



Test Report Serial Number:

45461484 R2.0

Test Report Date:

4 March 2019

Project Number:

1436

EMC Test Report - New Filing

Applicant:



Uniden America Corporation
3001 Gateway Drive
Suite 130
Irving, Tx, 75063, USA

FCC ID:

AMWUT659

Product Model Number / HVIN

Atlantis155

IC Registration Number

513C-UT659

Product Name / PMN

Atlantis155

In Accordance With:

CFR Title 47, Part 80 Subpart E, Part 15 Subpart B

Stations in the Maritime Services

RSS-Gen, RSS-182 Issue 5

Maritime Radio Transmitters and Receivers in the Band 156-162.5 MHz

Approved By:

Ben Hewson, President

Celltech Labs Inc.
21-364 Lougheed Rd.
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Canada



Test Lab Certificate: 2470.01



**Industry
Canada**

IC Registration 3874A-1



FCC Registration: CA3874

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1.0 DOCUMENT CONTROL

Revision History					
Samples Tested By:		Art Voss, P.Eng.	Date(s) of Evaluation:	29 January - 28 Febrary, 2019	
Report Prepared By:		Art Voss, P.Eng.	Report Reviewed By:	Ben Hewson	
Report Revision	Description of Revision		Revised Section	Revised By	Revision Date
1.0	Initial Release		n/a	Art Voss	28 February 2019
2.0	Revised Operating Frequency Range		2	Art Voss	4 March 2019
	Extended Audio Frequency Range		7		

2.0 CLIENT AND DUT INFORMATION

Client Information	
Applicant Name	Uniden America Corporation
Applicant Address	3001 Gateway Drive
	Irving, TX, 75063
	USA
DUT Information	
Device Identifier(s):	FCC ID: AMWUT659
	ISED ID: 513C-UT659
Device Type:	Portable FM VHF PTT Transceiver
Type of Equipment:	Analog FM Transceiver
Device Model(s) / HVIN:	Atlantis155
Device Marketing Name / PMN:	Atlantis155
Firmware Version ID Number / FVIN:	-
Host Marketing Name / HMN:	-
Test Sample Serial No.:	T/A Sample - Identical Prototype
Transmit Frequency Range:	Tx: 156.05 - 157.425MHz, Rx: 156.05 - 162.55MHz
Number of Channels:	60 Channel Programmable
Manuf. Max. Rated Output Power:	30dBm (1W), 34.77 dBm +/- .2dB, (3W)
Manuf. Max. Rated BW/Data Rate:	n/a
Antenna Make and Model:	1/4 Wavelength Stub
Antenna Type and Gain:	-2 dBi
Modulation:	FM
Mode:	Simplex/Duplex
Emission Designator:	16K0F3E
DUT Power Source:	AAA X4, Alkaline, Ni-MH Rechargeable, Li-Ion
DUT Dimensions [HxWxD] (mm)	H x W x D:
Deviation(s) from standard/procedure:	None
Modification of DUT:	None

3.0 SCOPE

This Certification Report was prepared on behalf of:

Uniden America Corporation

,(the '*Applicant*'), in accordance with the applicable Federal Communications Commission (FCC) CFR 47 and Innovation, Scientific and Economic Development (ISED) Canada rules parts and regulations (the '*Rules*'). The scope of this investigation was limited to only the equipment, devices and accessories (the '*Equipment*') supplied by the *Applicant*. The tests and measurements performed on this *Equipment* were only those set forth in the applicable *Rules* and/or the Test and Measurement Standards they reference. The *Rules* applied and the Test and Measurement Standards used during this evaluation appear in the Normative References section of this report. The limits set forth in the technical requirements of the applicable *Rules* were applied to the measurement results obtained during this evaluation and ,unless otherwise noted, these limits were used as the Pass/Fail criteria. The Pass/Fail statements made in this report apply to only the tests and measurements performed on only the *Equipment* tested during this evaluation. Where applicable and permissible, information including test and measurement data and/or results from previous evaluations of same or similar equipment, devices and/or accessories may be cited in this report.

As per FCC CFR 47 Part §2.1091 and §2.1093 and Health Canada Safety Code 6, an RF Exposure evaluation report is required for this *Equipment* and the results of the RF Exposure evaluation appear in a separate exhibit from this report.

This *Equipment* is subject to FCC Declaration of Conformity (DoC). DoC evaluations were performed on this *Equipment* and the results of the DoC evaluation appear in a separate exhibit from this report.

Application: New Certification

I attest that the data reported herein is true and accurate within the tolerance of the Measurement Instrument Uncertainty; that all tests and measurements were performed in accordance with accepted practices or procedures; and that all tests and measurements were performed by me or by trained personnel under my direct supervision. The results of this investigation are based solely on the test sample(s) provided by the client which were not adjusted, modified or altered in any manner whatsoever, except as required to carry out specific tests or measurements. This test report has been completed in accordance with ISO/IEC 17025.



Art Voss, P.Eng.
Technical Manager
Celltech Labs Inc.

11 February 2019

Date



4.0 TEST RESULT SUMMARY

TEST SUMMARY						
Section	Description of Test	Procedure Reference	Applicable Rule Part(s) FCC	Applicable Rule Part(s) ISCED	Test Date	Result
7.0	Modulation Characteristics Modulation Limiting	ANSI/TIA/EIA-603-E-2016	§2.1047(a) §80.213(a)(2)	RSS-182 [7.3(d)]	29 Jan 2019	Complies
8.0	Modulation Characteristics Audio Low Pass Filter Response	ANSI/TIA/EIA-603-E-2016	§2.1047(a) §80.213(e)	RSS-182 [7.3(c)]	29 Jan 2019	Complies
9.0	Conducted Power (Fundamental)	ANSI/TIA/EIA-603-E-2016	§2.1046 §80.215(c)(2)	RSS-Gen RSS-182 [7.5]	29 Jan 2019	Complies
10.0	Occupied Bandwidth Emission Mask	ANSI/TIA/EIA-603-E-2016	§2.1049 §80.205(a)	RSS-Gen RSS-182 [7.9]	29 Jan 2019	Complies
11.0	Conducted TX Spurious Emissions	ANSI/TIA/EIA-603-E-2016	§2.1051 §80.211	RSS-Gen RSS-182 [7.9]	29 Jan 2019	Complies
12.0	Conducted TX Spurious Emissions Restricted Bands	ANSI/TIA/EIA-603-E-2016	§2.1051 §15.211(c)	n/a	29 Jan 2019	Complies
13.0	Radiated RX Spurious Emissions	ANSI/TIA/EIA-603-E-2016 ANSI C63.4-2014	§15.109	ICES-003[6.2]	1 Feb 2019	Complies
14.0	Frequency Stability	ANSI/TIA/EIA-603-E-2016	§2.1055 §80.209	RSS-182 [7.4]	30 Jan 2019	Complies

Test Station Day Log				
Date	Ambient Temp (°C)	Relative Humidity (%)	Barometric Pressure (kPa)	Test Station
28 Jan 2019	22	16	103.6	EMC
29 Jan 2019	22	17	103.1	EMC
30 Jan 2019	18	18	102.3	TC
31 Jan 2019	18	18	101.6	TC
1 Feb 2019	21	17	100.5	EMC
1 Feb 2019	19	17	100.5	SAC
1 Feb 2019	5	55	100.5	OATS
4 Feb 2019	20	17	101.9	EMC

EMC - EMC Test Bench

SAC - Semi-Anechoic Chamber

OATS - Open Area Test Site

TC - Temperature Chamber

In accordance with ANSI C63.4:

6.2.11 Temperature and humidity

a) The ambient air temperature of the test site shall be within the range of 10 °C to 40 °C (50 °F to 104 °F), unless the EUT requirements specify testing over a different temperature range. The EUT and the measuring equipment shall be operated until temperature stabilizes before the testing proceeds. The warm-up time shall be included along with the measurement results if the ambient conditions are outside of the range stated above, and evidence shall be given that the measuring equipment is accurate at the temperatures used.

The EUT was wrapped with non-conductive insulation material to maintain an operating temperature above 10 °C and monitored periodically during evaluation. The antenna and cabling have been evaluated in this temperature range in accordance with ANSI C63.4, 4.7.6 Cable Insertion Loss, and the measurement results compensated for any variations. All other measurement equipment was maintained at ambient indoor room temperature.

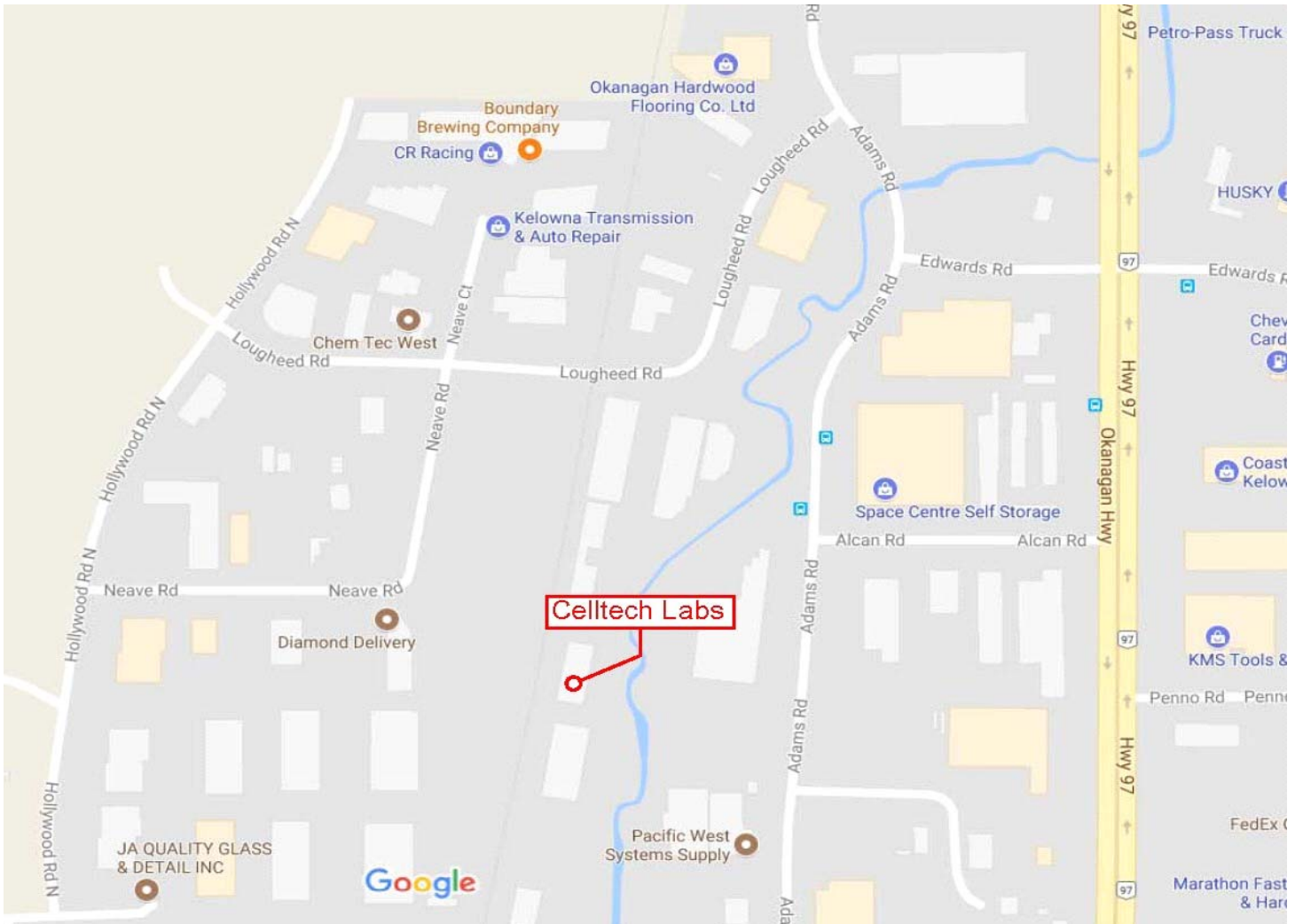
5.0 NORMATIVE REFERENCES

Normative References	
ANSI / ISO 17025:2005	General Requirements for competence of testing and calibration laboratories
IEEE/ANSI C63.4:2014	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI/TIA/EIA-603-E-2016	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards
CFR Title 47	Code of Federal Regulations Title 47: Telecommunication Part 2: Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
CFR Title 47	Code of Federal Regulations Title 47: Telecommunication Part 80: Stations in the Maritime Services
CFR Title 47	Code of Federal Regulations Title 47: Telecommunication Part 15: Radio Frequency Devices Subpart B: Unintentional Radiators
ISED	Innovation, Science and Economic Development Canada Spectrum Management and Telecommunications Radio Standards Specification RSS-Gen Issue 5: General Requirements and Information for the Certification of Radiocommunication Equipment
ISED	Innovation, Science and Economic Development Canada Spectrum Management and Telecommunications Radio Standards Specification RSS-182 Issue 5: Maritime Radio Transmitters and Receivers in the Band 156-162.5 MHz

6.0 FACILITIES AND ACCREDITATIONS

Facility and Accreditation:

The facilities used to evaluate this device outlined in this report are located at 21-364 Lougheed Road, Kelowna, British Columbia, Canada V1X 7R8. The radiated emissions site (OATS) conforms to the requirements set forth in ANSI C63.4 and is filed and listed with the FCC under Test Firm Registration Number CA3874A-1 and Industry Canada under Test Site File Number IC 3874A-1. Celltech is accredited to ISO 17025, through accrediting body A2LA and with certificate 2470.01.



