



Test Report – FCC Part 15.225 Intentional Radiator

Applicant: Motorola Solutions, Inc.

Approved for Release By:

Signature: Bruno Clavier

Name & Title: Bruno Clavier, General Manager

Date of Signature 10/11/2022

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Timco Engineering, Inc., an IIA Company
849 NW State Road 45, Newberry, Florida 32669
(352) 472-5500 / testing@timcoengr.com

1. Customer Information

Applicant: Motorola Solutions, Inc.
Address: 8000 West Sunrise Blvd
Ft Lauderdale FL 33322-9947

1.1 Test Result Summary

The following regulatory standards were used FCC Title 47 CFR Part 15.225. The following test procedure was used ANSI C63.10-2013, C63.4-2014. Full test results are available in this report.

No additions to the test methods were needed. There were no deviations, or exclusions from the test methods. No test results are from external providers or from the customer. The test results relate only to the items tested. Timco does not offer opinions and interpretations, only a pass/fail statement.

FCC Rule Part No.	Requirement	Result
15.207	Conducted Emissions	Pass
15.225(a)	Fundamental	Pass
15.225(d)	Harmonics	Pass
2.1055 15.225(e)	Frequency stability	Pass
15.207(a), (c)	AC Powerline Conducted Emissions	Pass
15.203	Antenna Requirement	Pass



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2. Location of Testing

2.1 Test Laboratory

Timco Engineering Inc. is a subsidiary of Industrial Inspection & Analysis, Inc. ("IIA"). Testing was performed at Timco's permanent laboratory located at 849 NW State Road 45, Newberry, Florida 32669

FCC test firm # 578780

FCC Designation # US1070

FCC site registration is under A2LA certificate # 0955.01

ISED Canada test site registration # 2056A

EU Notified Body # 1177

For all designations see A2LA scope # 0955.01

2.2 Testing was performed, reviewed by

Dates of Testing: 9/15/2022

Signature:

Sr. EMC Engineer
EMC-003838-NE



Name & Title:

Tim Royer, EMC Engineer

Date of Signature

10/11/2022

Signature:

Name & Title:

Kristoffer Costa, EMC Technician

Date of Signature

10/11/2022



3. Test Sample(s) (EUT/DUT)

The test sample was received: 9/15/2022

3.1 Description of the EUT

A description as well as unambiguous identification of the EUT(s) tested. Where more than one sample is required for technical reasons (such as the use of connected units for the purpose of conducted output power testing where the product units will have integral antennas), each specific test shall identify which unit was tested.

Identification	
FCC ID:	AZ489FT7147
Brief Description	Motorola Solutions, Inc.
Model(s) #	APX N70

Technical Characteristics	
Technology	13.56 MHz NFC Card Reader
Number of Channels	1
Antenna Connector	PCB Trace
Voltage Rating (AC or Batt.)	7.2vDC



3.2 Configuration of EUT

Band (MHz)	Mode	Number of Ant.
13.56	Transmit	1

Operating conditions during Testing:

No modifications of the device under test (including firmware, specific software settings, and input/output signal levels to the EUT).

Peripherals used during Testing:

No peripherals used.

3.3 Test Setup of EUT

Equipment, antenna, and cable arrangement. The setup of the equipment and cable or wire placement on the test site that produces the highest radiated and the highest ac power-line conducted emissions shall be shown clearly and described. Information on the orientation of portable equipment during testing shall be included. Drawings or photographs may be used for this purpose.

Test Setups are included in the test report.



4. Test methods & Applicable Regulatory Limits

4.1 Test methods/Standards/Guidance

The measurement was performed as per ANSI 63.10. Full test results are available in this report.

Limits and Regulatory Limits:

- 1) FCC 15.225

5. Measurement Uncertainty

Parameter	Uncertainty (dB)
Conducted Emissions	± 3.14 dB
Radiated Emissions (9kHz – 30 MHz)	± 3.08 dB
Radiated Emissions (30 – 200 MHz)	± 2.16 dB
Radiated Emissions (200 – 1000 MHz)	± 2.15 dB
Radiated Emissions (1 GHz – 18 GHz)	± 2.14 dB
Radiated Emissions (18 GHz – 40 GHz)	± 2.31 dB
Note: The uncertainties provided in this table represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of K=2.	

6. Environmental Conditions

Temperature & Humidity

Measurements performed at the test site did not exceed the following:

Parameter	Measurement
Temperature	23 C +/- 5%
Humidity	55% +/- 5%
Barometric Pressure	30.05 in Hg
Note: Specific environmental conditions that are applicable to a specific test are available in the test result section.	



