Timco Test Report # TR_3915-21_FCC_PT90_3
Revision: 3
Final Test Date: 8/11/2021
Issue Date: 8/26/2021

TIMCO ENGINEERING, Inc.

An IIA Company

Test Report - FCC PART 90
Applicant: Ritron, Inc.

Approved for Release By:

Signature: Bruno Clavier

Name & Title: Bruno Clavier, General Manager

Date of Signature 8/11/2021

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1. Customer Information

Customer:	Ritron, Inc.
Address:	505 West Carmel Drive P.O. Box 1998 Carmel, IN 46032 United States

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1.1 Part 90 Test Result Summary

The following test procedure and guidance were used for measuring FCC PART 90 (PRIVATE LAND MOBILE RADIO SERVICES) known as Licensed Land Mobile; ANSI C63.26-2015. Full test results are available in this report.

The Following is for Test item FCC ID: AIERIT39-26006

Applicable Clauses from Part 2		
FCC Clauses	Description of the requirements	Result: (Pass, Fail, N/A)
2.202	Bandwidth & Emission	Pass
2.1033 (c)(8)	Power at the Final Amplifier	Reported
2.1046 (a)	RF Output Power	Pass
2.1047	Modulation characteristics	n/a
2.1049	Occupied Bandwidth	Pass
2.1051	Spurious emissions at antenna terminals	Pass
2.1053	Field strength of spurious radiation	Pass
2.1055	Frequency stability	Pass

Applicable Clauses from Part 90		
FCC Clauses	Description of the requirements	Result: (Pass, Fail, N/A)
90.205 (r)	Transmitter Power	Pass
90.207 (n)	Emission designator	Reported
90.209 (b) (5) footnote 2	Bandwidth limitations	Pass
90.210 (n)	Emission masks, In-band	Pass
90.210 (n)	Emission masks, Out-of-band	Pass
90.213 (a) footnote 10	Frequency stability	Pass
90.214	Transient Frequency Behavior	n/a
90.221	Adjacent channel power limits	n/a

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.

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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

2.1 Testing was performed, reviewed by

Dates of Testing: 8/10/2021 – 8/11/2021

Signature: Sr. EMC Engineer EMC-003838-NE

Name & Title: Tim Royer, EMC Engineer

Date of Signature 8/11/2021

Signature:

Name & Title: Kristoffer Costa, EMC Technician

Date of Signature 8/11/2021

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

The test sample was received: 8/2/2021

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:	AIERIT39-26006
Brief Description	VHF MODEM TRANSCEIVER
Type of Modular	n/a
Model(s) #	DTXM-260-0BS6I
Firmware version	n/a
Software version	1.2.1
Serial Number	A100817416

Technical Characteristics	
Technology	TRANSCEIVER
Frequency Range	220-222 MHz
RF O/P Power (Max.)	6W
Modulation	4FSK
Bandwidth & Emission Class	3K90F1D
Duty Cycle	20%
Antenna Connector	BNC
Voltage Rating (AC or Batt.)	11-16VDC

Antenna Characteristics			
Antenna	Frequency Range	Mode / BW	Antenna Gain
1	220-222 MHz	n/a	0 dBi
2			

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3.2 Configuration of EUT

Test Modes				
Mode (#)	Mode (Type)	Test Frequencies	BW (nominal)	Emission Designator
1	Transmit	220.005 MHz 221.995 MHz	5kHz	3K90F1D

Carson's Rule

By Carson's rule, the occupied bandwidth for an FM signal may be calculated by:

$BW = 2(f_D + f_m)$ where f_D is the frequency deviation and f_m is the modulating frequency.

Modulation	$f_{D(}$	f_m	BW(kHz)	Emissions Designator
5 kHz	1.0	0.95	3.9	3K90F1E

Note, for data, that the baud (symbol) rate is 2400 for a bit rate of 4800 bps. With the root-raised cosine filter, the effective modulation frequency is 0.95 kHz with a deviation of 1 kHz.

Operating conditions during Testing:

The device was operated without the provided antenna(s).

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

Peripherals used during Testing:

A laptop was used to program the EUT.

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.

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4. Test methods & Applicable Regulatory Limits

4.1 Test methods/Standards/Guidance:

Test procedures and guidance for measuring Licensed Part 90 Licensed device:

1) ANSI C63.26-2015

4.2 Applied Limits and Regulatory Limits:

1) FCC CFR 47 Part 90

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

6.1 Temperature & Humidity

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

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

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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.