7.0 MODULATION RESPONSE - LIMITING

Test Conditions

Normative Reference FCC 47 CFR §2.1047, §80.213, RSS-182

Limits

47 CFR §2.1047	a) Voice modulated communication equipment. A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz shall be submitted.
47 CFR §80	§80.213 Modulation requirements. (a) Transmitters must meet the following modulation requirements: (e) Coast station transmitters operated in the 156-162 MHz band must be equipped with an audio low-pass filter. The filter must be installed between the modulation limiter and the modulated radio frequency stage. At frequencies between 3 kHz and 20 kHz it must have an attenuation greater than at 1 kHz by at least $60\log_{10}(f/3)$ dB where "f" is the audio frequency in kilohertz. At frequencies above 20 kHz the attenuation must be at least 50 dB greater than at 1 kHz.
RSS-182	7.3 Types of Modulation and Equipment Characteristics VHF radiocommunication shall employ G3E or F3E modulation for voice communication and G2B for DSC signals. (d) the audio-frequency band shall be 3000 Hz;

Measurement Procedure

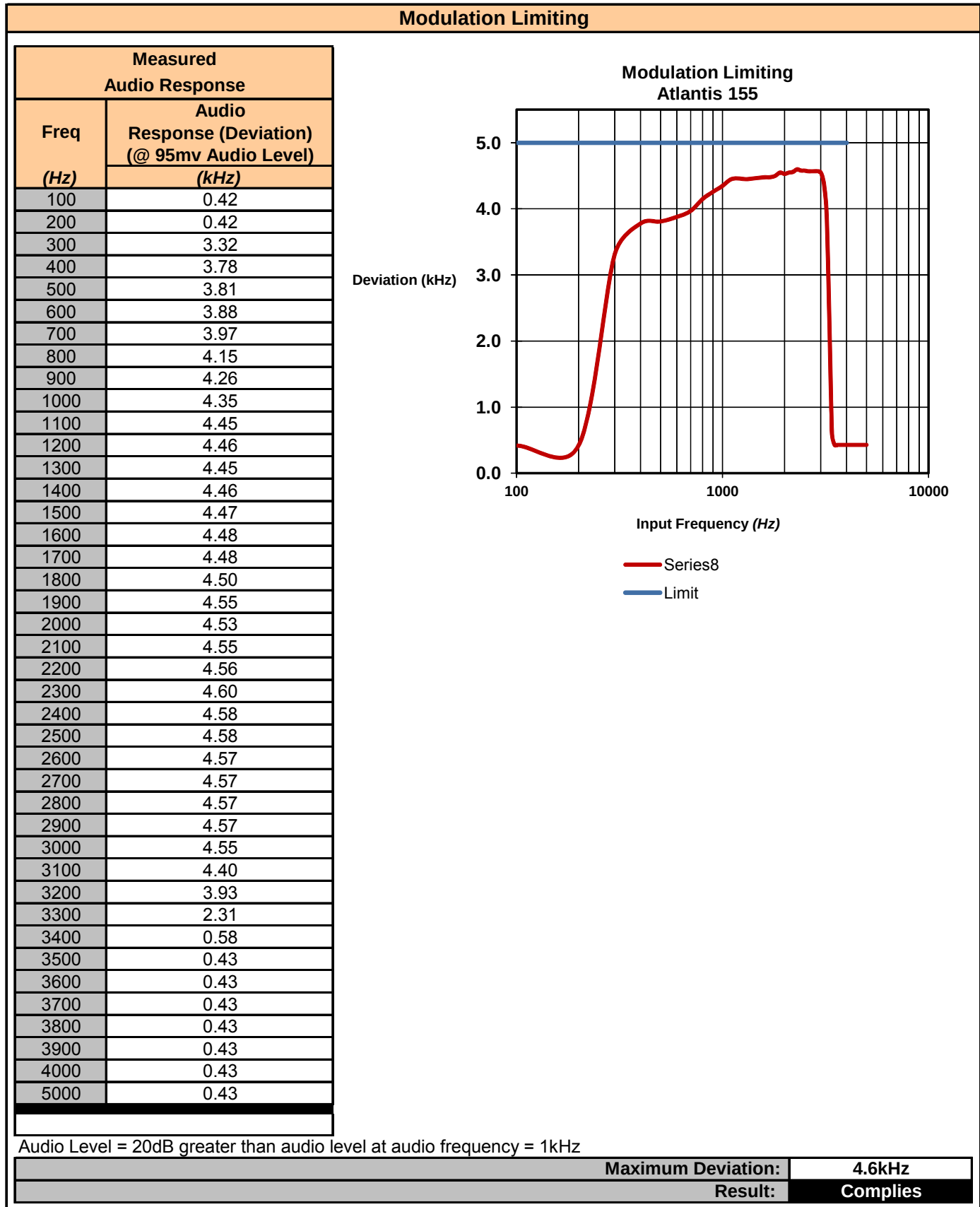
TIA 603-E 2.2.6.2.2 Transmitter Audio Frequency Response - Constant Input

- Connect the equipment as illustrated.
- Set the test receiver to measure peak positive deviation. Set the audio bandwidth for ≤ 50 Hz to $\geq 15,000$ Hz. Turn the de-emphasis function off.
- Adjust the transmitter per the manufacturer's procedure for full rated system deviation.
- Apply a 1000 Hz tone and adjust the audio frequency generator to produce 20% of the rated system deviation.
- Set the test receiver to measure rms deviation and record the deviation reading as DEVREF .
- Set the audio frequency generator to the desired test frequency between 300 Hz and 3000 Hz.
- Record the test receiver deviation reading as DEVFREQ .
- Calculate the audio frequency response at the present frequency as: $AFR = 20\log(D_{freq}/D_{ref})$

Graph the audio level in dB relative to the 0 dB reference level as a function of the modulating frequency. Record any audio frequency where it is impossible to perform the measurement.

Test Setup Appendix A Figure A.2

Plot 7.1 – Modulation Limiting



8.0 MODULATION RESPONSE – AUDIO LOW PASS FILTER RESPONSE

Test Conditions

Normative Reference FCC 47 CFR §2.1047, §80.213, RSS-182

Limits

47 CFR §2.1047	a) Voice modulated communication equipment. A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz shall be submitted.
47 CFR §80	§80.213 Modulation requirements. (a) Transmitters must meet the following modulation requirements: (e) Coast station transmitters operated in the 156-162 MHz band must be equipped with an audio low-pass filter. The filter must be installed between the modulation limiter and the modulated radio frequency stage. At frequencies between 3 kHz and 20 kHz it must have an attenuation greater than at 1 kHz by at least $60\log_{10}(f/3)$ dB where “f” is the audio frequency in kilohertz. At frequencies above 20 kHz the attenuation must be at least 50 dB greater than at 1 kHz.
RSS-182	7.3 Types of Modulation and Equipment Characteristics VHF radiocommunication shall employ G3E or F3E modulation for voice communication and G2B for DSC signals. (d) the audio-frequency band shall be 3000 Hz;

Measurement Procedure

TIA 603-E 2.2.6.2.2 Transmitter Audio Frequency Response - Constant Input

- Connect the equipment as illustrated.
- Set the test receiver to measure peak positive deviation. Set the audio bandwidth for ≤ 50 Hz to $\geq 15,000$ Hz. Turn the de-emphasis function off.
- Adjust the transmitter per the manufacturer's procedure for full rated system deviation.
- Apply a 1000 Hz tone and adjust the audio frequency generator to produce 20% of the rated system deviation.
- Set the test receiver to measure rms deviation and record the deviation reading as DEVREF .
- Set the audio frequency generator to the desired test frequency between 300 Hz and 3000 Hz.
- Record the test receiver deviation reading as DEVFREQ .
- Calculate the audio frequency response at the present frequency as: $AFR = 20\log(D_{freq}/D_{ref})$

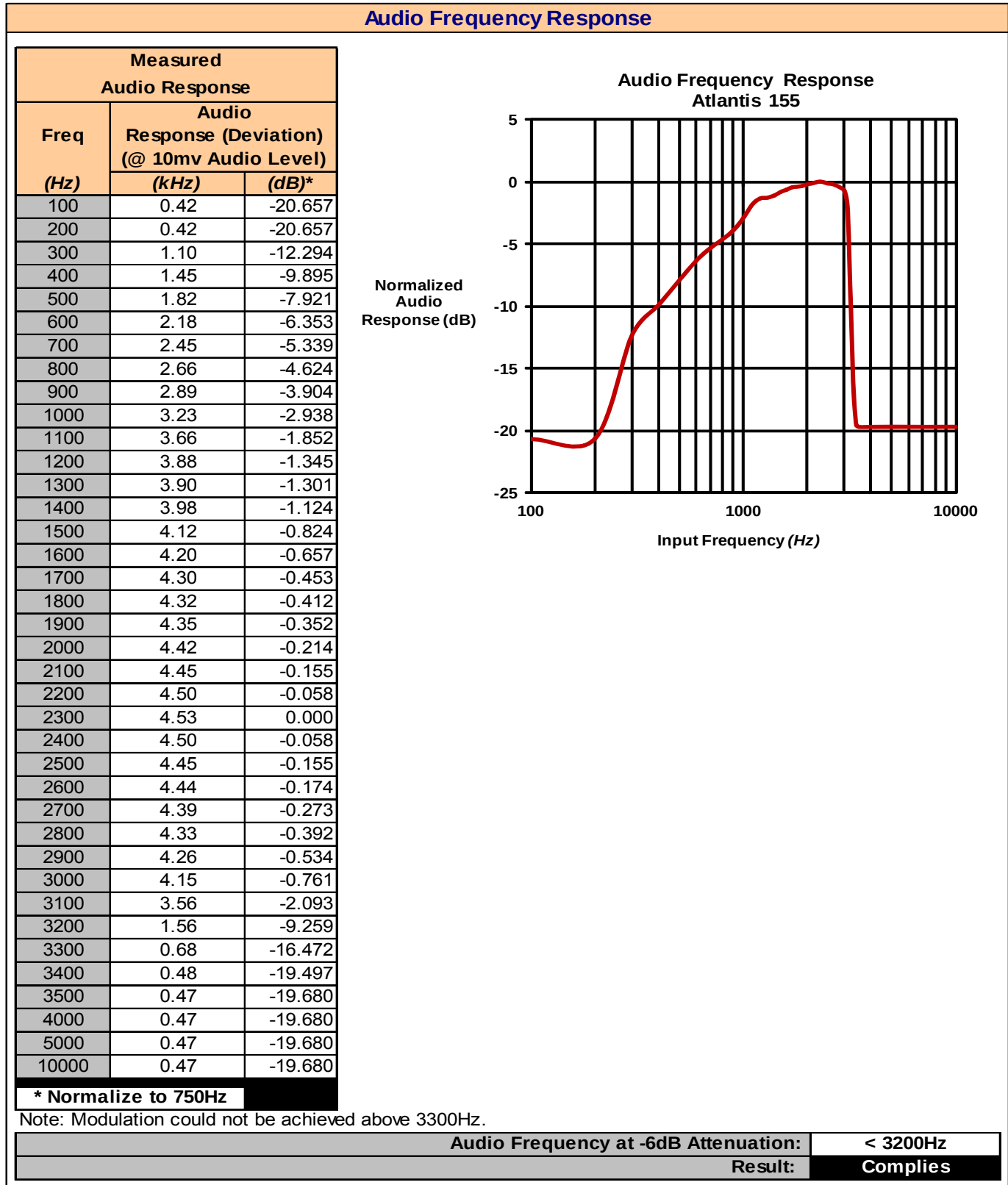
Graph the audio level in dB relative to the 0 dB reference level as a function of the modulating frequency. Record any audio frequency where it is impossible to perform the measurement.

Test Setup

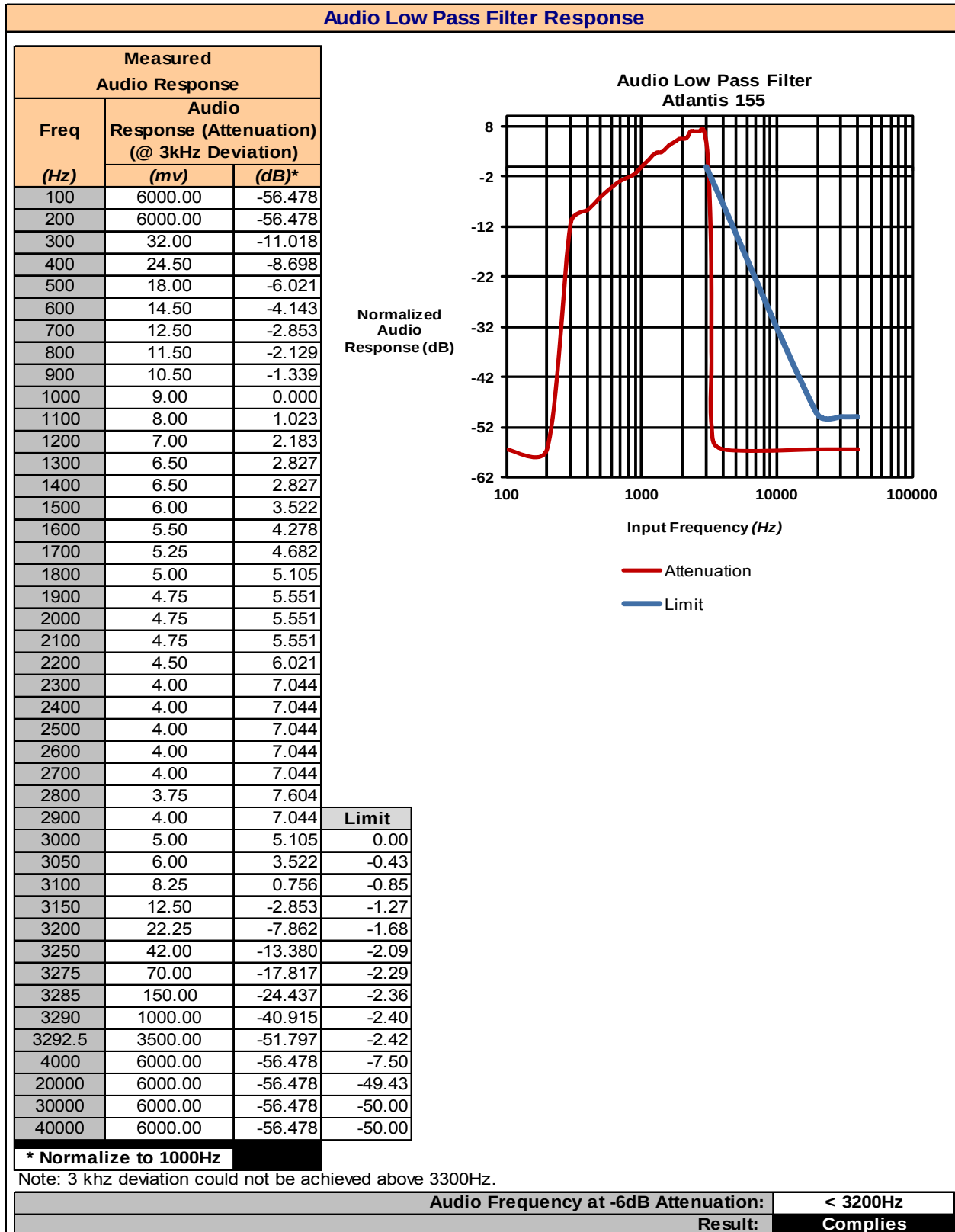
Appendix A

Figure A.2

Plot 8.1 – Audio Frequency Response



Plot 8.2 – Audio Low Pass Filter Response



9.0 CONDUCTED POWER

Test Procedure

Normative Reference	FCC 47 CFR §2.1046, §2.1033(c)(8), §80.215, RSS-182 EIA/TIA-603-E
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Limits