7. List of Test Equipment and Test Facility

The test equipment used identified by type, manufacturer, serial number, or other identification and the date on which the next calibration or service check is due.

Description of the firmware or software used to operate EUT for testing purposes.

A complete list of all test equipment used shall be included with the test report. The manufacturer's model and serial numbers, and date of last calibration, and calibration interval shall be included. Measurement cable loss, measuring instrument bandwidth and detector function, video bandwidth, if appropriate, and antenna factors shall also be included where applicable.

List of Test Equipment

Test Equipment						
Type	Device	Manufacturer	Model	SN#	Current Cal	Cal Due
Antenna, NSA	Log-Periodic 1243	Eaton	96005	1243	5/4/21	5/3/2024
Antenna	Double-Ridged Horn/ETS Horn 1	ETS-Lindgren	3117	00035923	2/25/20	2/24/2023
CHAMBER	CHAMBER	Panashield	3M	N/A	3/12/19	12/21/2023
Pre-amp	Pre-amp	RF-LAMBDA	RLNA00M45GA	NA	2/27/19	7/26/2025
Receiver	EMI Test Receiver R&S ESU 40	Rohde & Schwarz	ESU 40	100320	5/27/21	5/26/2024

Software			
Software	Author	Version	Validation on
ESU Firmware	Rohde & Schwarz	4.43 SP3; BIOS v5.1-24-3	2018
RSCCommander	Rohde & Schwarz	1.6.4	2014
ScopeExplorer	LeCroy	v2.25.0.0	2009
Field Strength	Timco	v4.10.7.0	2016



8. Test Results

The results of the test are usually indicated in the form of tables, spectrum analyzer plots, charts, sample calculations, as appropriate for each test procedure.

A description and/or a block diagram of the test setup is usually provided.

The measurement results, along with the appropriate limits for comparison, may be presented in tabular or graphical form. In addition, any variation in the measurement environment may be reported if applicable (e.g., a significant change of temperature that could affect the cable loss and amplifier response).

Units of measurement

Unless noted otherwise in the referenced standard, the measurements of ac power-line conducted emissions and conducted power output will be reported in units of dB μ V. Unless noted otherwise in the referenced standard, the measurements of radiated emissions will be reported in units of decibels, referenced to one microvolt per meter (dB μ V/m) for electric fields, or to one ampere per meter (dBA/m) for magnetic fields, at the distance specified in the appropriate standards or requirements. The measurements of antenna-conducted power for receivers may be reported in units of dB μ V if the impedance of the measuring instrument is also reported. Otherwise, antenna-conducted power will be reported in units of decibels referenced to one milliwatt (dBm). All formulas for data conversions and conversion factors, if used, will be included in this measurement report.

Example:

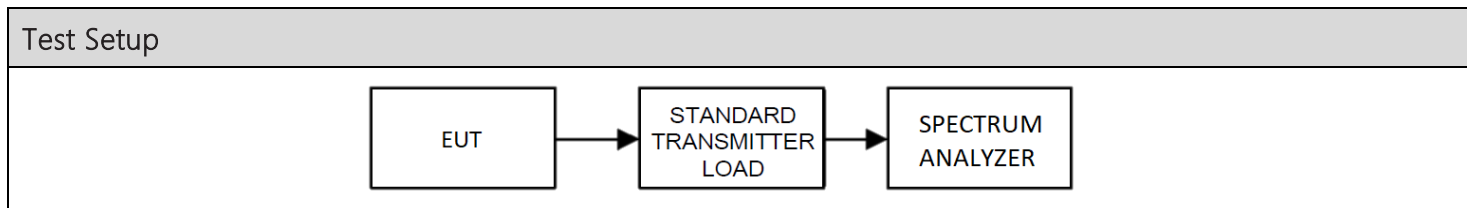
Freq (MHz)	Meter Reading	+ ACF	+CL	= FS
33	20 dB μ V	+ 10.36 dB/m	+0.40 dB	=30.36 dB μ V/m @ 3m

$EIRP = P_{cond} \text{ (dBm)} + dBi$



8.1 20dB Bandwidth

Limits from FCC Part 15.215 (c) as applicable, and test procedure from ANSI C63.10-2013 section 7.8 or 11.8 as applicable.