7.1 List of Test Equipment

Audio Analyzer	Audio Analyzer	HP	8903B	3011A13084	1/13/21	1/13/2024
Function Generator	Function Generator	Standford	DS340	25200	1/13/21	1/13/2024
Modulation Analyzer	Modulation Analyzer	HP	8901A	3050A05856	4/23/20	4/23/2023
Signal Generator	Signal Generator HP 8648C	HP	8648C	3847A04696	3/31/21	3/30/2024
Signal Generator	Sweep/Signal Generator	Anritsu	68369B	985112	1/19/21	1/19/2024
Multimeter	Digital Multimeter	Fluke	77	35053830	9/9/20	9/9/2023
Frequency Counter	Frequency Counter	HP	5385A	2730A03025	9/9/20	9/9/2023
Antenna	Biconical 1057	Eaton	94455-1	1057	10/16/20	10/16/2023
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	3/11/2022
Pre-amp	Pre-amp	RF-LAMBDA	RLNA00M45GA	NA	2/27/19	2/26/2022
Receiver	EMI Test Receiver R&S ESU 40	Rohde & Schwarz	ESU 40	100320	5/27/21	5/26/2024
Frequency Counter	Frequency Counter Small	HP	5385A	3242A07460	9/9/20	9/9/2023
Thermometer	Type K J Thermometer	Martel	303	080504494	1/18/20	1/17/2023
Receiver	Service Monitor 3920	Aeroflex	3920	299001542	1/13/20	1/12/2023

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

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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).

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 dBµV. 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 (dBµV/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 dBµV 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.

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8.1 Power at the Final Amplifier

Limits from FCC Part 2.1033 (c)(8). No method of measurement is specified.

Test Results		
EUT Operating Voltage (V)	EUT Current (A)	Power at the Final Amplifier (W)
12.5	6	75

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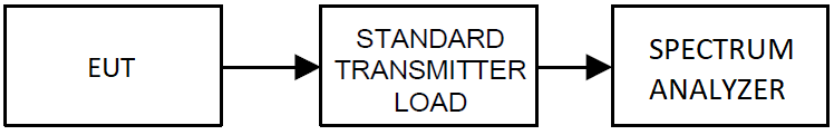
8.2 RF Output Power

Limits from FCC Parts 2.1046(a), and 90.205 (r); and test procedure from ANSI C63.26-2015.

Test Setup


Test Results, Mode 1		
Tuned Frequency (MHz)	Power Output (dBm)	Power Output (W)
220.005	37.81	6.04
221.995	37.85	6.1

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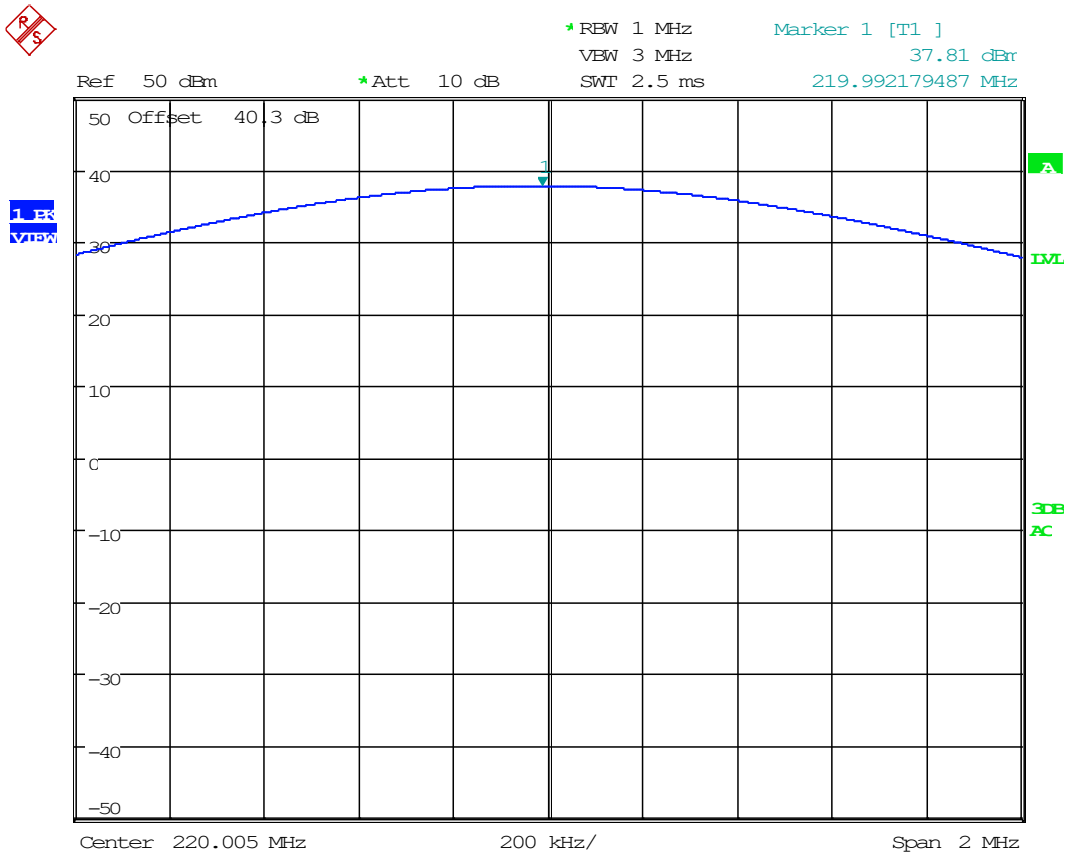
8.2.1 Measurement Plot, Output Power, 220.005 MHz