47 CFR §80	§80.215 Transmitter power. (c) Coast station frequencies above 27500 kHz. The maximum power must not exceed the values listed below. (2) Marine utility stations: 156-162MHz - 10W
RSS-182	7.5 Transmitter Output Powers The output power shall be within "1.0 dB of the manufacturer's rated power and not exceed the limits listed in Table 3, unless indicated otherwise. Typical Power: 5W

General Procedure

TIA-603-E	2.2.1 TRANSMITTER CARRIER POWER OUTPUT Transmitter Carrier Power Output for this service is the power (rms) available at the output terminals of the transmitter when the output terminals are connected to a standard output load. This measurement shall be performed without modulation, at standard test conditions.
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Test Setup	Appendix A - Figure A.1
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Measurement Procedure

The DUT was connected to a Power Meter via a 30dB attenuator connected to the DUT's antenna port. The output power of the DUT was set to the manufacturer's lowest and highest output power setting at the Low, Mid and High frequency channels as permitted by the device. The DUT was set to transmit unmodulated.

Table 9.1 - Summary of Conduct Power Measurements

Conducted Power Measurement Results								
Channel	Frequency (MHz)	Modulation	Nominal Input Voltage (VDC)	Power Setting	Measured Power [E _{Meas.}] (dBm)	Measured Power [E _{Meas.}] (W)	Limit (W)	Margin (dB)
1	156.050	CW	6	High	34.97	3.14	6.0	2.8
74	156.725				34.97	3.14		2.8
88	157.425				34.97	3.14		2.8
1	156.050			Low	31.06	1.28	6.0	6.7
74	156.725				30.64	1.16		7.1
88	157.425				30.22	1.05		7.6
Result:							Complies	

(1) The output power is factory set to maximum
Margin = $10 \cdot \log(\text{Limit} / E_{\text{meas}})$

Table 9.2 – Compliance to §2.1033(c)(8)

FCC CFR 47 §2.1033(c)(8): Power to Transmitter:	
Measured Receiver Current:	IRx = 0.01A
Measured Total Current:	ITx = 1.13A
Transmitter Current (ITx - IRx):	IXmitter = 1.12A
Power to Transmitter:	(6VDC)(1.12) = 6.72W
Result:	Complies

10.0 OCCUPIED BANDWIDTH AND EMISSION MASKS

Test Conditions

Normative Reference FCC 47 CFR §2.1049, §80.205, §80.211, RSS-182

Limits

47 CFR §80	§80.205 Bandwidths. (a) An emission designator shows the necessary bandwidth for each class of emission of a station except that in ship earth stations it shows the occupied or necessary bandwidth, whichever is greater. The following table gives the class of emission and corresponding emission designator and authorized bandwidth: F3E: 16K0F3E, Authorized BW: 20kHz
RSS-182	7.3 Types of Modulation and Equipment Characteristics (e) the authorized channel bandwidth for voice shall be 16 kHz; and
47 CFR §80	§80.211 Emission limitations. The emissions must be attenuated according to the following schedule. (f) The mean power when using emissions other than those in paragraphs (a), (b), (c) and (d) of this section: (1) On any frequency removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: At least 25 dB; (2) On any frequency removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: At least 35 dB; and (3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 plus $10\log_{10}$ (mean power in watts) dB.
RSS-182	7.9.1 Emission Mask B for Equipment with 25 kHz Channel Spacing This mask is for FM or PM modulation equipment with 25 kHz channel spacing, an authorized bandwidth of 16 kHz for voice or 20 kHz for data, and equipped with or without an audio low-pass filter. The power of any emission shall be attenuated below the transmitter output power (P, in dBW) as follows: (a) on any frequency removed from the carrier frequency by more than 50%, but not more than 100% of the authorized bandwidth: at least 25 dB, measured with a bandwidth of 300 Hz; (b) on any frequency removed from the carrier frequency by more than 100%, but not more than 250% of the authorized bandwidth: at least 35 dB, measured with a bandwidth of 300 Hz; and (c) on any frequency removed from the carrier frequency by more than 250% of the authorized bandwidth: at least $43 + 10 \log_{10} p(\text{watts})$ dB, measured with a bandwidth of 30 kHz.

Measurement Procedure

TIA 382 23.2

Transmitter Modulation Occupied Bandwidth

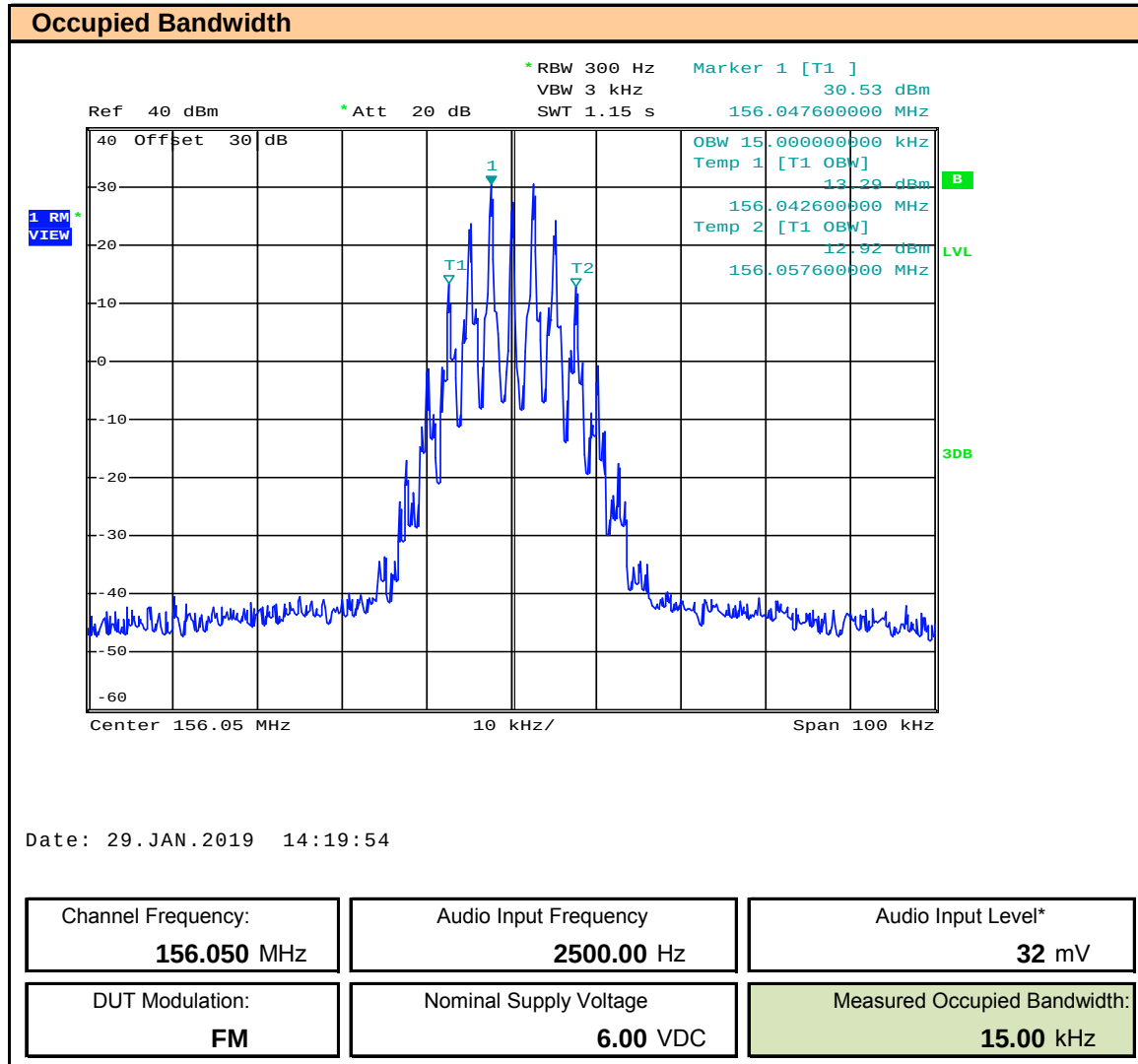
The transmitter is modulated by a sinusoidal audio signal applied to the microphone input jack. First, the frequency is adjusted to deliver 50% modulation at the highest audio response level (minimum applied audio level). Then the audio signal level is increased 16 dB and the audio frequency is readjusted to 2500 Hz. The analyzer is adjusted to display each of the discrete modulation sidebands and their respective harmonic products within ± 50 kHz of the carrier frequency.