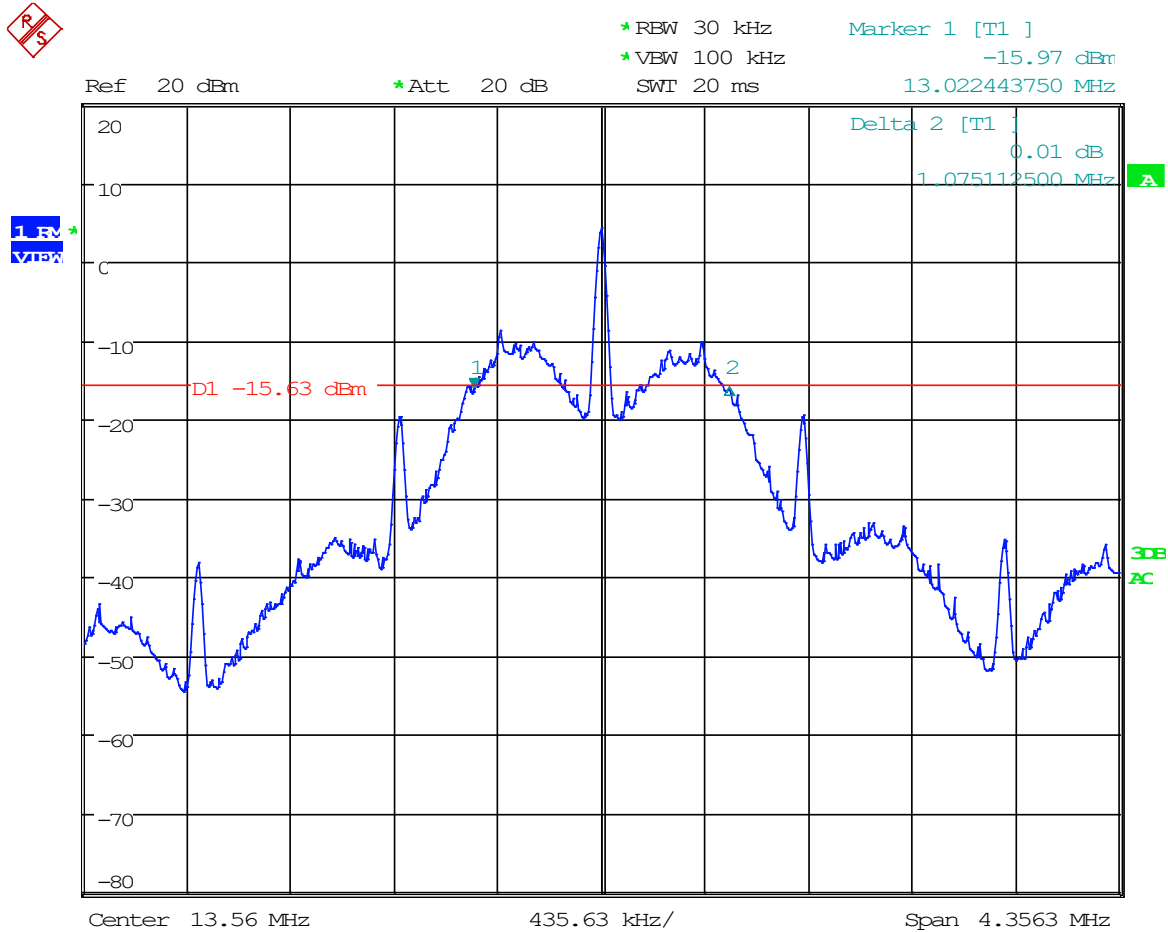
20dB Bandwidth Test Results

Test Results, Mode 1	
Tuned Frequency (MHz)	20dB Bandwidth (MHz)
13.56 MHz	1.075



20dB Bandwidth, Spectrum Plots

8.1.1 20 dB Bandwidth, 13.56 MHz



Date: 6.OCT.2022 10:21:22

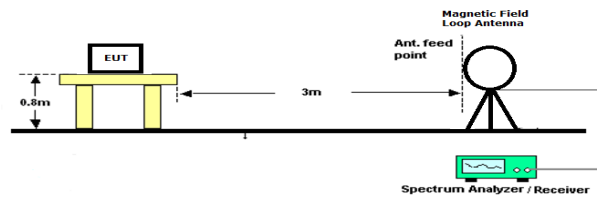
8.2 Radiated Spurious Emissions

Requirements:

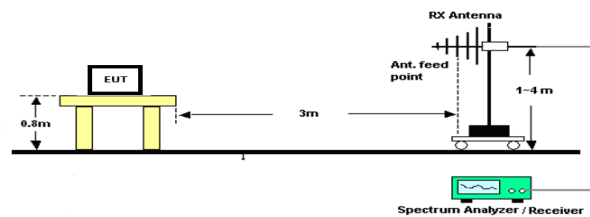
Requirements and limits from FCC part 15.225 (a)(d)(c).