Date: 10.AUG.2021 10:57:41

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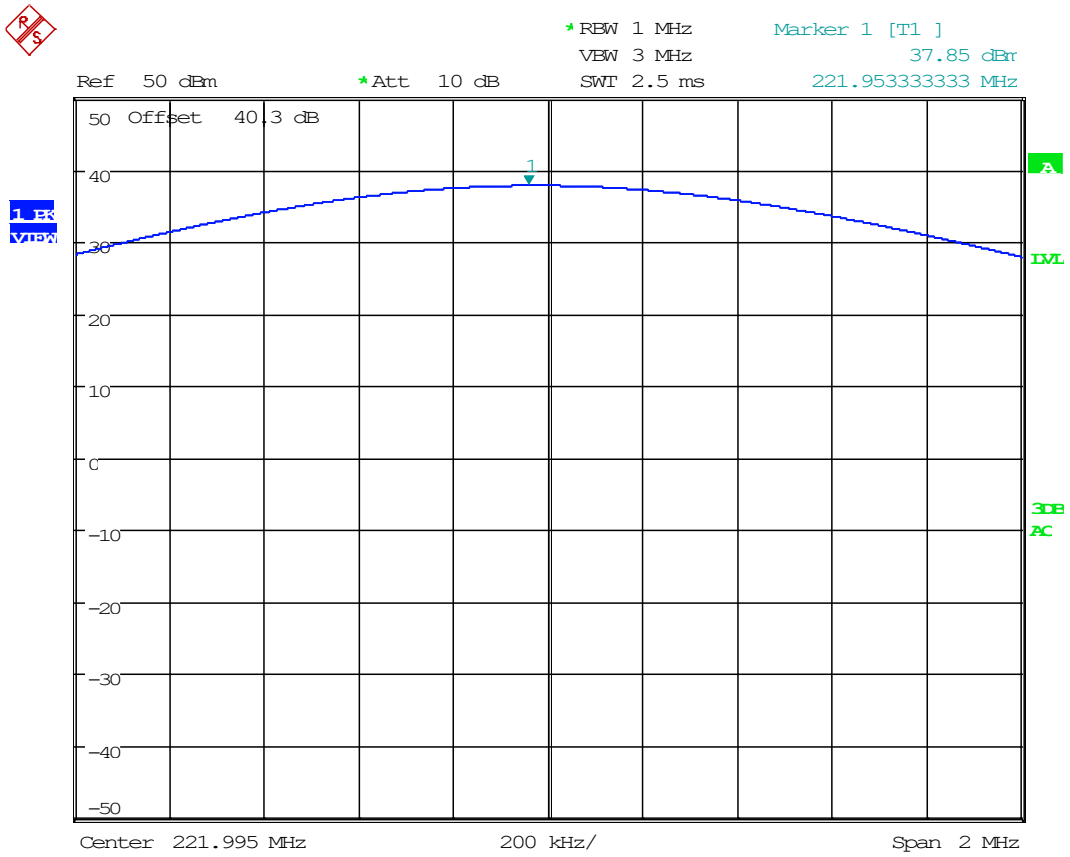
8.2.2 Measurement Plot, Output Power, 221.995 MHz



Date: 10.AUG.2021 11:00:06

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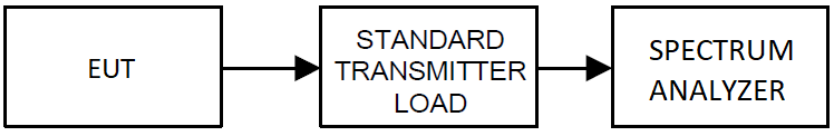
8.3 Bandwidth & Emission

Limits from FCC Parts 2.1049, and 90.207 & 90.209, and test procedure from ANSI C63.26-2015.

Test Setup


Test Results, Authorized Bandwidth		
Rule Part	Operating Range	Authorized Bandwidth
Part 90	220-222 MHz	4kHz

Test Results, Occupied Bandwidth				
Tuned Frequency (MHz)	Mode	Emission Designator	Occupied Bandwidth (kHz)	Bandwidth Type
220.005	1	3K90F1D	2.686	99%
221.995	1	3K90F1D	2.658	99%