Test Setup

Appendix A

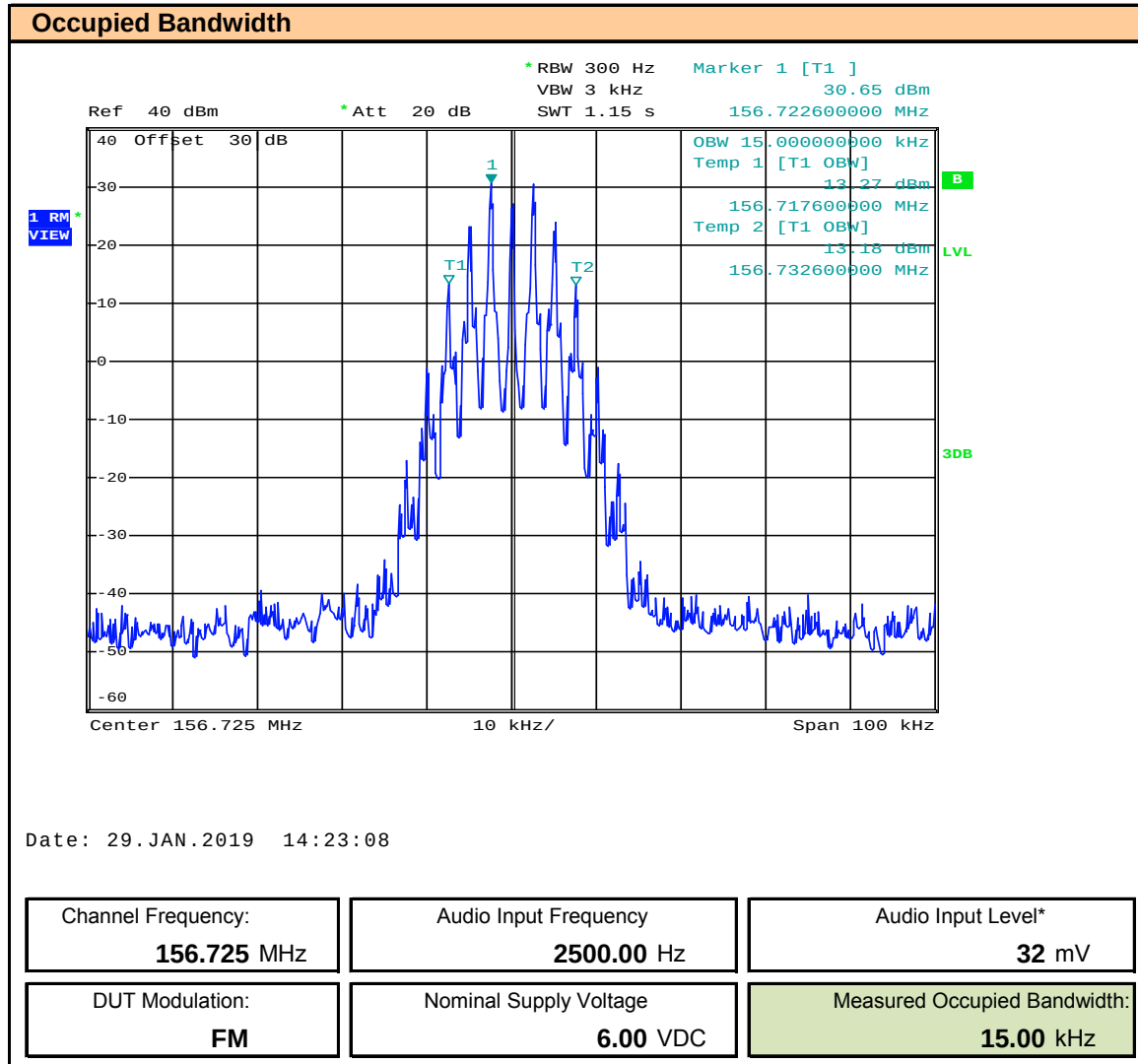
Figure A.1

Plot 10.1 – Occupied Bandwidth Channel 1



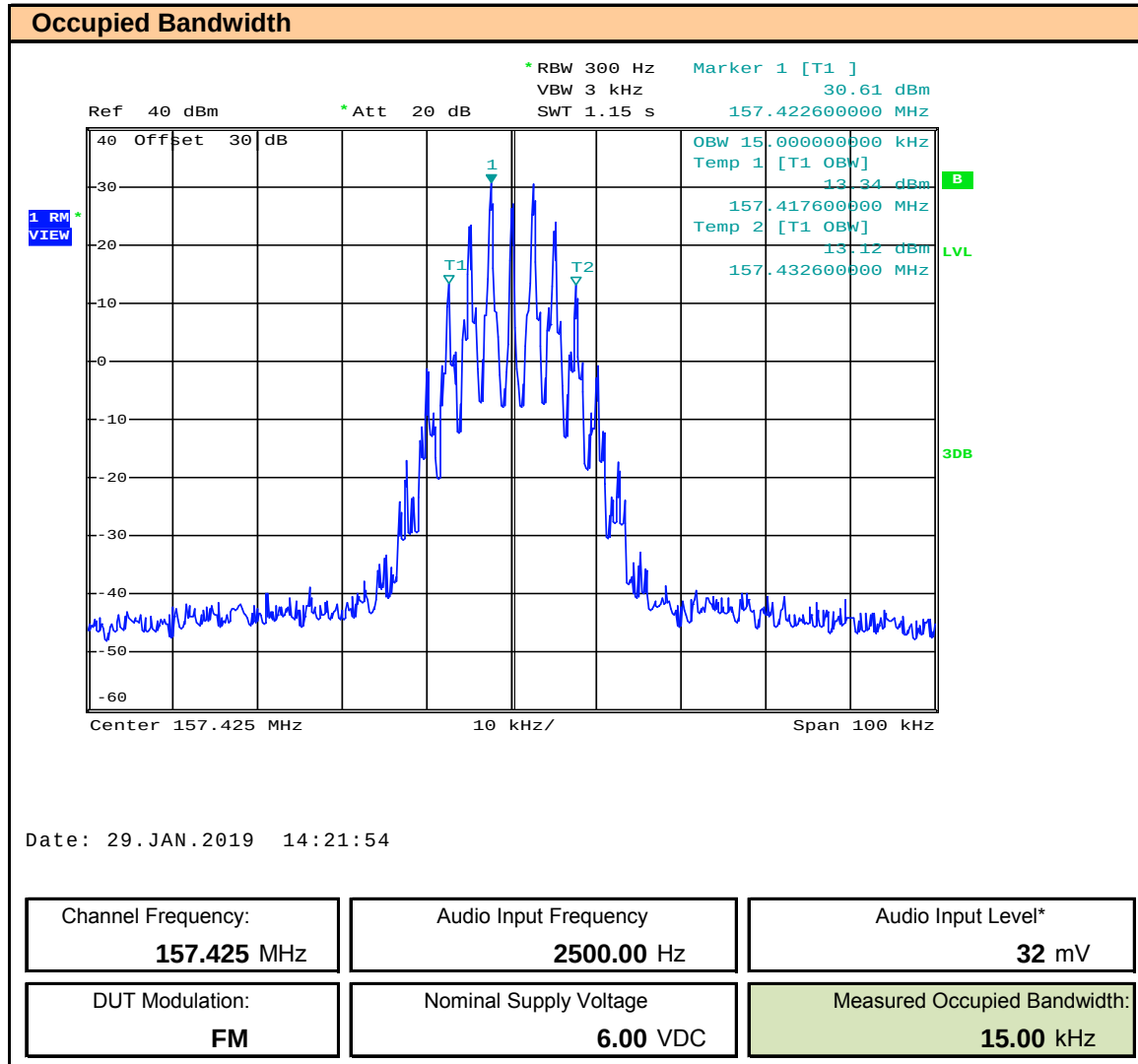
* Audio Input Level > 16dB of Level Required for 50% Deviation

Plot 10.2 – Occupied Bandwidth Channel 74



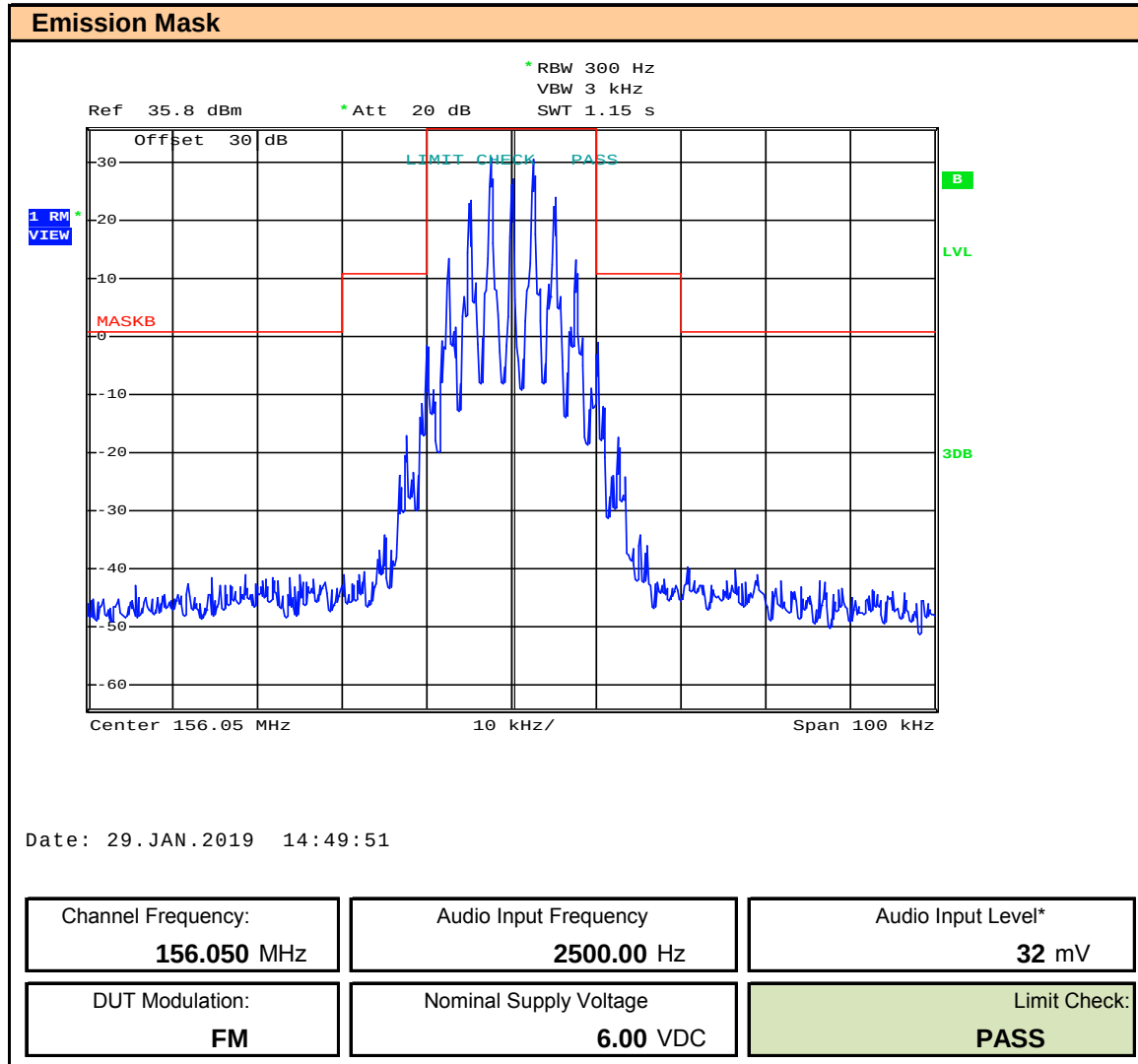
* Audio Input Level > 16dB of Level Required for 50% Deviation

Plot 10.3 – Occupied Bandwidth Channel 88



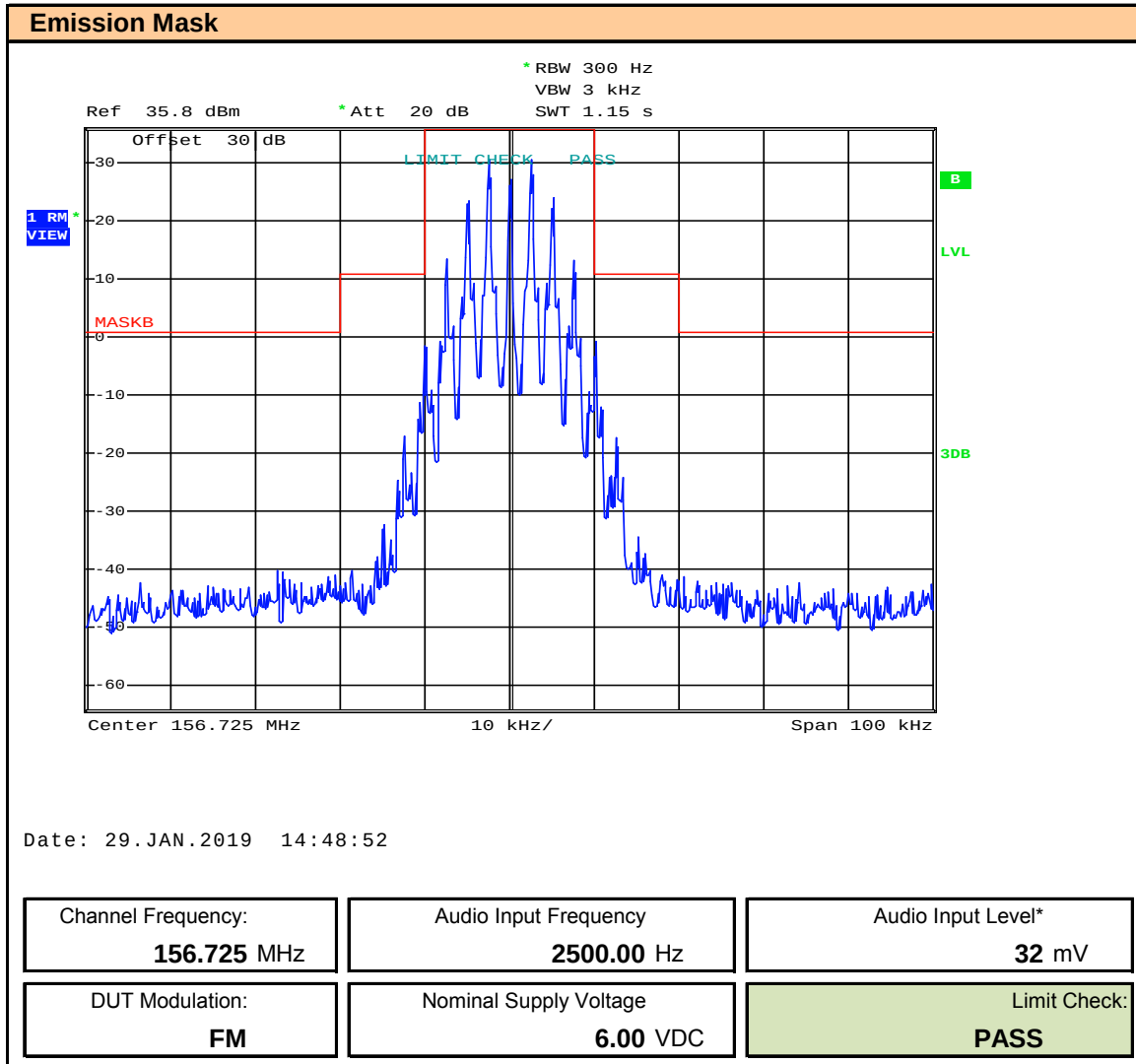
* Audio Input Level > 16dB of Level Required for 50% Deviation

Plot 10.4 – Emission Mask Channel 1



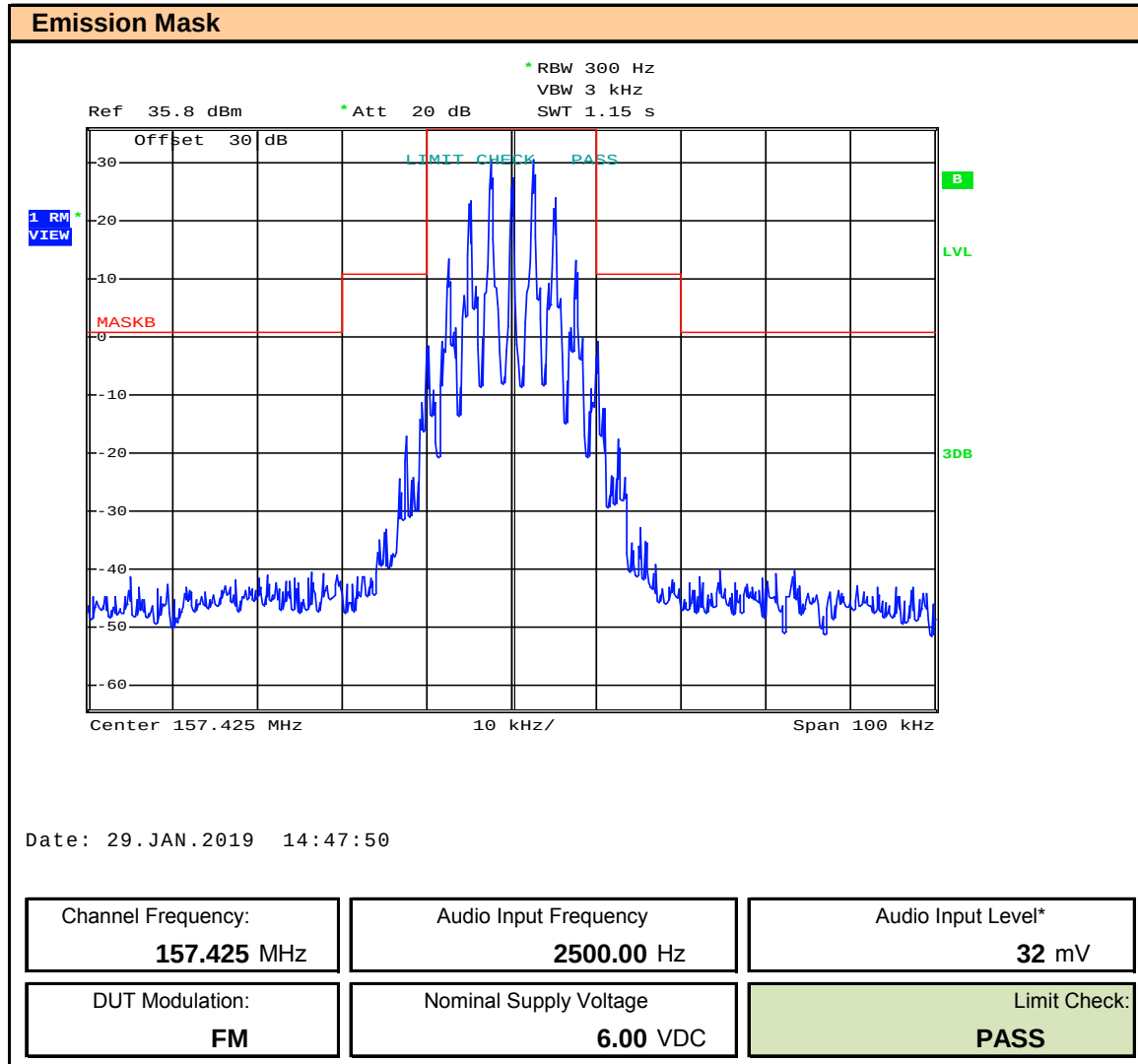
* Audio Input Level > 16dB of Level Required for 50% Deviation

