40	100255/040	Rhode & Schwarz	4.35	11/16/2019
TEMC00160	Pre-amplifier	PAM-118A	18040042	Com-power	N/A	2/7/2020
TEMC00012	Spectrum Analyzer	E7405A	MY42000055	Agilent	A.09.02	3/28/2020
	Test Software	EMC32	854-0I100119	Rhode & Schwarz	V8.54	N/A
Temperature						
TAME01012	Thermometer	52	4475338	Fluke	N/A	1/08/2019
TEMC00095	DVM	87	5920853	Fluke	N/A	11/14/2018
TEMC00091	Spectrum Analyzer	E7402A	US39150137	Agilent	N/A	6/14/2019
NA	Temperature Chamber	EC127	EC0152	Sun Electronics	NCR	

TÜV SÜD AMERICA INC 5610 West Sligh Ave., Suite 100, Tampa, FL 33634 Phone: 813 284 2715
Website: www.TUVamerica.com

3.2 MEASUREMENT UNCERTAINTY

For a 95% confidence level, the measurement uncertainties for defined systems are:

Table 3.2-1 - Values of U_{cispr} and U_{Lab}

Measurement	U_{cispr}	U_{Lab}
Conducted disturbance (mains port) (9 kHz – 150 kHz) (150 kHz – 30 MHz)	 3.8 dB 3.4 dB	 3.71 dB 3.31 dB
Conducted disturbance (telecom port) (150 kHz – 30 MHz 55 dB LCL) (150 kHz – 30 MHz 65 dB LCL) (150 kHz – 30 MHz 75 dB LCL)	 5.0 dB 5.0 dB 5.0 dB	 4.11 dB 4.50 dB 4.94 dB
Radiated disturbance (electric field strength on an open area test site or alternative test site) (30 MHz – 1 000 MHz) (1 – 6 GHz) (6-18 GHz)	 6.3 dB 5.2 dB 5.5 dB	 5.85 dB 4.48 dB 4.48 dB

Notes:

U_{cispr} resembles a value of measurement uncertainty for a specific test, which was determined by considering uncertainties associated with the quantities listed in CISPR 16-4-2:2011.

Compliance or non-compliance with a disturbance limit shall be determined in the following manner.

If U_{Lab} is less than or equal to U_{cispr} in Table 5.0-1, then:

- compliance is deemed to occur if no measured disturbance exceeds the disturbance limit;
- non-compliance is deemed to occur if any measured disturbance exceeds the disturbance limit.

If U_{Lab} is greater than U_{cispr}, then:

- compliance is deemed to occur if no measured disturbance, increased by ($U_{Lab} – U_{cispr}$), exceeds the disturbance limit;
- non-compliance is deemed to occur if any measured disturbance, increased by ($U_{Lab} – U_{cispr}$), exceeds the disturbance limit.

The TÜV SÜD AMERICA, Inc. calculated MU is less than the internationally accepted MU, therefore an adjustment to the measured result as mentioned above is not necessary.