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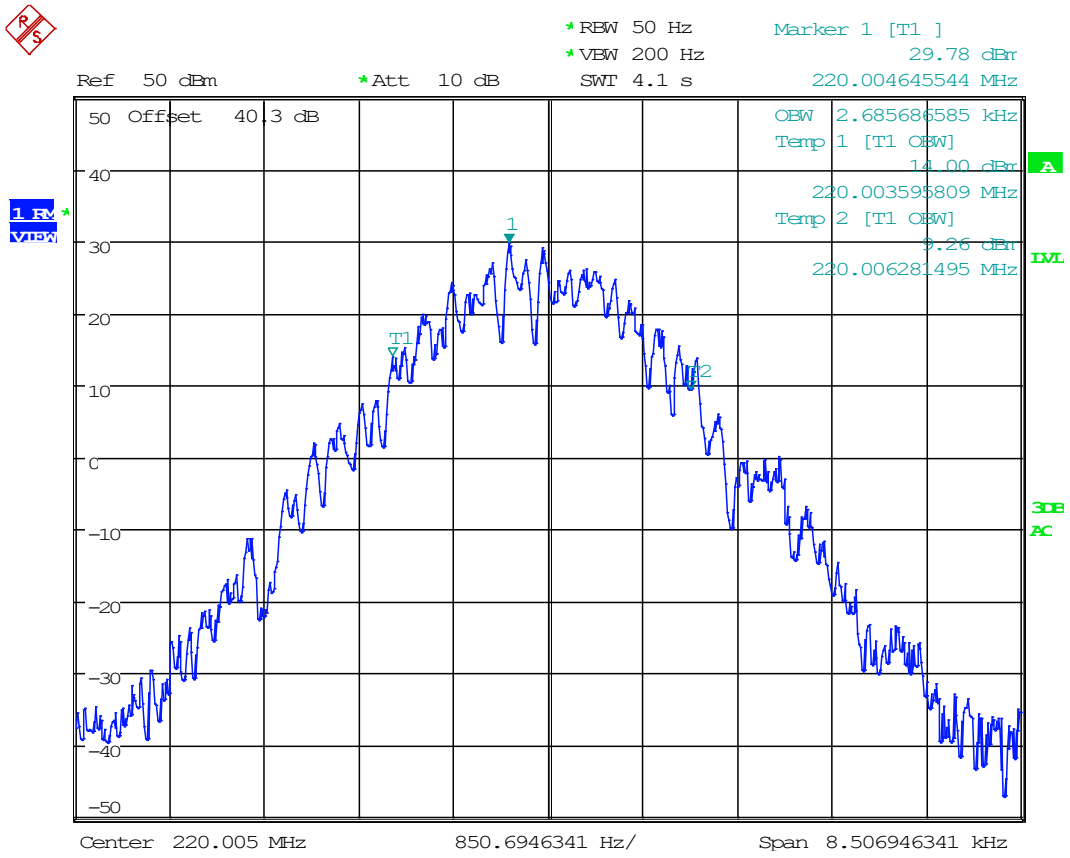
Occupied Bandwidth, Spectrum Plots

8.3.1 Bandwidth Plot, 99%, 3 kHz, 220.005 MHz



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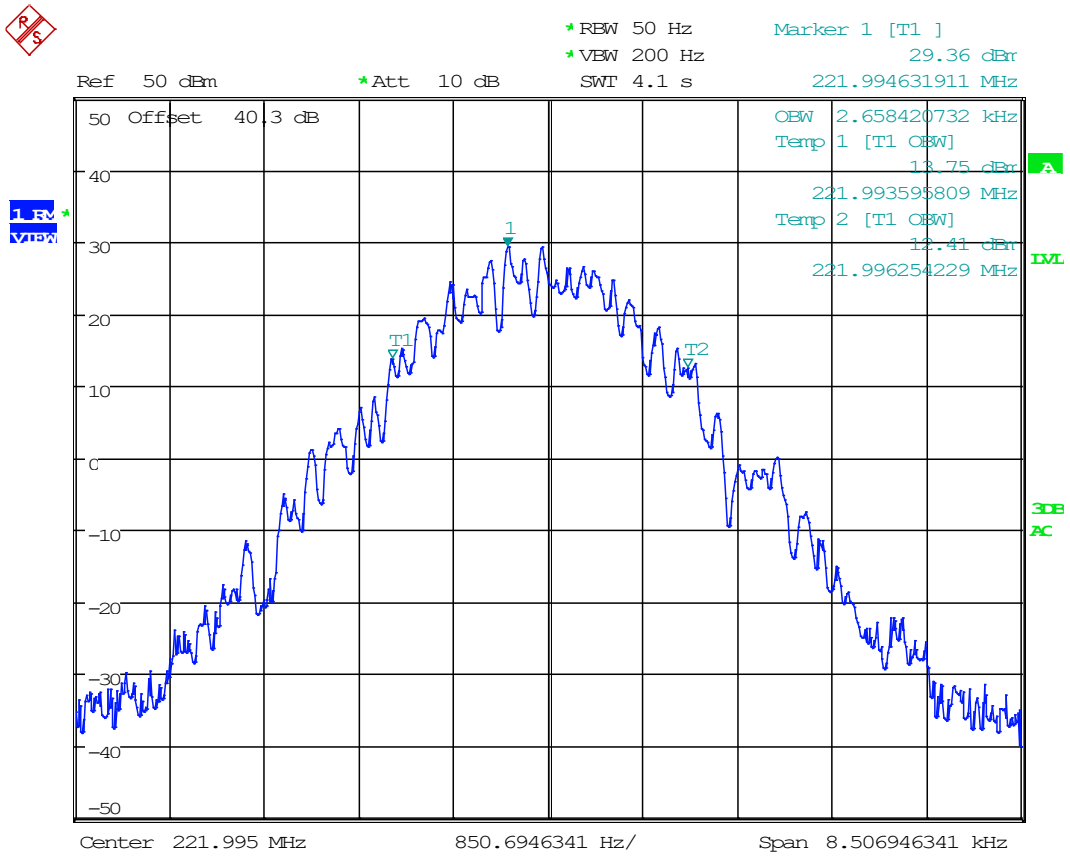
8.3.2 Bandwidth Plot, 99%, 3 kHz, 221.995 MHz