Plot 10.5 – Emission Mask Channel 74



* Audio Input Level > 16dB of Level Required for 50% Deviation

Plot 10.6 – Emission Mask Channel 88



* Audio Input Level > 16dB of Level Required for 50% Deviation

Table 10 - Summary of Occupied Bandwidth and Emission Mask Results

Occupied Bandwidth Measurement Results							
Channel	Frequency (MHz)	DUT Modulation	Measured Occupied Bandwidth (kHz)	Authorized Bandwidth (kHz)	Margin (kHz)	Emission Mask	Emission Designator
1	156.05	FM	15.0	16.0	1.0	PASS	16K0F3E
74	156.725		15.0		1.0	PASS	16K0F3E
88	157.425		15.0		1.0	PASS	16K0F3E
Margin = Authorized BW - Measured BW							
Result:						Complies	

11.0 CONDUCTED OUT OF BAND SPURIOUS EMISSIONS

Test Conditions

Normative Reference FCC 47 CFR §2.1049, §80.205, §80.211, RSS-182

Limits

47 CFR §80	§80.211 Emission limitations. The emissions must be attenuated according to the following schedule. (f) The mean power when using emissions other than those in paragraphs (a), (b), (c) and (d) of this section: (1) On any frequency removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: At least 25 dB; (2) On any frequency removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: At least 35 dB; and (3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 plus 10log10 (mean power in watts) dB.
RSS-182	7.9.1 Emission Mask B for Equipment with 25 kHz Channel Spacing This mask is for FM or PM modulation equipment with 25 kHz channel spacing, an authorized bandwidth of 16 kHz for voice or 20 kHz for data, and equipped with or without an audio low-pass filter. The power of any emission shall be attenuated below the transmitter output power (P, in dBW) as follows: (a) on any frequency removed from the carrier frequency by more than 50%, but not more than 100% of the authorized bandwidth: at least 25 dB, measured with a bandwidth of 300 Hz; (b) on any frequency removed from the carrier frequency by more than 100%, but not more than 250% of the authorized bandwidth: at least 35 dB, measured with a bandwidth of 300 Hz; and (c) on any frequency removed from the carrier frequency by more than 250% of the authorized bandwidth: at least 43 + 10 log10 p(watts) dB, measured with a bandwidth of 30 kHz.

Measurement Procedure

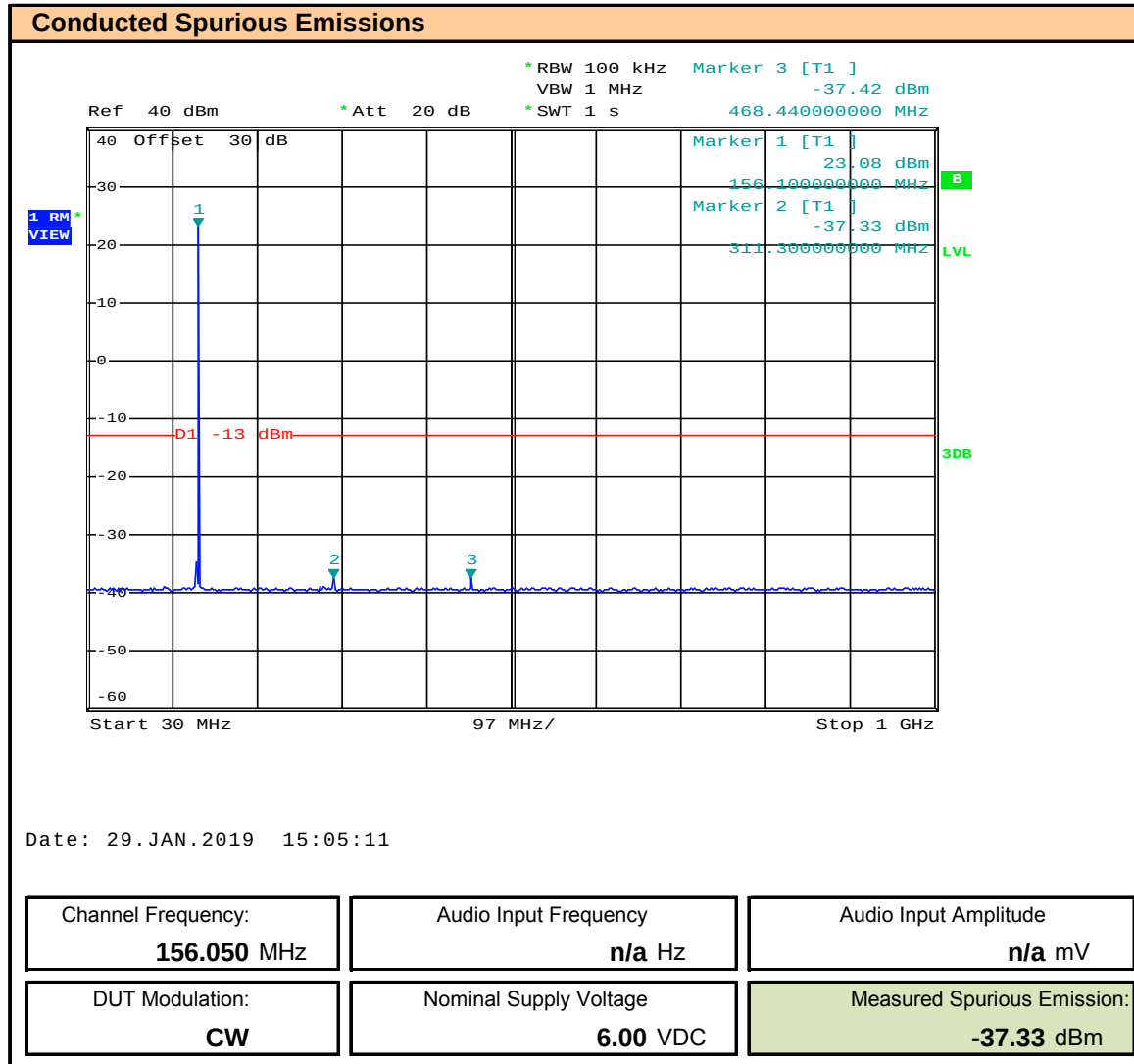
The transmitter was set to the highest output power unmodulated. The emissions were evaluated to the 10th harmonic.