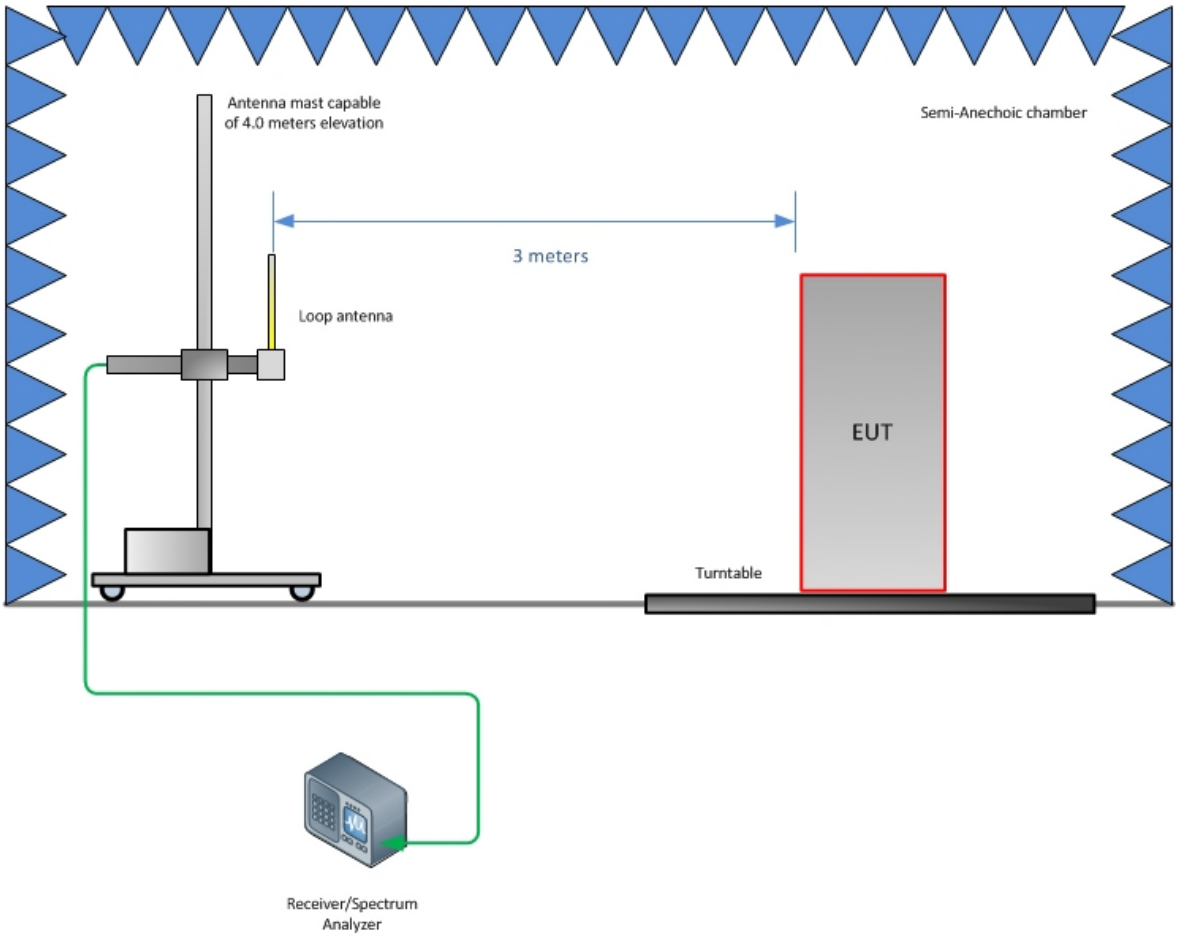
TÜV SÜD AMERICA INC 5610 West Sligh Ave., Suite 100, Tampa, FL 33634 Phone: 813 284 2715
Website: www.TUVamerica.com