Setup:

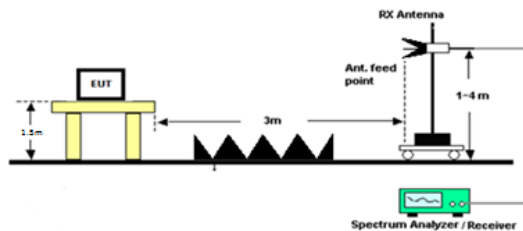
Radiated Test Setup, Below 30 MHz



Radiated Test Setup, 30 – 1000 MHz



Radiated Test Setup, Above 1000 MHz





Radiated Emissions Tabular Data

8.2.1 Fundamental Data

Tuned Frequency (MHz)	Detector	Meter Reading (dBμV)	Antenna Polarity	Coax Loss (dB)	Antenna Correction Factor (dB/m)	Distance (m)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
13.56	PK	3.10	H	0.70	10.60	3.00	14.40	104.00	89.60

15.225 (b)(c) Radiated Emissions Tabular Data

8.2.2 Field Strength at 3 Meters, 13.56 MHz

Tuned Frequency (MHz)	Emission Frequency (MHz)	Detector	Meter Reading (dBμV)	Antenna Polarity	Coax Loss (dB)	Antenna Correction Factor (dB/m)	Distance (m)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
13.56	13.45	PK	17.55	V	0.70	10.60	3.00	28.85	70.47	41.62
13.56	13.52	PK	16.09	V	0.70	10.60	3.00	27.39	70.47	43.08
13.56	13.61	PK	29.37	V	0.70	10.60	3.00	40.67	70.47	29.80