Test Setup

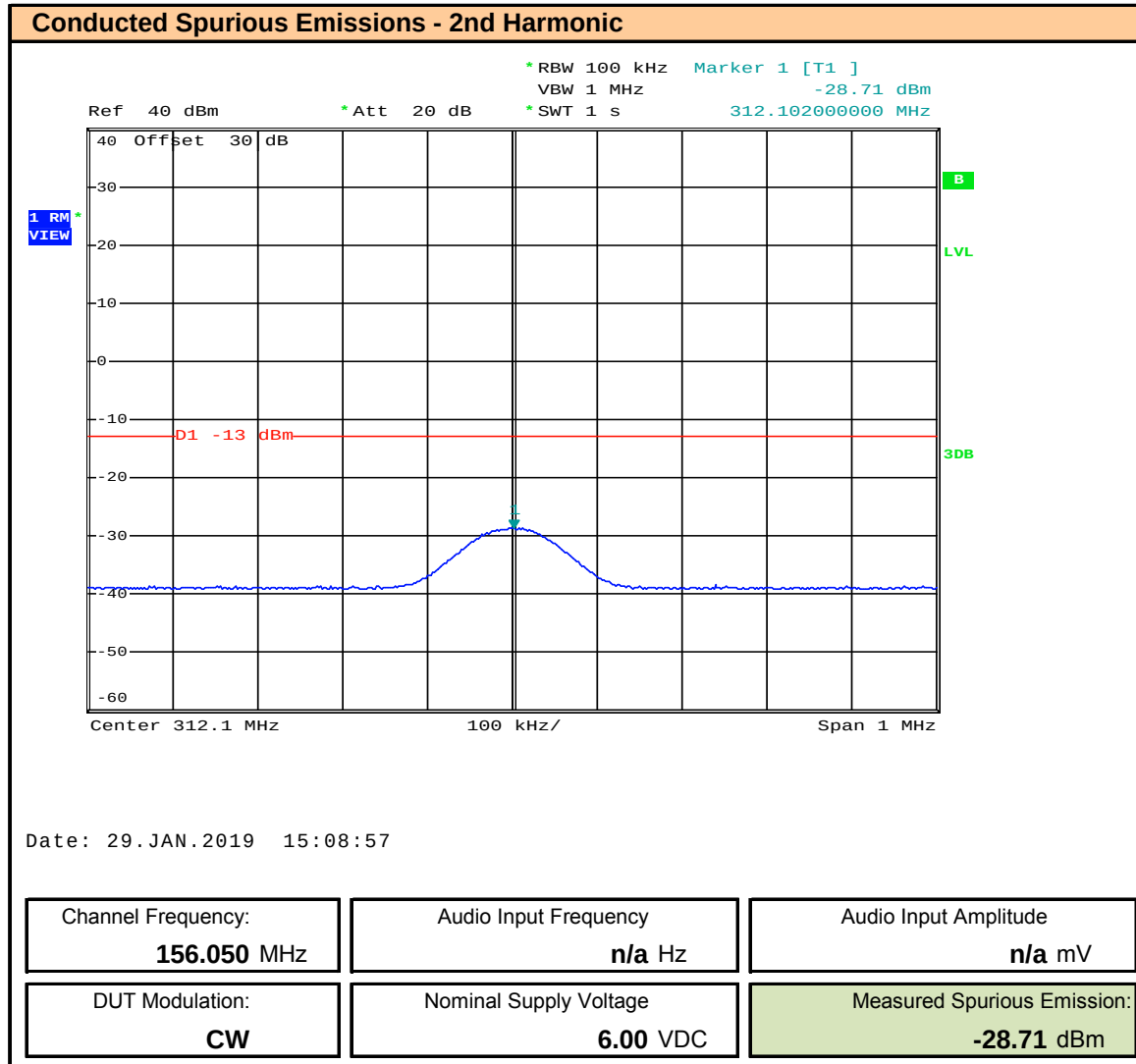
Appendix A

Figure A.1

Plot 11.1 – Conducted Out of Band Emissions, 30MHz – 1000MHz, Channel 1



Plot 11.2 – Conducted Out of Band Emissions, Channel 1, 2nd Harmonic



Plot 11.3 – Conducted Out of Band Emissions, Channel 1, 3rd Harmonic

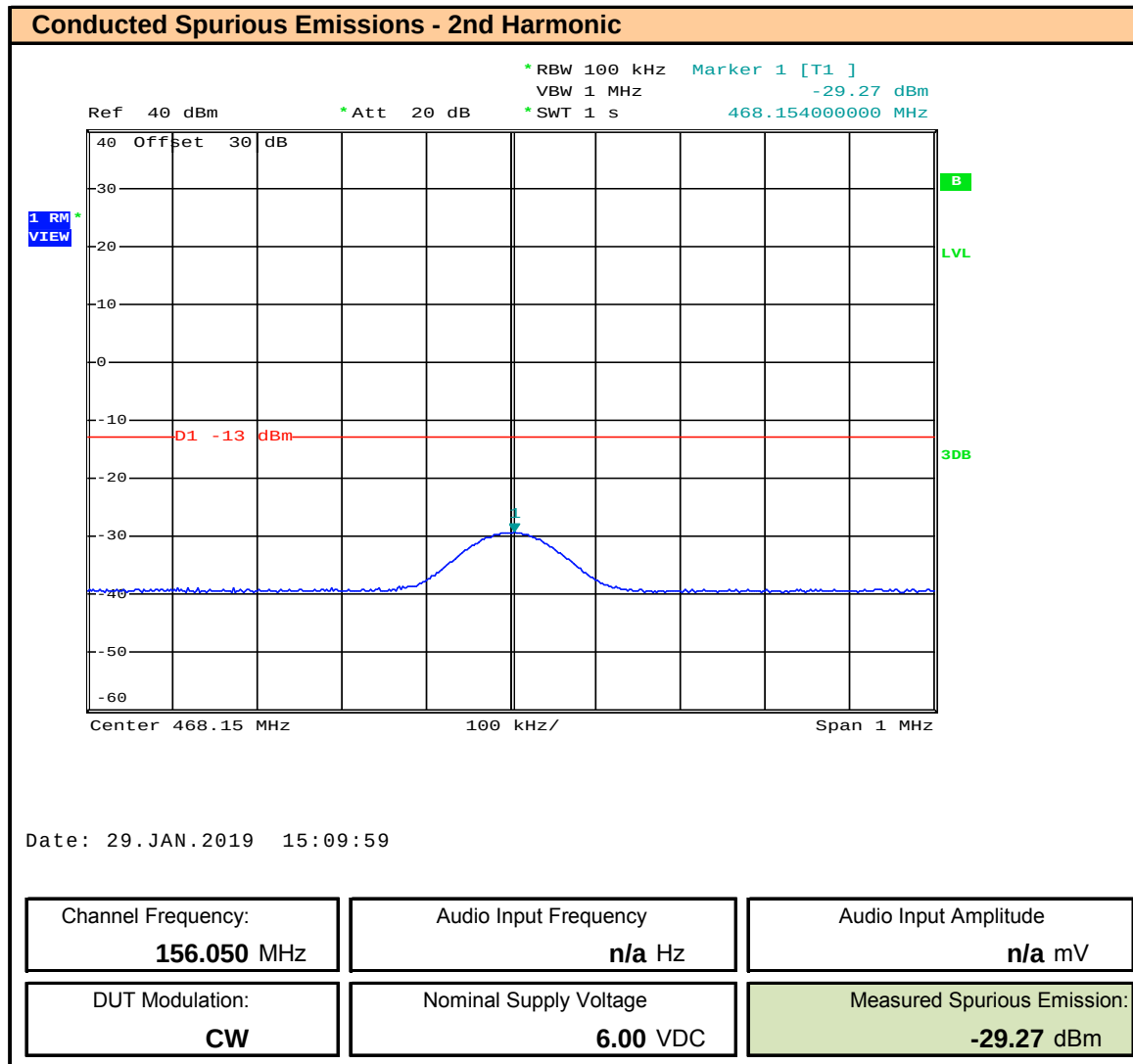


Table 11.1 – Summary of Conducted Out of Band Emissions

Conducted Spurious Emissions							
Channel Frequency <i>(MHz)</i>	Emission Frequency <i>(MHz)</i>	DUT Modulation	Fundamental Power [P] <i>(dBm)</i>	Out of Band Emission [P _E] <i>(dBm)</i>	Attenuation <i>[dB]</i>	Limit <i>(dB)</i>	Margin <i>(dB)</i>
156.05	312.1	CW	34.97	-28.7	63.7	43.0	20.68
	80.89		34.97	-29.3	64.3		21.27
Attenuation = P - P _E							
Margin = Limit - Attenuation							
						Result:	Complies
Data for fundamental and spurious emissions presented using an RMS detector.							

12.0 CONDUCTED OUT OF BAND SPURIOUS EMISSIONS – RESTRICTED BAND

Test Conditions

Normative Reference	FCC 47 CFR §2.1046, §80.211(c)
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Limits

47 CFR §80.211(c)	§ 80.211 Emission limitations
	(c) In any 4 kHz band the peak power of spurious emissions and noise at the input to the transmit antenna must be attenuated below the peak output power of the station as follows: (1) 125 dB at 1525.0 MHz, increasing linearly to 90 dB at 1612.5 MHz; (3) 90 dB from 1624.0 MHz to 1650.0 MHz, except at frequencies near the transmitted carrier where the requirements of paragraphs (b)(1) through (3) of this section, apply; (4) 60 dB at 1650.0 MHz decreasing linearly to 90 dB at 1662.5 MHz; (5) 90 dB at 1662.5 MHz decreasing linearly to 125 dB at 1752.5 MHz; and (6) 125 dB outside above range, except for harmonics which must comply with (b)(3) of this section.

Test Setup

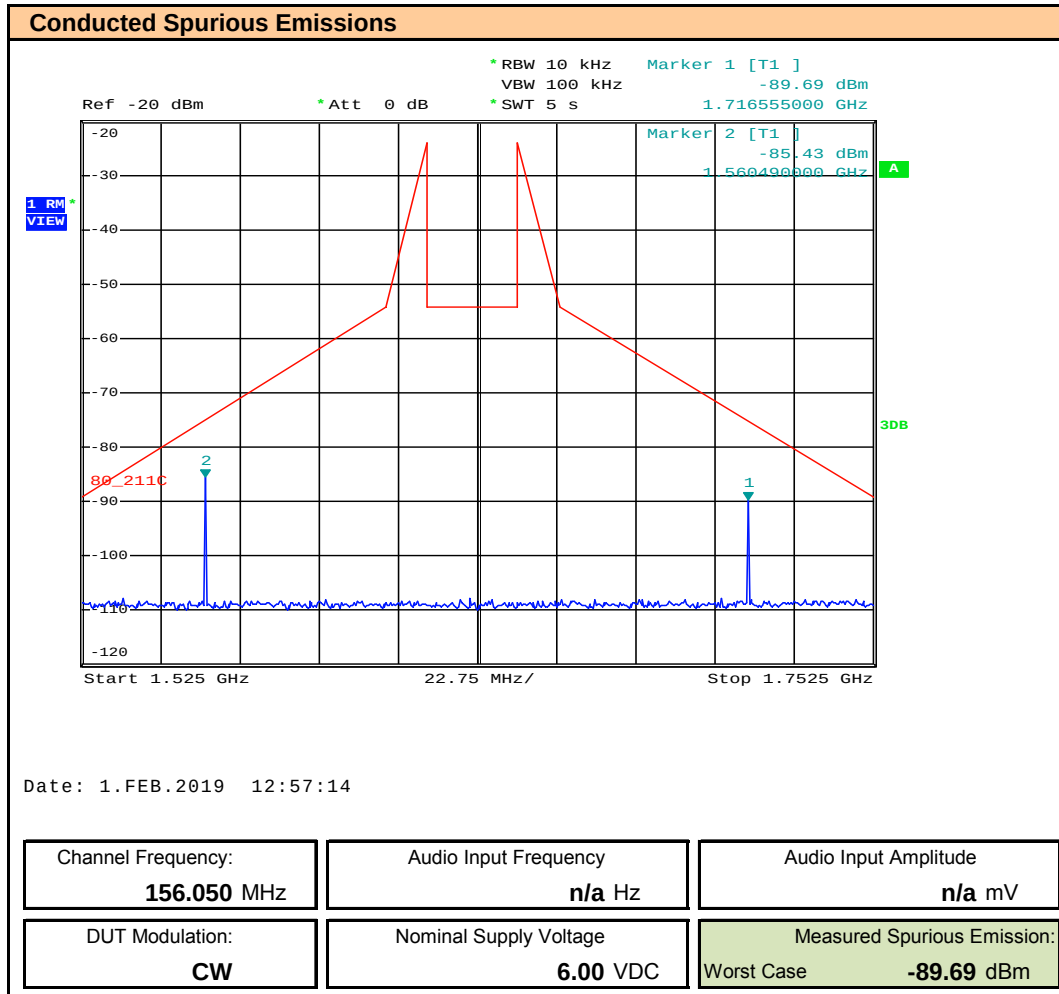
Appendix A

Figure A.2

Measurement Procedure

The DUT was connected to a Spectrum Analyzer (SA) via the DUT's antenna port using a high-pass filter to filter out the carrier. The SA Detector was set to RMS. The output power of the DUT was set to the manufacturer's highest rated setting. To determine compliance an emission mask was created in accordance with the above requirements referenced to the carrier, or dBc. The DUT frequency was set a frequency which would produce a harmonic at the frequency of the worst case attenuation criteria from above. The emission was measured with minimum *attenuation* referenced to the carrier, dBc.

Plot 12.1 – Conducted Out of Band Emissions, Restricted Band, Channel 1



Plot 12.2 – Conducted Out of Band Emissions, Restricted Band, Channel 88

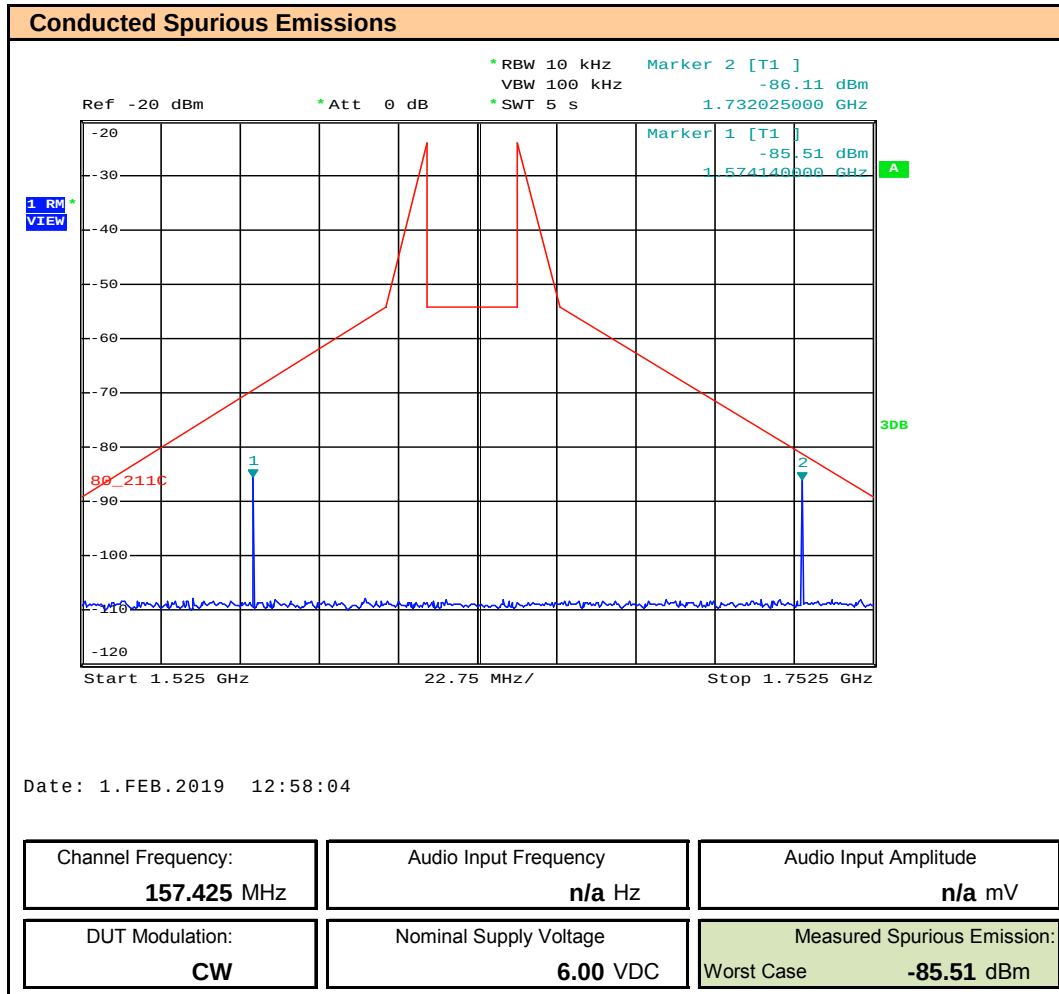


Table 12.1 – Summary of Conducted Out of Band Emissions, Restricted Band

§80.211 (c) Out of Band Emission in 1525 - 1752.5MHz Band									
Channel	Modulation	Fundamental Power	Emission Frequency	Measured Emission	Attenuation	Filter Loss*	Corrected Attenuation	Limit	Margin
Freq (MHz)		[E _{Meas}] (dBm)	[F _{Emission}] (MHz)	[E _{EM}] (dBm)	[A] (dBc)	[L _F] (dB)	[A _C] (dBc)	[Limit _{Emission}] (dB)	(dB)
156.05000	CW	34.97	1560	-85.43	120.40	0.50	119.90	109.0	10.9
156.05000		34.97	1717	-89.69	124.66	0.50	124.16	112.0	12.2
157.42500		34.97	1574	-85.51	120.48	0.50	119.98	103.0	17.0
157.42500		34.97	1732	-86.11	121.08	0.50	120.58	117.8	2.8
Results:								Complies	

* Insertion Loss of Hi-Pass Filter at Measured Frequency

Attenuation [A] = E_{Meas} - E_{EM}

Corrected Attenuation = [A] - L_F

Slope of Limit of §80.211 (c)(1) = 0.4dB/MHz, F_{Start} = 1520MHz, Limit_{Start} = 125dB

Slope of Limit of §80.211 (c)(5) = -0.4dB/MHz, F_{Start} = 1662.5MHz, Limit_{Start} = 90dB