SECTION 4

DIAGRAM OF TEST SETUP

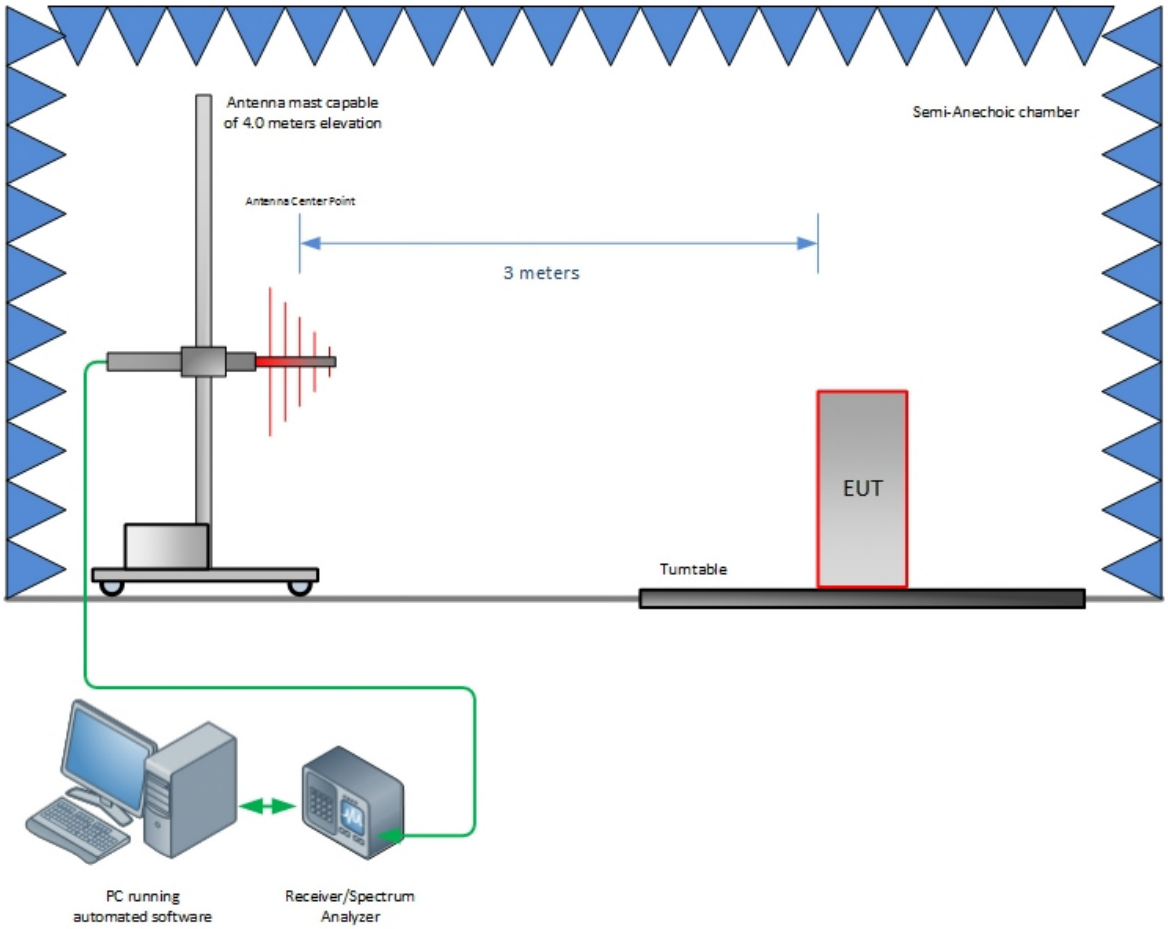
TÜV SÜD AMERICA INC 5610 West Sligh Ave., Suite 100, Tampa, FL 33634 Phone: 813 284 2715
Website: www.TUVamerica.com

4.1 TEST SETUP DIAGRAM (EMISSION MASK AND BELOW 30 MHZ)



TÜV SÜD AMERICA INC 5610 West Sligh Ave., Suite 100, Tampa, FL 33634 Phone: 813 284 2715
Website: www.TUVamerica.com