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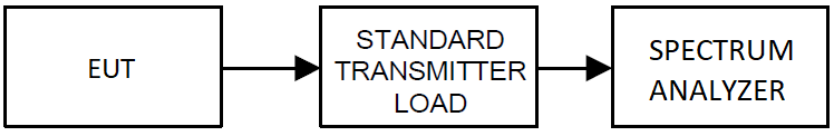
8.4 Emission Limitations, In-Band

Limits from FCC Part 90.210; and test procedure from ANSI C63.26-2015.

Conducted Test Setup


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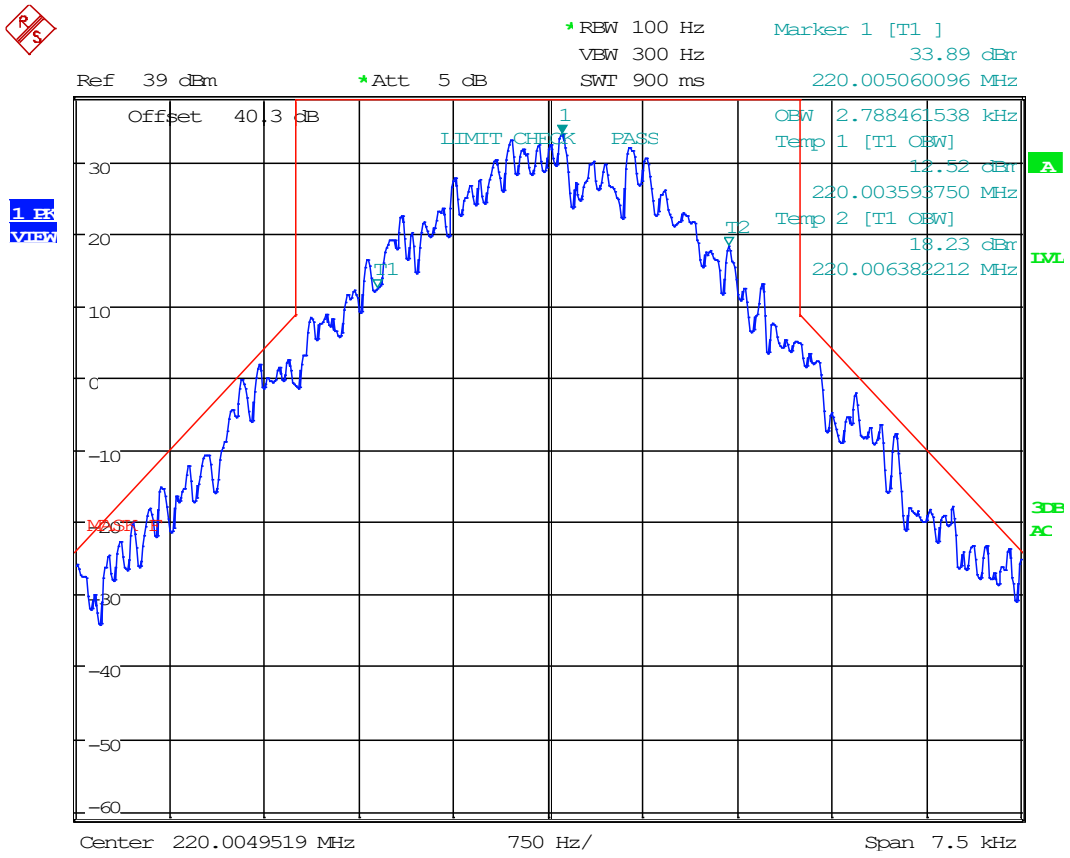
Conducted Emissions Mask, Spectrum Plots