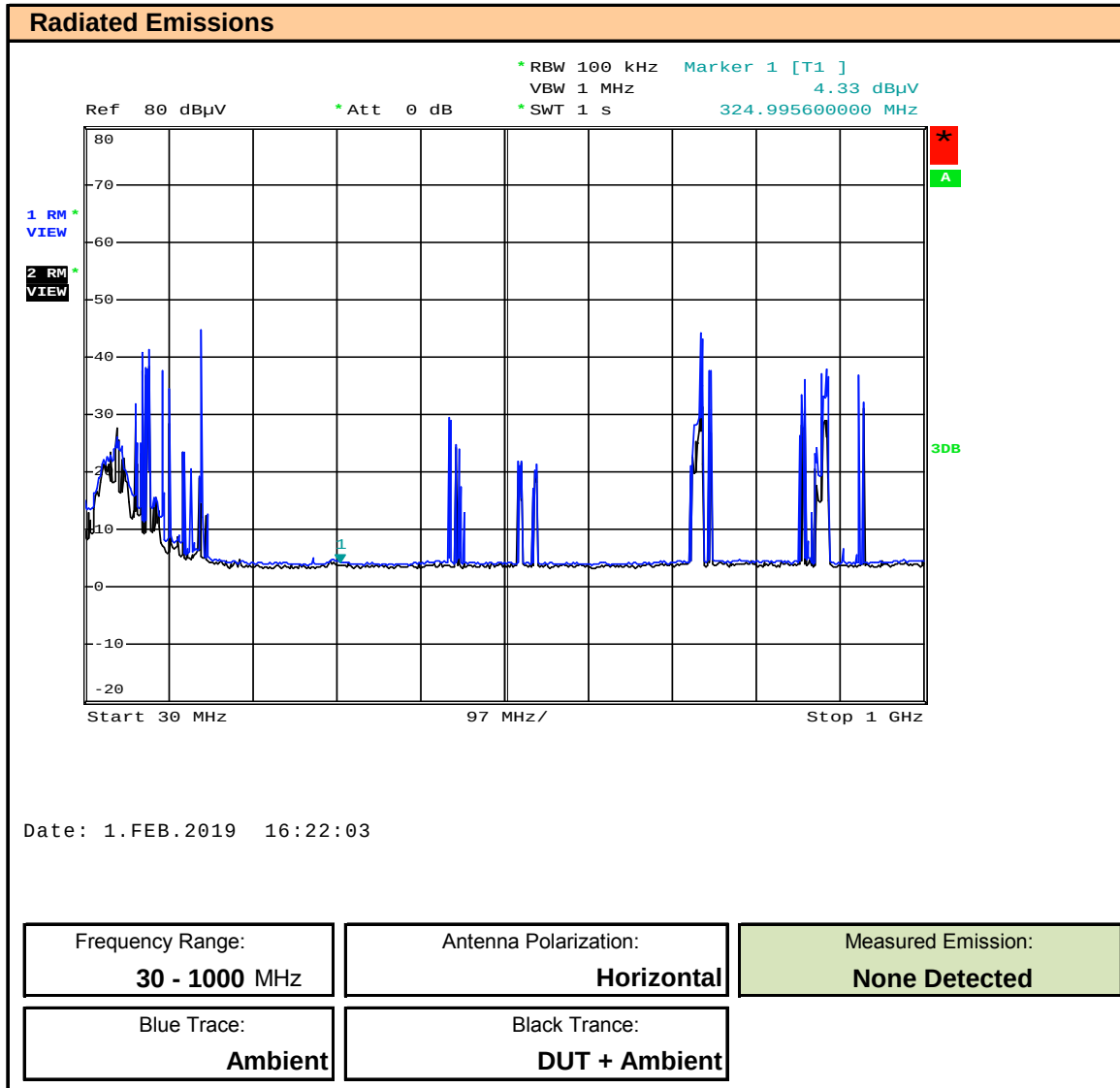
Limit_{Emission} = Limit_{Start} + ((F_{Start} - F_{Emission}) x Slope)

Margin = A_C - Limit_{Emission}

13.0 RECEIVER RADIATED EMISSIONS - DOC

Test Procedure	
Normative Reference	FCC 47 CFR §15.109, ICES-003(6.2) ANSI C63.4:2014
Limits	
47 CFR §15.109	(a) Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values: 30-88MHz: 40dBuV/m 88-216MHz: 216-960MHz: > 960MHz: 54dBuV/m
ICES-003(6.2.1)	6.2.1 - Radiated Emissions Limits Below 1 GHz Class B: ITE that does not meet the conditions for Class A operation shall comply with the Class B radiated limits set out in Table 5 determined at a distance of 3 metres. 30-88MHz: 40dBuV/m 88-216MHz: 216-960MHz: > 960MHz: 54dBuV/m
Test Setup	Appendix A Figure A.2
Measurement Procedure	
The DUT was set up as per ANSI C63.4:2014. Emissions were scanned between 30MHz and 1000MHz. The turntable was rotated 360 degrees and the antenna was elevated to 4m to optimize the measured emissions.	

Plot 13.1 – Radiated Spurious Emissions OATS, 30MHz – 1000MHz, Horizontal



Plot 13.2 – Radiated Spurious Emissions OATS, 30MHz – 1000MHz, Vertical

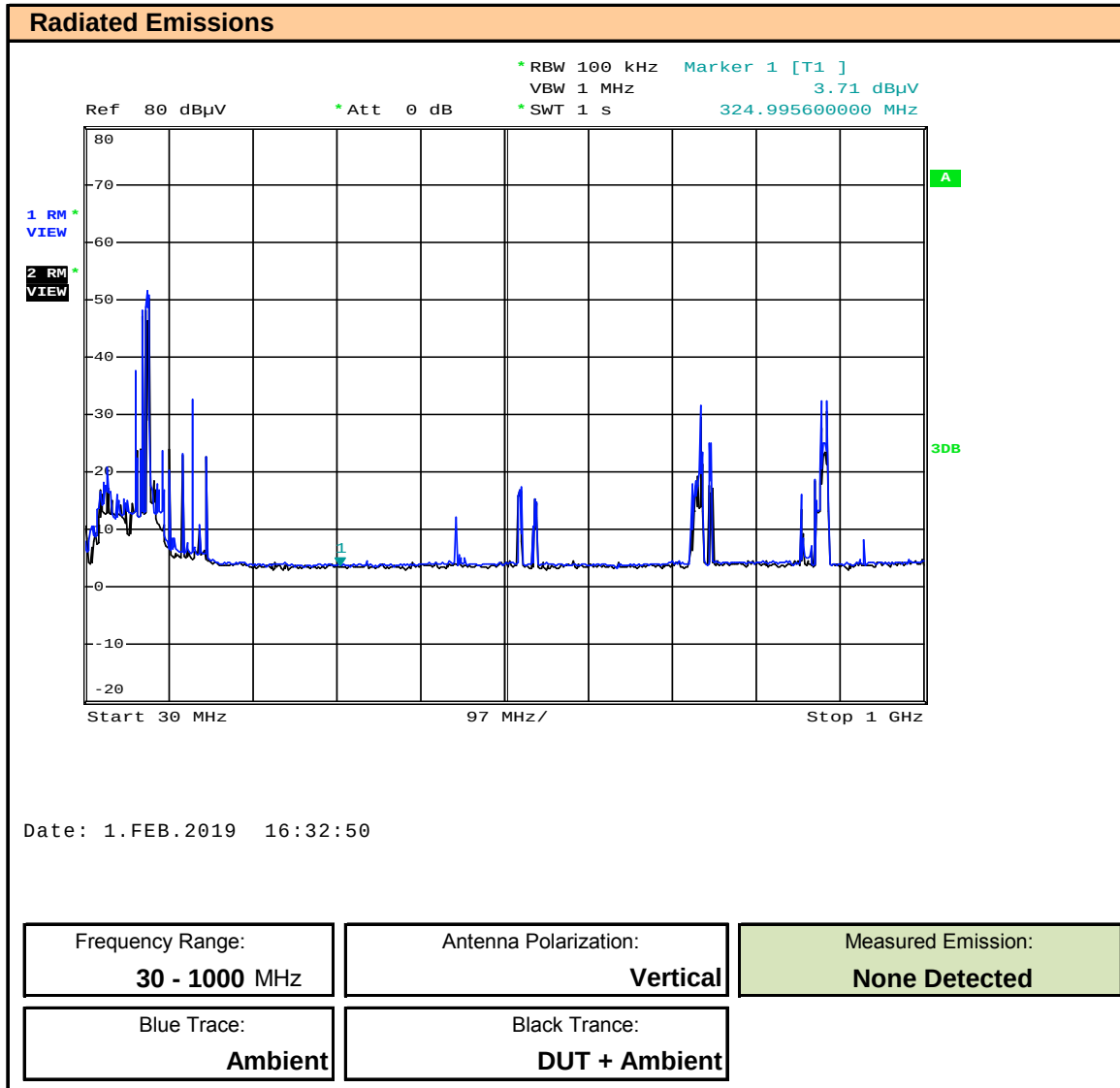


Table 13.1 – Summary of Radiated Spurious Emissions

§15.109, ICES-003 (6.2)					
Emission Frequency (MHz)	Antenna Polarization	Measured Emission [E _{Meas}] (dBuV)	Corrected Emission [E _{Corr}] (W)	Limit (W)	Margin (dB)
30-1000	Horizontal	n/a	n/a	-	-
30-1000	Vertical	n/a	n/a	-	-
Results:				Complies	

No emissions detected above ambient noise.

14.0 FREQUENCY STABILITY

Test Conditions

Normative Reference	FCC 47 CFR §2.1055, §80.209, RSS-182
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Limits

47 CFR §80	§80.209 Transmitter frequency tolerances. (a) The frequency tolerance requirements applicable to transmitters in the maritime services are shown in the following table. Tolerances are given as parts in 10⁶: Below 3W: 10ppm, 3 to 100W, 5ppm
RSS-182	7.4 Frequency Stability With the exception of DSC emissions, the RF carrier frequency shall not depart from the reference frequency in excess of the limits listed in Table 2. +/-10.0 ppm for transmitter power less than 3 watts +/-5.0 ppm for transmitter power between 3 and 100 watts

Measurement Procedure

47 CFR §2.1055 Frequency Stability

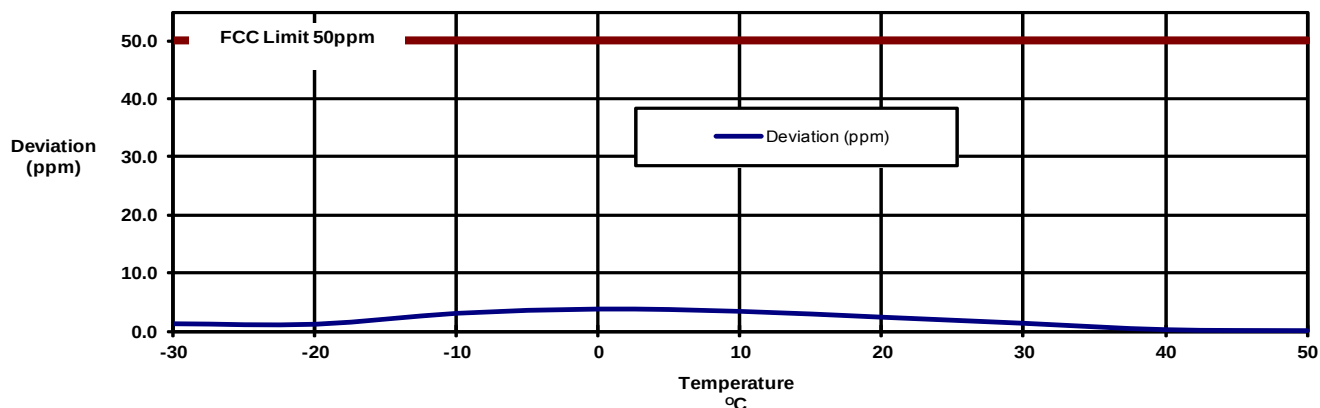
- (a) The frequency stability shall be measured with variation of ambient temperature as follows:
- (1) From -30° to +50° centigrade for all equipment except that specified in paragraphs (a) (2) and (3) of this section.
- (b) Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10° centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement.
- (d) The frequency stability shall be measured with variation of primary supply voltage as follows:
- (1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

Test Setup	Appendix A	Figure A.4
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Table 14.1 – Summary of Frequency Stability Results

Frequency Stability

Nominal Frequency (MHz):	157.425
Nominal Channel BW (KHz):	CW
Nominal Voltage (VDC):	6
Nominal Temperature (°C):	20



Frequency Stability Measurements (Temperature)

Temp (°C)	Assigned Frequency (MHz)	Measured Frequency (MHz)	Deviation (Hz)	Deviation [Absolute] (ppm)
-30	157.425000	157.424795	-205	1.30
-20		157.424805	-195	1.24
-10		157.425478	478	3.04
0		157.425590	590	3.75
10		157.425526	526	3.34
20		157.425376	376	2.39
30		157.425221	221	1.40
40		157.425052	52	0.33
50		157.425030	30	0.19
Maximum Deviation:				3.75
Maximum Limit (ppm):				5.00
Result:				Complies

Frequency Stability Measurements (Voltage)

Voltage* (VDC)	Assigned Frequency (MHz)	Measured Frequency (MHz)	Deviation (Hz)	Deviation [Absolute] (ppm)
6.9 (115%)	157.425000	157.425377	377	2.39
6 (100%)		157.425376	376	2.39
4.6 (85%)		157.425370	370	2.35
Maximum Deviation:				2.39
Maximum Limit (ppm):				5.00
Result:				Complies

Battery Operated Device at 6VDC.
Power Supply Setting.