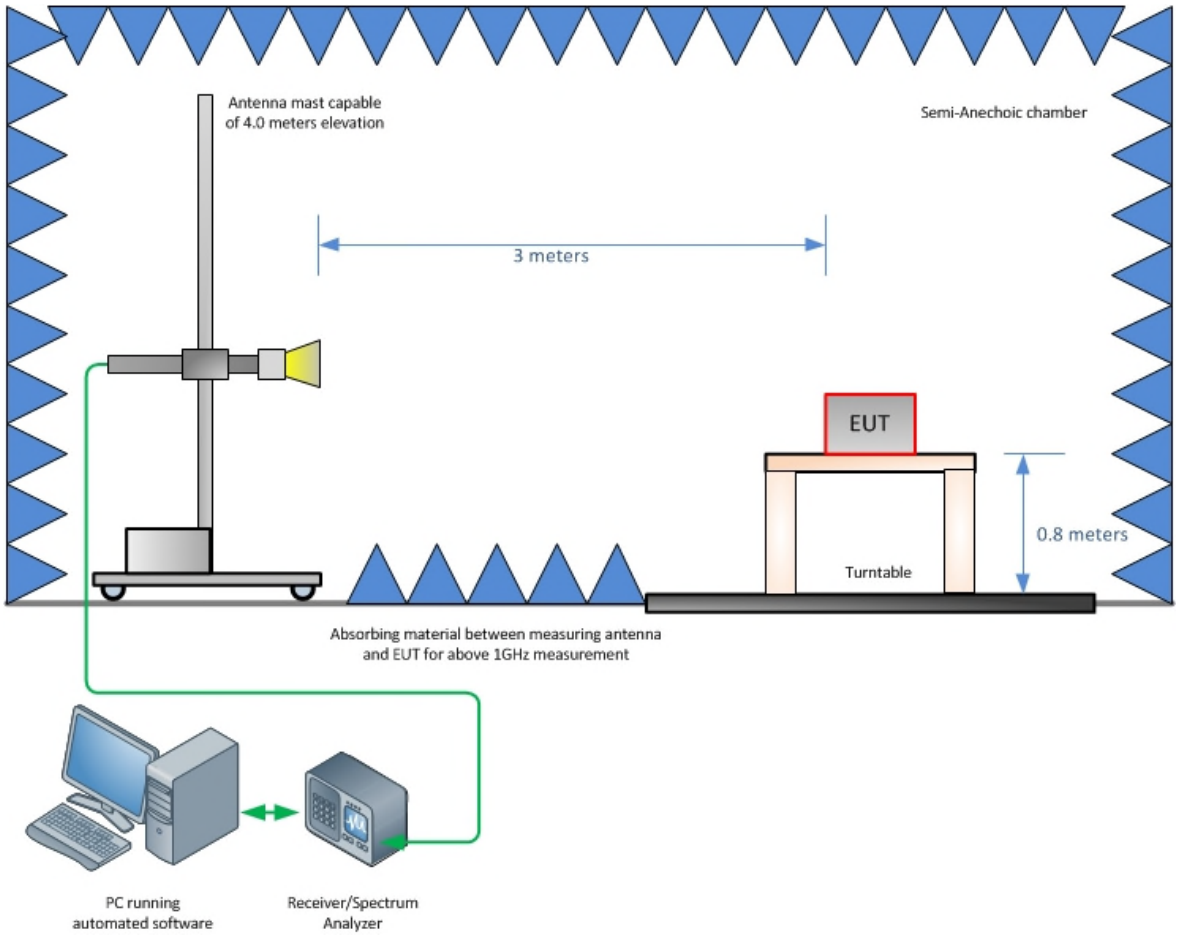
4.2 TEST SETUP DIAGRAM (30 MHZ TO 1 GHZ)



Radiated Emission Test Setup (Below 1GHz)

TÜV SÜD AMERICA INC 5610 West Sligh Ave., Suite 100, Tampa, FL 33634 Phone: 813 284 2715
Website: www.TUVamerica.com