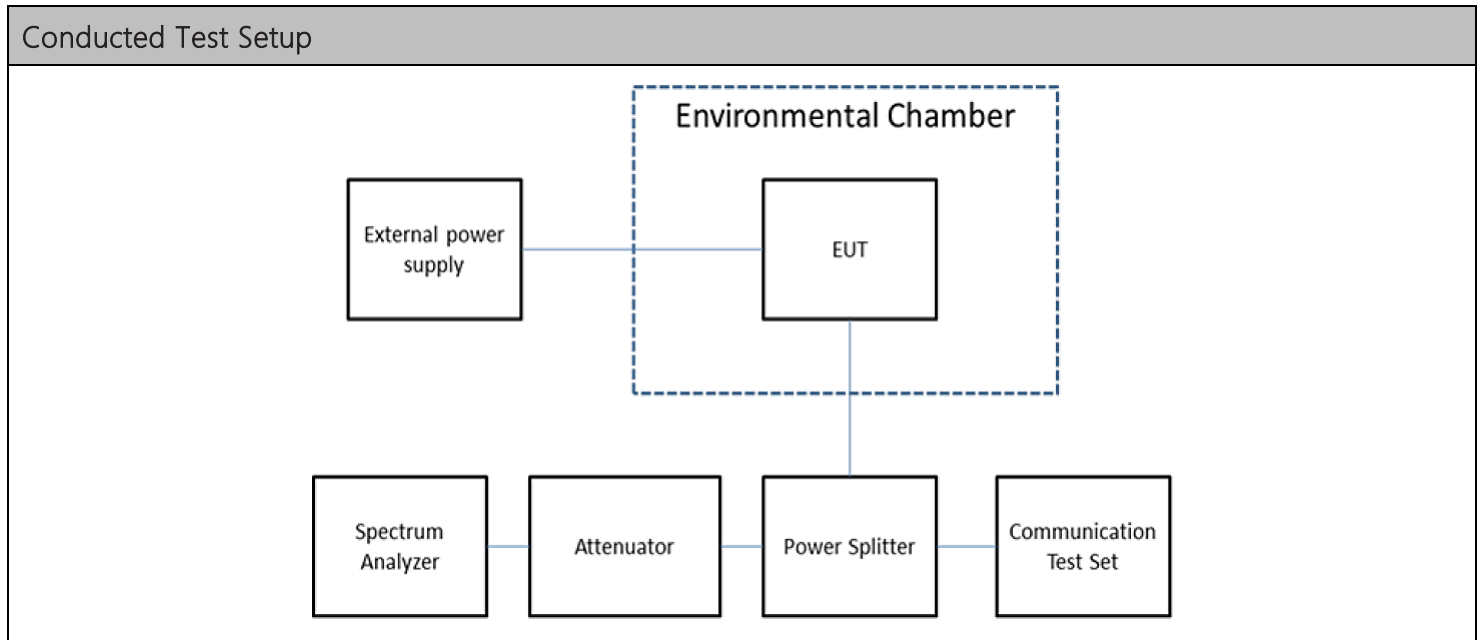
Radiated Emissions Tabular Data

8.2.1 Field Strength at 3 Meters, 13.56 MHz

Tuned Frequency (MHz)	Emission Frequency (MHz)	15.205, 15.35 Detector	Meter Reading (dBμV)	Antenna Polarity	Coax Loss (dB)	Antenna Correction Factor (dB/m)	Distance (m)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
13.56	27.12	PK	0.30	H	0.71	8.89	3.00	9.90	50.00	40.10
13.56	40.68	PK	0.40	H	0.71	13.23	3.00	14.34	100.00	85.66
13.56	40.68	PK	0.40	V	0.71	13.23	3.00	14.34	100.00	85.66
13.56	54.24	PK	0.50	H	0.86	9.70	3.00	11.06	100.00	88.94
13.56	54.24	PK	1.70	V	0.86	9.70	3.00	12.26	100.00	87.74
13.56	67.80	PK	0.10	H	0.97	5.92	3.00	6.99	100.00	93.01
13.56	67.80	PK	0.90	V	0.97	5.92	3.00	7.79	100.00	92.21
13.56	81.36	PK	0.30	H	1.09	8.87	3.00	10.26	100.00	89.74
13.56	81.36	PK	1.20	V	1.09	8.87	3.00	11.16	100.00	88.84
13.56	94.92	PK	1.20	H	1.15	10.80	3.00	13.15	100.00	86.85
13.56	94.92	PK	0.90	V	1.15	10.80	3.00	12.85	100.00	87.15
13.56	108.48	PK	1.60	H	1.19	10.25	3.00	13.05	170.00	156.95
13.56	108.48	PK	0.90	V	1.19	10.25	3.00	12.35	170.00	157.65
13.56	108.48	AVG	-12.00	H	1.19	10.25	3.00	-0.55	150.00	150.55
13.56	108.48	AVG	-12.10	V	1.19	10.25	3.00	-0.65	150.00	150.65
13.56	122.04	PK	0.70	H	1.26	11.11	3.00	13.07	150.00	136.93
13.56	122.04	PK	0.50	V	1.26	11.11	3.00	12.87	150.00	137.13
13.56	135.60	PK	1.50	H	1.32	14.42	3.00	17.24	170.00	152.76
13.56	135.60	PK	1.90	V	1.32	14.42	3.00	17.64	170.00	152.36
13.56	135.60	AVG	-11.70	H	1.32	14.42	3.00	4.04	150.00	145.96
13.56	135.60	AVG	-11.70	V	1.32	14.42	3.00	4.04	150.00	145.96