8.4.1 Emission Mask, 3kHz, 220.005 MHz



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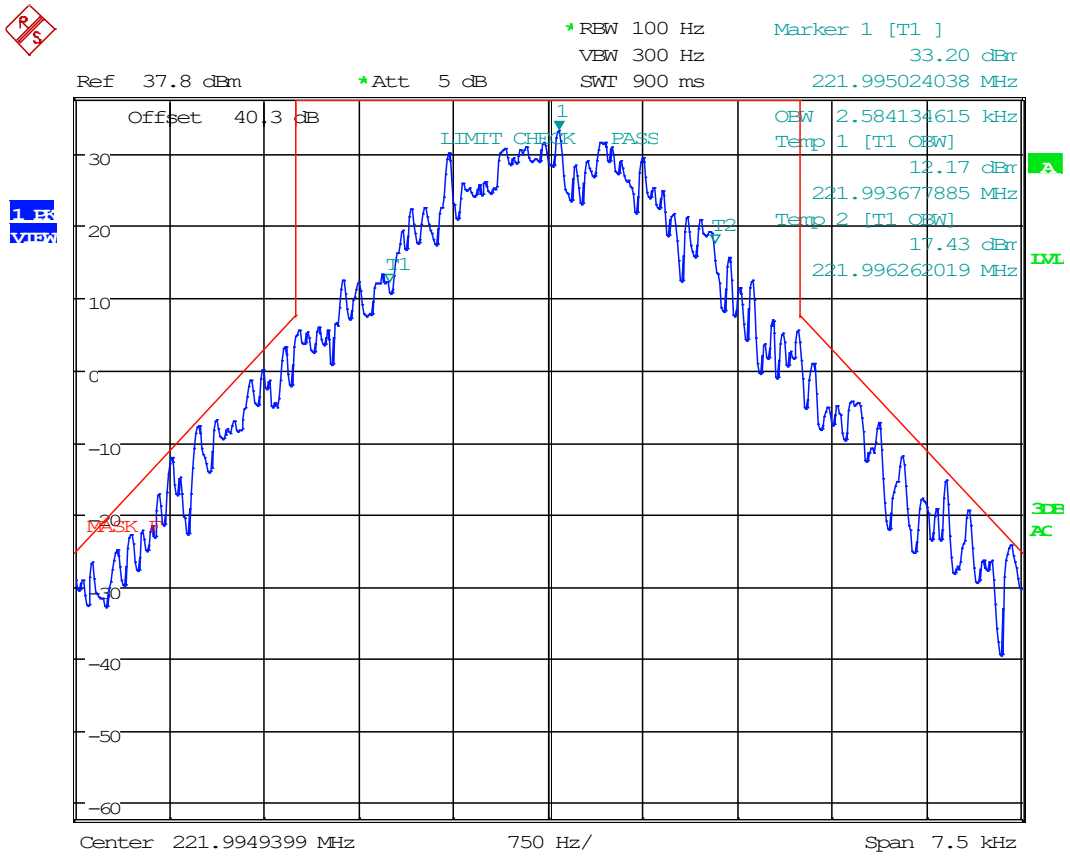
8.4.2 Emission Mask, 3kHz, 221.995 MHz



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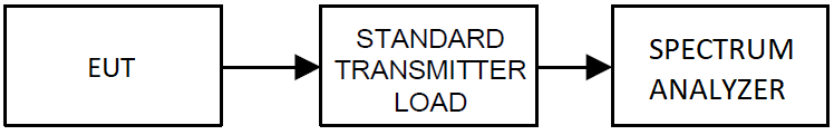
8.5 Emission Limitations, Out-of-Band

Limits from FCC Parts 2.1051, and 90.210; and test procedure from ANSI C63.26-2015.

Conducted Test Setup


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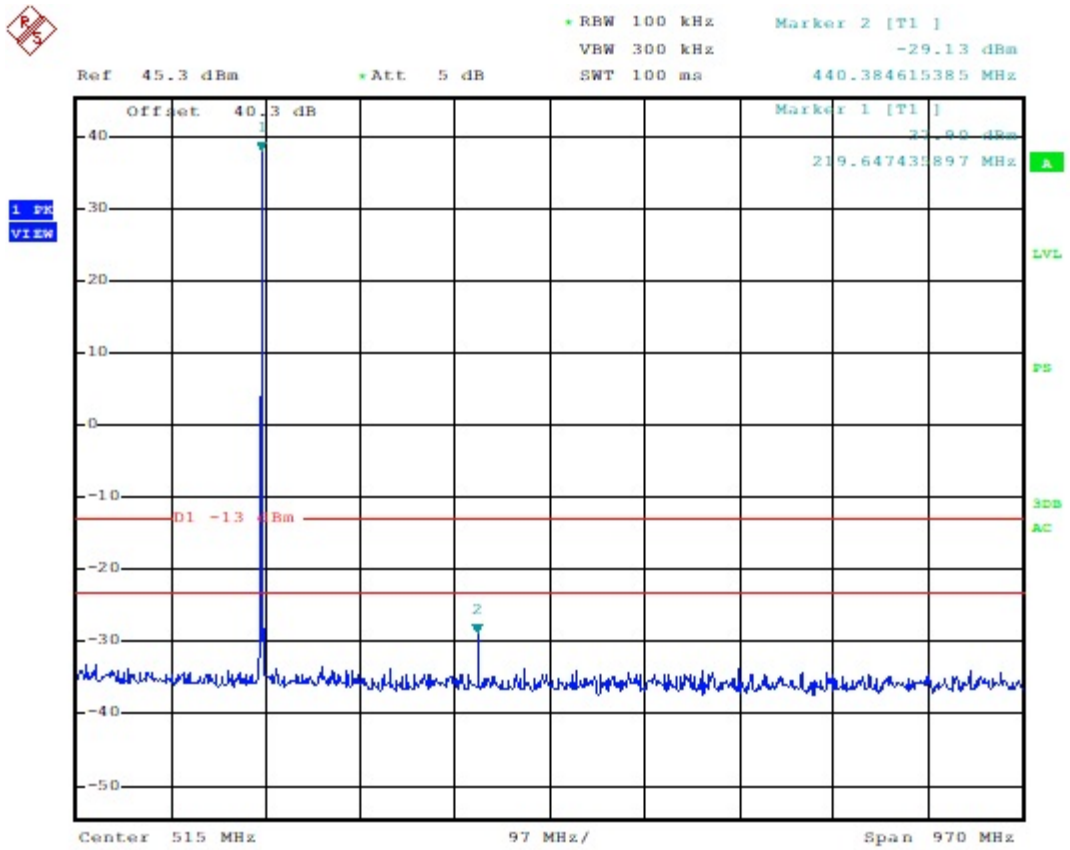
Conducted Emissions Spectrum Plots