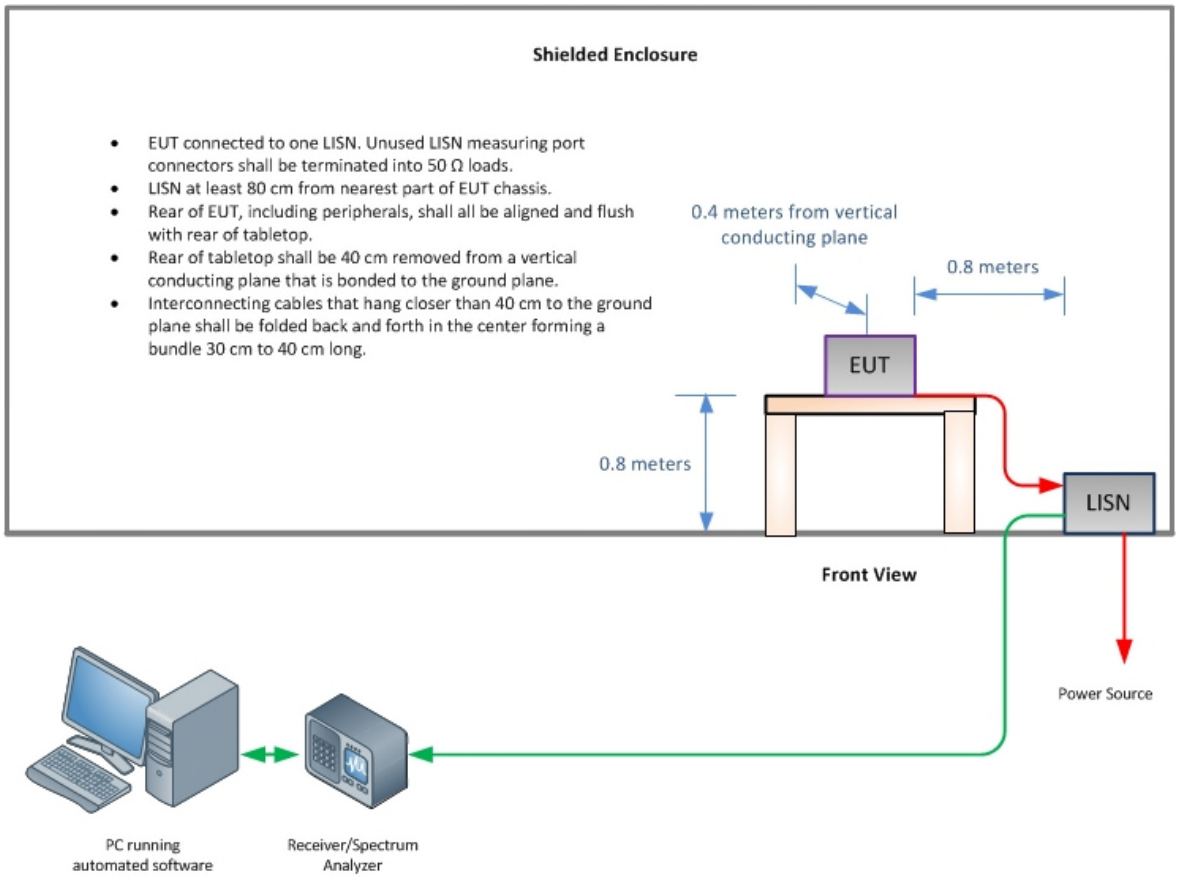
4.3 TEST SETUP DIAGRAM ABOVE 1 GHZ)



Radiated Emission Test Setup (Above 1GHz)

TÜV SÜD AMERICA INC 5610 West Sligh Ave., Suite 100, Tampa, FL 33634 Phone: 813 284 2715
Website: www.TUVamerica.com

4.4 TEST SETUP DIAGRAM (CONDUCTED EMISSIONS)



Conducted Emission Test Setup

TÜV SÜD AMERICA INC 5610 West Sligh Ave., Suite 100, Tampa, FL 33634 Phone: 813 284 2715
Website: www.TUVamerica.com

SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

TÜV SÜD AMERICA INC 5610 West Sligh Ave., Suite 100, Tampa, FL 33634 Phone: 813 284 2715
Website: www.TUVamerica.com

5.1 Accreditation, Disclaimers and Copyright

TÜV SÜD America Inc.'s reports apply only to the specific sample tested under stated test conditions. It is the manufacturer's responsibility to assure the continued compliance of production units of this model. TÜV SÜD America, Inc. shall have no liability for any deductions, inferences or generalizations drawn by the client or others from TÜV SÜD America, Inc.'s issued reports.

This report is the confidential property of the client. As a mutual protection to our clients, the public and TÜV SÜD America, Inc., extracts from the test report shall not be reproduced, except in full without TÜV SÜD America, Inc.'s written approval.

This report must not be used to claim product certification, approval, or endorsement by A2LA, NIST, or any agency of the federal government.

TÜV SÜD America, Inc. and its professional staff hold government and professional organization certifications for A2LA, AAMI, ACIL, AEA, ANSI, IEEE, and iNARTE.

A2LA Cert. No. 2955.15

TÜV SÜD AMERICA INC 5610 West Sligh Ave., Suite 100, Tampa, FL 33634 Phone: 813 284 2715
Website: www.TUVamerica.com