8.3 Frequency Stability

Requirements and limits from FCC 15.225(e) and test method from ANSI C63.10



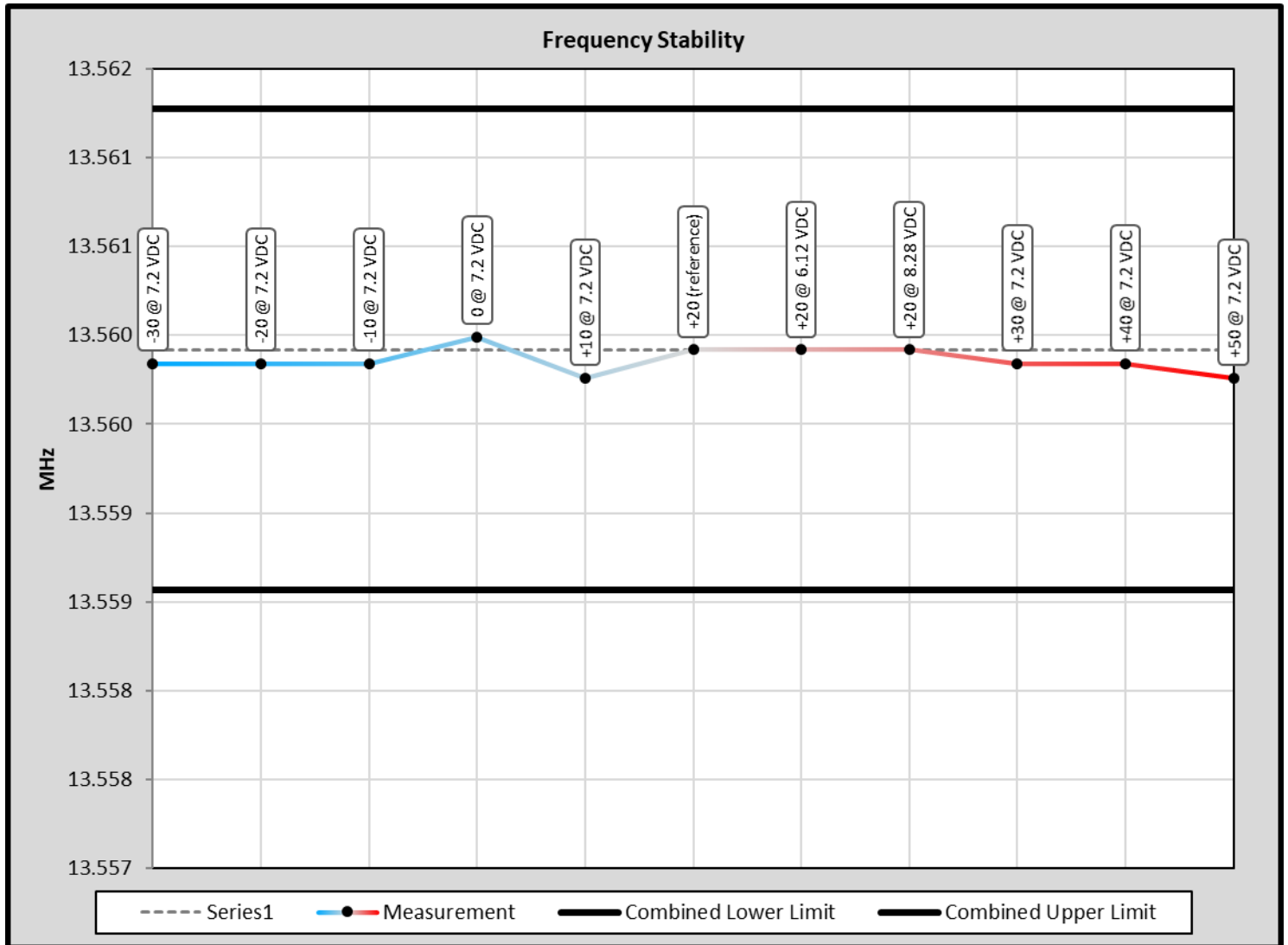
Test Results, Mode 1		
Tuned Frequency (MHz)	Max Deviation (kHz)	Limit (ppm)
13.56	0.16	100



8.3.1 Frequency Stability Data

FCC Part 15.225 Limit	100.0	ppm	
FCC Part 15.225 Limit, as ppb	100000	ppb (Parts per Billion)	
FCC Part 15.225 Limit, as %	0.01000	%	
Strictest Combined Limit, as Hz	1355.992	Hz	
Combined Lower Limit	13.558564	MHz	
Combined Upper Limit	13.561276	MHz	
Rated Supply Voltage	7.2	☐ AC ☒ DC	
Temperature / Voltage Variation			
Temperature (°C)	Supplied Voltage (V)	Frequency (MHz)	Deviation (kHz)
-30	7.2	13.559840	0.080
-20	7.2	13.559840	0.080
-10	7.2	13.559840	0.080
0	7.2	13.559990	-0.071
+10	7.2	13.559760	0.160
+20 (reference)	7.2	13.559920	0.000
+20	6.1	13.559920	0.000
+20	8.3	13.559920	0.000
+30	7.2	13.559840	0.080
+40	7.2	13.559840	0.080
+50	7.2	13.559760	0.160