8.5.1 Conducted Emissions, Below 1GHz, 220.005 MHz



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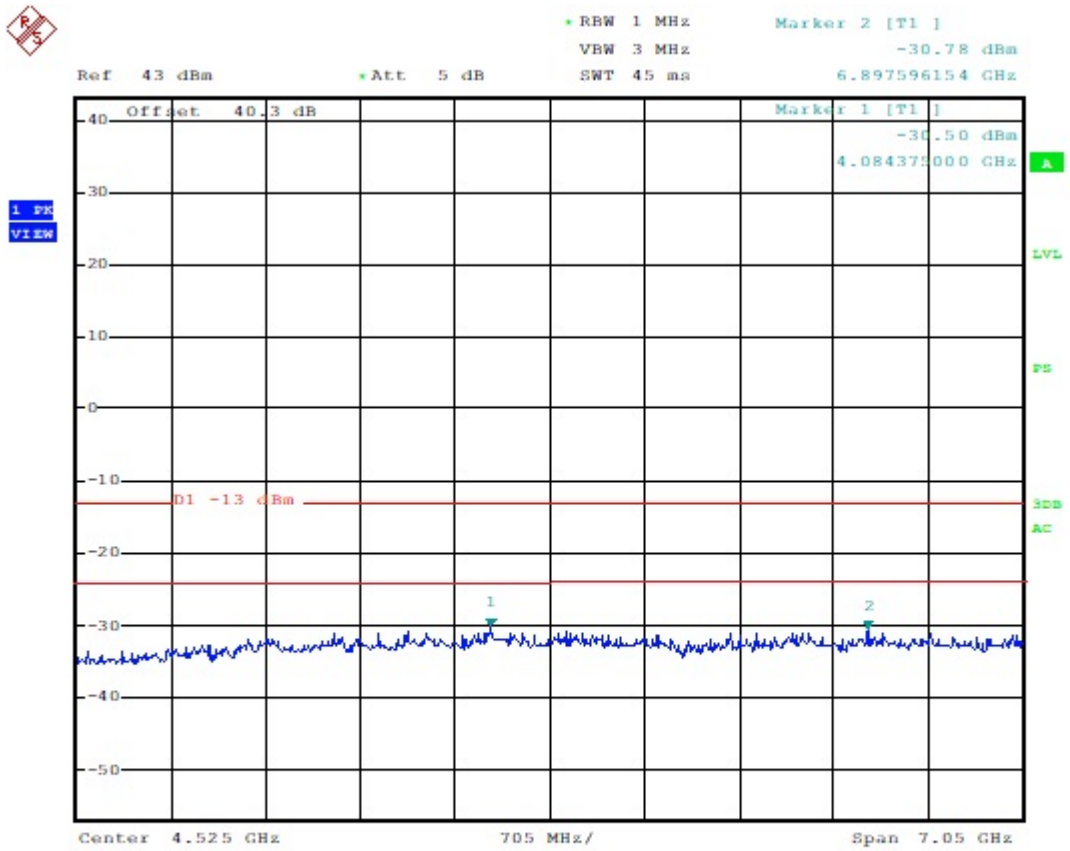
8.5.2 Conducted Emissions Above 1GHz, 220.005 MHz