APPENDIX A – TEST SETUP DRAWINGS AND EQUIPMENT

Table A.1 – Setup - Conducted Measurements Equipment

Equipment List			
Asset Number	Manufacturer	Model Number	Description
00241	R&S	FSU40	Spectrum Analyzer

Figure A.1 – Test Setup Conducted Measurements

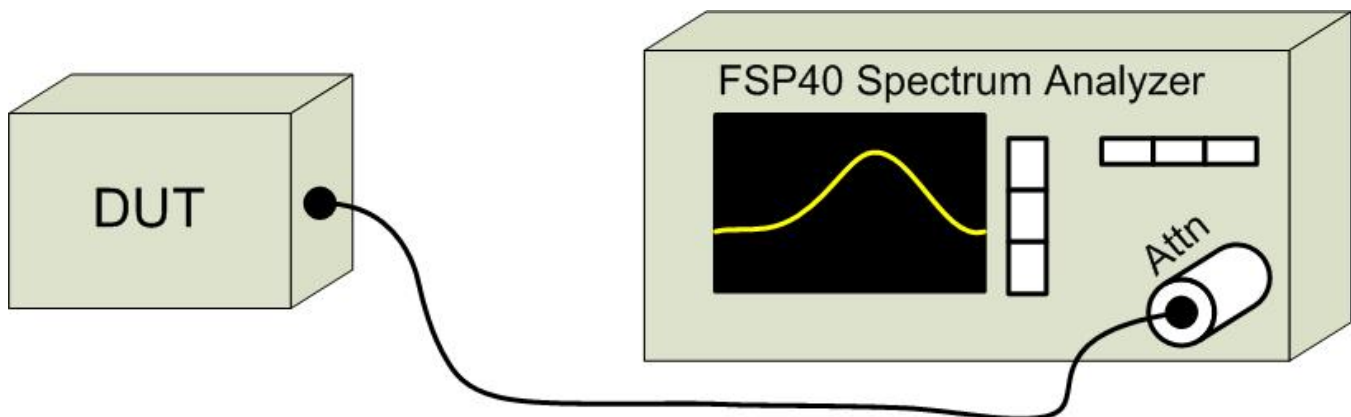


Table A.2 – Setup - Audio Modulation Equipment

Equipment List			
Asset Number	Manufacturer	Model Number	Description
00028	HP	8901A	Modulation Analyzer
00027	HP	8903B	Audio Analyzer/Generator

Figure A.2 – Test Setup Audio Modulation Response Measurements

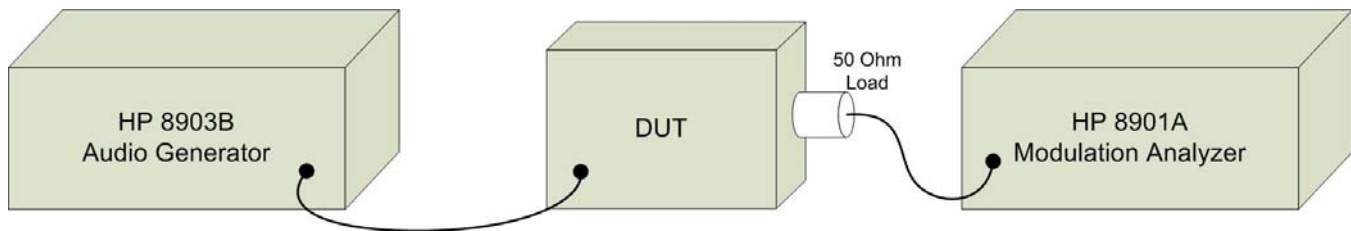


Table A.3 – Setup - Radiated Emissions Equipment

Equipment List			
Asset Number	Manufacturer	Model Number	Description
00051	HP	8566B	Spectrum Analyzer
00049	HP	85650A	Quasi-peak Adapter
00047	HP	85685A	RF Preselector
00072	EMCO	2075	Mini-mast
00073	EMCO	2080	Turn Table
00071	EMCO	2090	Multi-Device Controller
00265	Miteq	JS32-00104000-58-5P	Microwave L/N Amplifier
00241	R&S	FSU40	Spectrum Analyzer
00050	Chase	CBL-6111A	Bilog Antenna
00275	Coaxis	LMR400	25m Cable
00276	Coaxis	LMR400	4m Cable
00278	TILE	34G3	TILE Test Software
00034	ETS	3115	Double Ridged Guide Horn

CNR: Calibration Not Required
 COU: Calibrate On Use

Figure A.3 – Test Setup Radiated Emissions Measurements

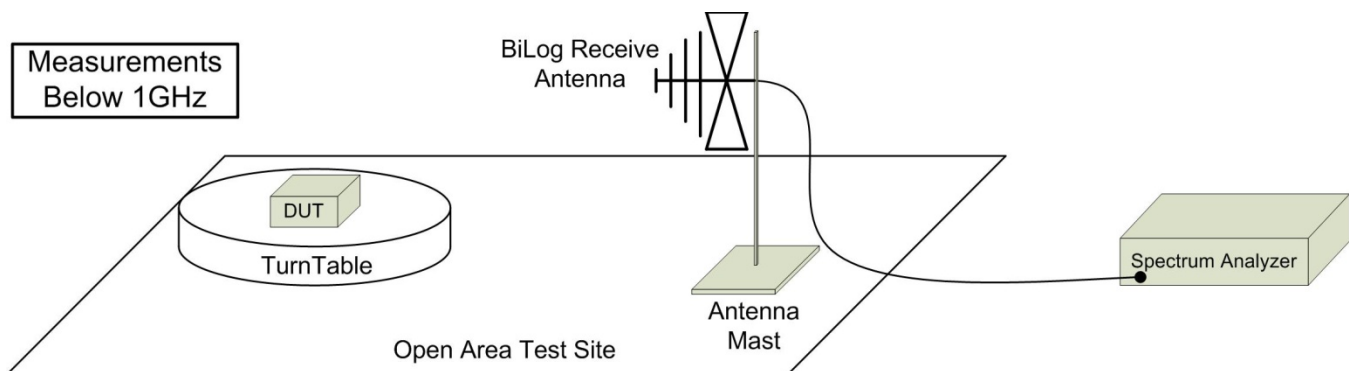
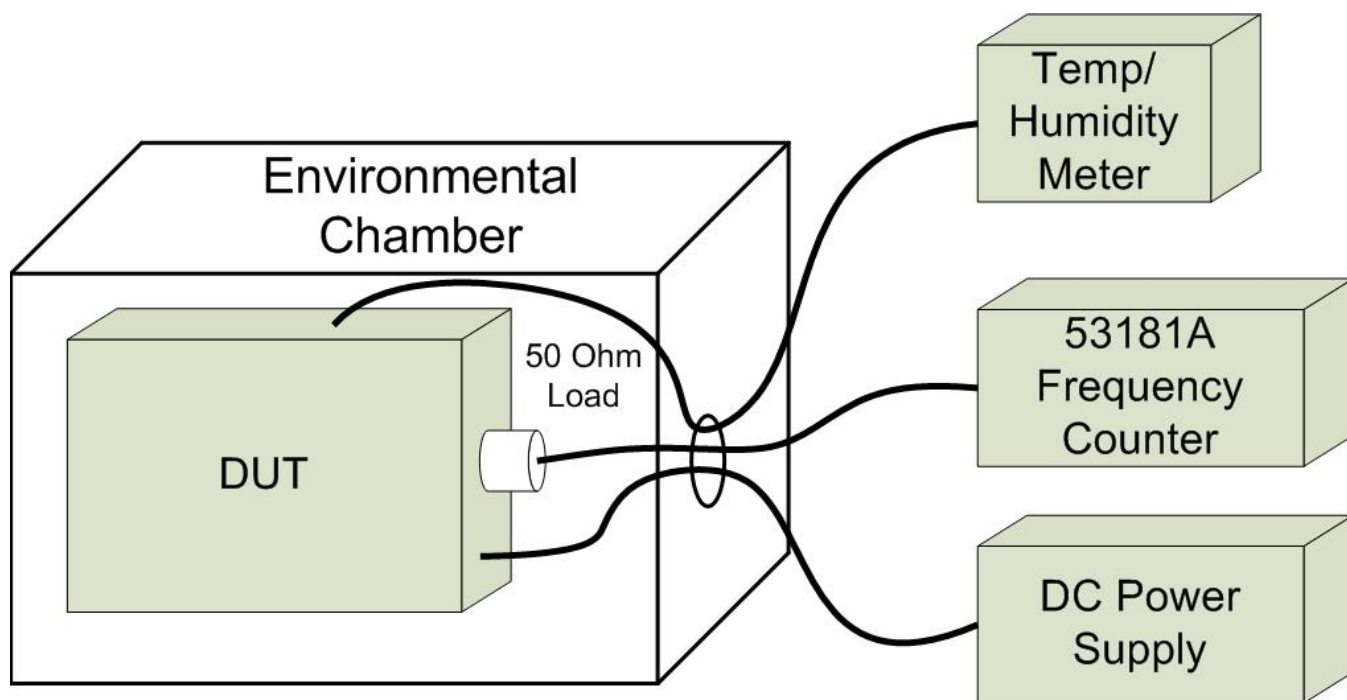


Table A.4 – Setup - Frequency Stability Measurement Equipment

Equipment List			
Asset Number	Manufacturer	Model Number	Description
n/a	ESPEC	ECT-2	Environmental Chamber
00003	HP	53181A	Frequency Counter
n/a	HP	E3611A	Power Supply
00234	VWR	61161-378	Temp/Humidity Meter

Figure A.4 – Test Setup Frequency Stability Measurements



APPENDIX B – EQUIPMENT LIST AND CALIBRATION

Equipment List								
(*)	Asset Number	Manufacturer	Model Number	Serial Number	Description	Last Calibrated	Calibration Interval	Calibration Due
*	00050	Chase	CBL-6111A	1607	Bilog Antenna	3 Jan 2019	Triennial	3 Jan 2022
*	00034	ETS	3115	6267	Double Ridged Guide Horn	26 Nov 2018	Triennial	26 Nov 2021
	00035	ETS	3115	6276	Double Ridged Guide Horn	2 Dec 2015	Triennial	2 Dec 2018
	00085	EMCO	6502	9203-2724	Loop Antenna	8 Jun 2016	Triennial	8 Jun 2019
*	00047	HP	85685A	2837A00826	RF Preselector	23 Jun 2017	Triennial	23 Jun 2020
*	00049	HP	85650A	2043A00162	Quasi-peak Adapter	23 Jun 2017	Triennial	23 Jun 2020
*	00051	HP	8566B	2747A05510	Spectrum Analyzer	23 Jun 2017	Triennial	23 Jun 2020
	00223	HP	8901A	3749A07154	Modulation Analyzer	27 Dec 2017	Triennial	27 Dec 2020
	00224	HP	8903B	3729A18691	Audio Analyzer	28 Dec 2017	Triennial	28 Dec 2020
*	00241	R&S	FSU40	100500	Spectrum Analyzer	15 May 2018	Triennial	15 May 2021
*	00005	HP	8648D	3847A00611	Signal Generator	21 Jun 2017	Triennial	21 Jun 2020
	00006	R&S	SMR20	100104	Signal Generator	29 May 2017	Triennial	29 May 2020
	00243	Rigol	DS1102E	DS1ET150502164	Oscilloscope	7 Nov 2017	Triennial	7 Nov 2020
	00254	LeCroy	WM8600A	532	Oscilloscope	NCR	n/a	NCR
	00110	Gigatronics	8652A	1875801	Power Meter	29 Feb 2016	Triennial	29 Feb 2019
	00237	Gigatronics	80334A	1837001	Power Sensor	23 Jun 2014	Triennial	23 Jun 2017
	00232	ETS Lindgren	HI-6005	91440	Isotropic E-Field Probe	18 Dec 2017	Triennial	18 Dec 2020
	00003	HP	53181A	3736A05175	Frequency Counter	21 Jun 2017	Triennial	21 Jun 2020
	00257	Com-Power	LI-215A	191934	LISN	5 Jan 2018	Triennial	5 Jan 2021
	00041	AR	10W1000C	27887	Power Amplifier	NCR	n/a	NCR
	00106	AR	5SIG4	26235	Power Amplifier	NCR	n/a	NCR
	00280	AR	25A250AM6	22702	Power Amplifier	NCR	n/a	NCR
	00265	Miteq	JS32-00104000-58-5P	1939850	Microwave L/N Amplifier	COU	n/a	COU
	00071	EMCO	2090	9912-1484	Multi-Device Controller	n/a	n/a	n/a
*	00072	EMCO	2075	0001-2277	Mini-mast	n/a	n/a	n/a
*	00073	EMCO	2080	0002-1002	Turn Table	n/a	n/a	n/a
	00081	ESPEC	ECT-2	0510154-B	Environmental Chamber	CNR	n/a	CNR
	00234	VWR	61161-378	140320430	Temp/Humidity Meter	New	Triennial	New
	00236	Nokia	-	236	ESD Table	NCR	n/a	NCR
	00255	Expert ESD	A4001	A4001-155	ESD Target	COU	n/a	COU
	00064	NARDA	3020A	n/a	Bi-Directional Coupler	COU	n/a	COU
	00263	Koaxis	KP10-1.00M-TD	263	1m Armoured Cable	COU	n/a	COU
*	00263B	Koaxis	KP10-1.00M-TD	263B	1m Armoured Cable	COU	n/a	COU
*	00264	Koaxis	KP10-7.00M-TD	264	7m Armoured Cable	COU	n/a	COU
*	00275	TMS	LMR400	n/a	25m Cable	COU	n/a	COU
*	00276	TMS	LMR400	n/a	4m Cable	COU	n/a	COU
*	00277	TMS	LMR400	n/a	4m Cable	COU	n/a	COU
*	00278	TILE	34G3	n/a	TILE Test Software	NCR	n/a	NCR
Rented Equipment								

* Used during the course of this investigation

CNR: Calibration Not Required

COU: Calibrate On Use

APPENDIX C – MEASUREMENT INSTRUMENT UNCERTAINTY

CISPR 16-4 Measurement Uncertainty (U_{LAB})

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence interval using a coverage factor of $k=2$

30MHz - 200MHz

$$U_{LAB} = 5.14\text{dB} \quad U_{CISPR} = 6.3\text{dB}$$

200MHz - 1000MHz

$$U_{LAB} = 5.90\text{dB} \quad U_{CISPR} = 6.3\text{dB}$$

1GHz - 6GHz

$$U_{LAB} = 4.80\text{dB} \quad U_{CISPR} = 5.2\text{dB}$$

6GHz - 18GHz

$$U_{LAB} = 5.1\text{dB} \quad U_{CISPR} = 5.5\text{dB}$$

If the calculated uncertainty U_{lab} is **less** than U_{CISPR} then:

- | | |
|---|---|
| 1 | Compliance is deemed to occur if NO measured disturbance exceeds the disturbance limit |
| 2 | Non-Compliance is deemed to occur if ANY measured disturbance EXCEEDS the disturbance limit |

If the calculated uncertainty U_{lab} is **greater** than U_{CISPR} then:

- | | |
|---|--|
| 3 | Compliance is deemed to occur if NO measured disturbance, increased by ($U_{lab} - U_{CISPR}$), exceeds the disturbance limit |
| 4 | Non-Compliance is deemed to occur if ANY measured disturbance, increased by ($U_{lab} - U_{CISPR}$), EXCEEDS the disturbance limit |