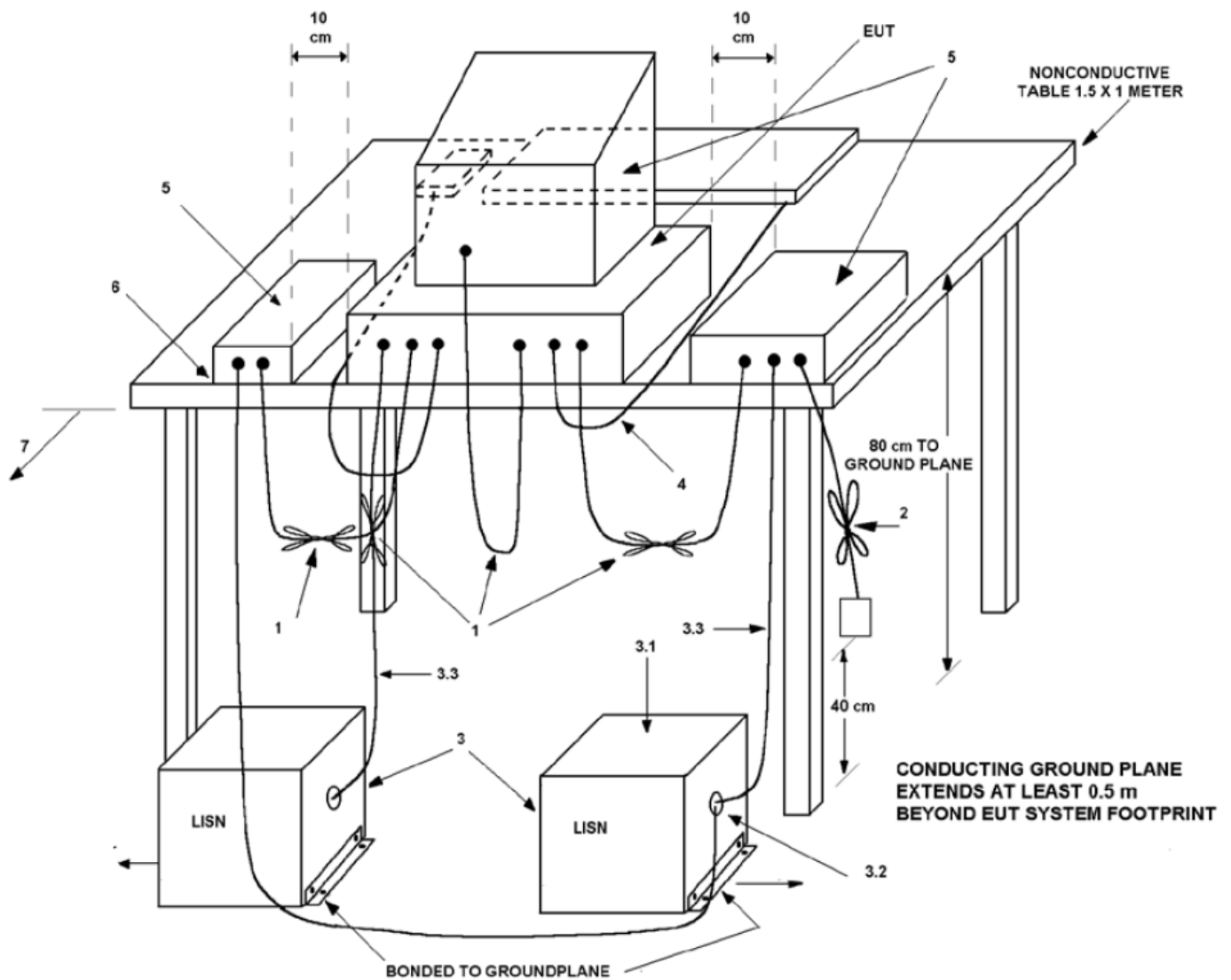
8.3.2 Frequency Stability Plot



8.4 Conducted Emissions

Limits from FCC 15.207 and test procedure from ANSI C63.4-2014.

Conducted Test Setup

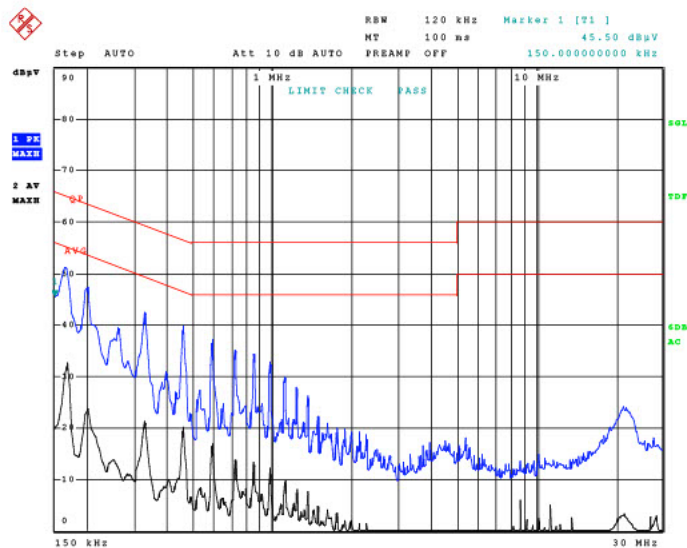




20.Sep 22 12:47

Scan Start: 150 kHz
Scan Stop: 30 MHz
Detector: Trace 1: MAX PEAK Trace 2: Average
Transducer: tdf 20

Start Frequency	Stop Frequency	Step Size	Res BW	Meas Time	RF Atten	Preamp	Input
150.000000 kHz	30.000000 MHz	4.00 kHz	9.00 kHz	100 ms	Auto	0 dB	INPUT2



Meas Time: 1 s
Margin: 20 dB
Subranges: 0



8.4.2 Line 1 Table

20.Sep 22 12:47

Transducer Table

Name: tdf_20
Interpolation: LIN
Comment: ANS 25/2 Primary LISN IL Line 1 + Coax Cable IL

Frequency	Factor (dB)
150.00 kHz	0.19
170.00 kHz	0.17
200.00 kHz	0.16
250.00 kHz	0.13
300.00 kHz	0.12
350.00 kHz	0.12
400.00 kHz	0.11
500.00 kHz	0.12
600.00 kHz	0.12
700.00 kHz	0.11
800.00 kHz	0.13
900.00 kHz	0.12
1.00 MHz	0.21
1.20 MHz	0.22
1.50 MHz	0.28
2.00 MHz	0.37
2.50 MHz	0.41
3.00 MHz	0.59
4.00 MHz	0.40
5.00 MHz	0.47
7.00 MHz	0.63
10.00 MHz	0.88
15.00 MHz	1.08
20.00 MHz	1.01
30.00 MHz	1.80

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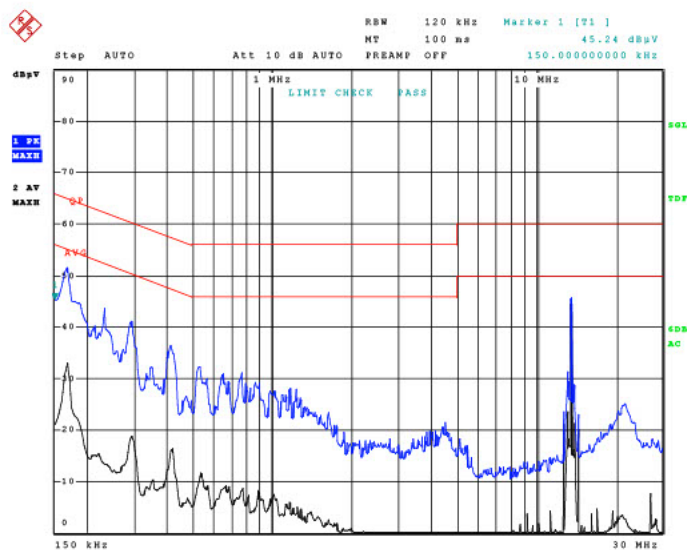
8.4.3 Line 2 Plot

20.Sep 22 12:30

Stepped Scan (1 Range)

Scan Start: 150 kHz
Scan Stop: 30 MHz
Detector: Trace 1: MAX PEAK Trace 2: Average
Transducer: tdf_20

Start Frequency	Stop Frequency	Step Size	Res BW	Meas Time	RF Atten	Preamp	Input
150.000000 kHz	30.000000 MHz	4.00 kHz	9.00 kHz	100 ms	Auto	0 dB	INPUT2



Final Measurement

Meas Time: 1 s
Margin: 20 dB
Subranges: 0



8.4.4 Line 2 Table

20.Sep 22 12:30

Transducer Table

Name: tdf_20
Interpolation: LIN
Comment: ANS 25/2 Primary LISN IL Line 1 + Coax Cable IL

Frequency	Factor (dB)
150.00 kHz	0.19
170.00 kHz	0.17
200.00 kHz	0.16
250.00 kHz	0.13
300.00 kHz	0.12
350.00 kHz	0.12
400.00 kHz	0.11
500.00 kHz	0.12
600.00 kHz	0.12
700.00 kHz	0.11
800.00 kHz	0.13
900.00 kHz	0.12
1.00 MHz	0.21
1.20 MHz	0.22
1.50 MHz	0.28
2.00 MHz	0.37
2.50 MHz	0.41
3.00 MHz	0.59
4.00 MHz	0.40
5.00 MHz	0.47
7.00 MHz	0.63
10.00 MHz	0.88
15.00 MHz	1.08
20.00 MHz	1.01
30.00 MHz	1.80

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9. ANNEX-A - Photographs of the EUT

Photographs of the EUT and any manufacturer supplied accessories to be used with the EUT are in a separate document.

10. ANNEX-B – Test Setup Photographs

Test setup photographs are located in a separate document.

11. History of Test Report Changes

Test Report #	Revision #	Description	Date of Issue
TR_4190.22_FCC 15.225_	1	Initial release	9/20/2022
	2	Updated Page 3 added section 8.1	10/6/2022
	3	Updated Page 13	10/11/0222



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END OF TEST REPORT