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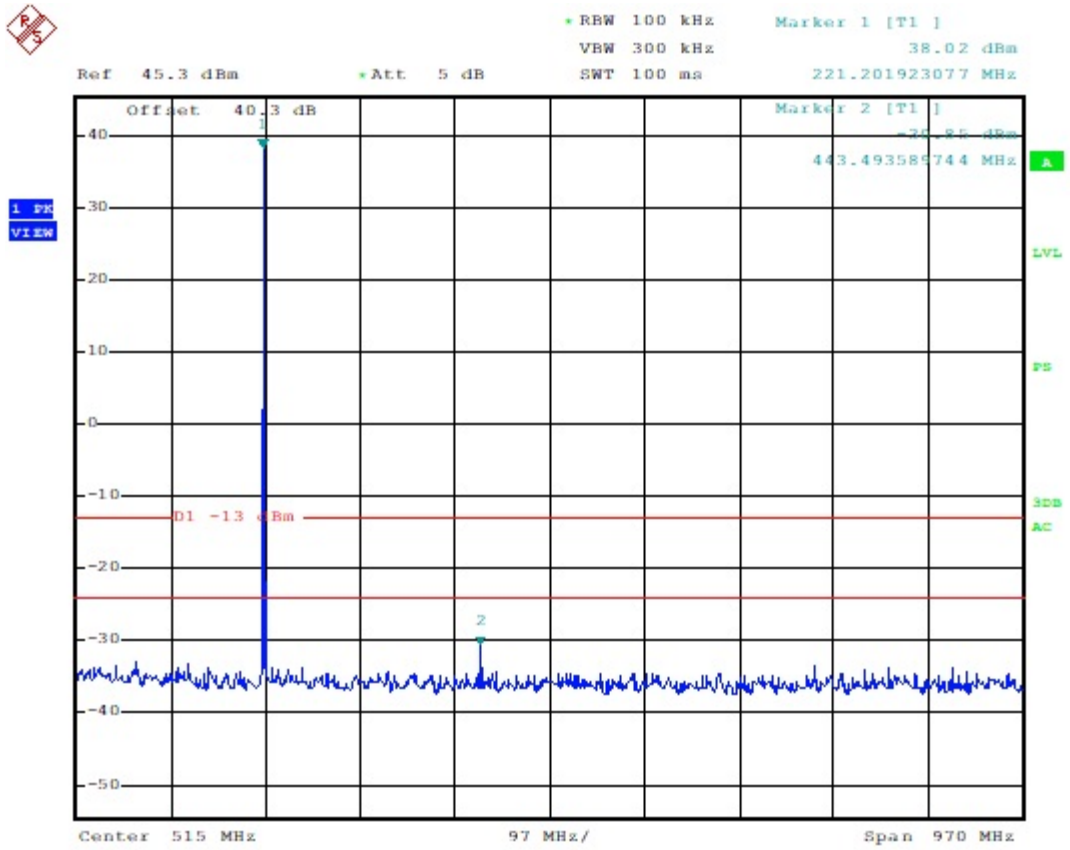
8.5.3 Conducted Emissions Below 1GHz, 221.995 MHz



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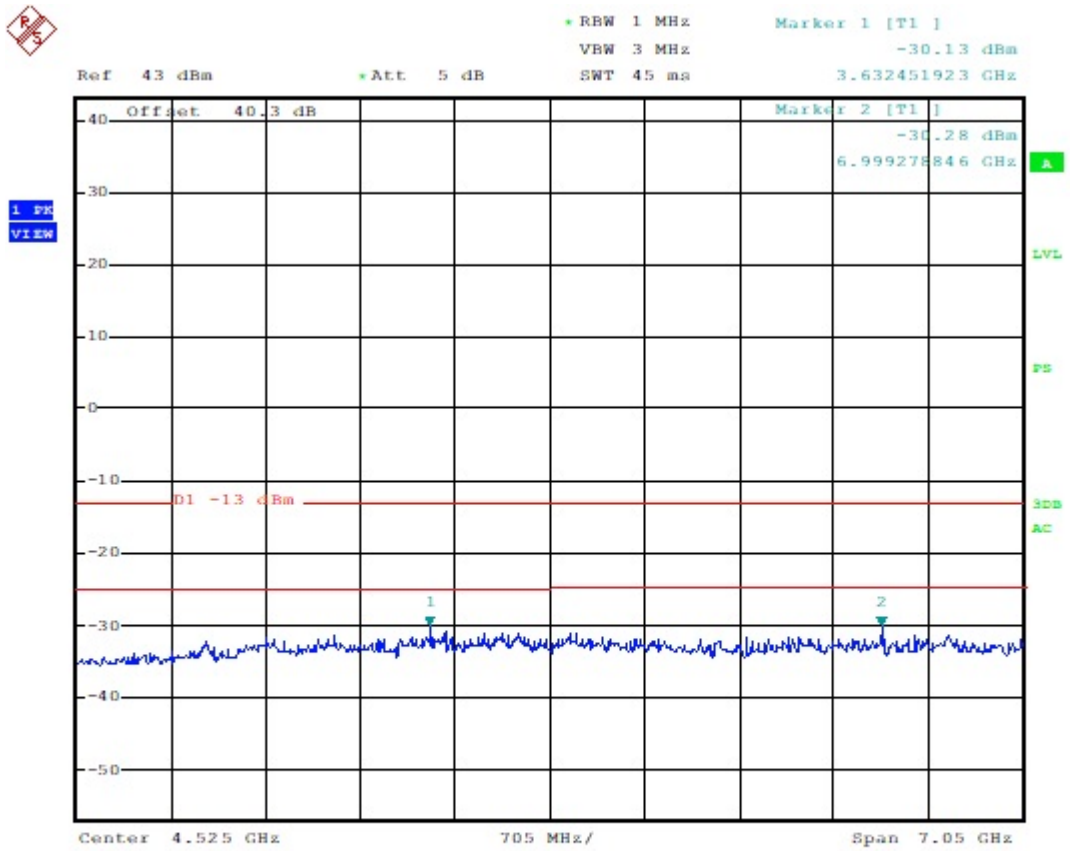
8.5.4 Conducted Emissions Above 1GHz, 221.995 MHz



Date: 10.AUG.2021 11:21:16

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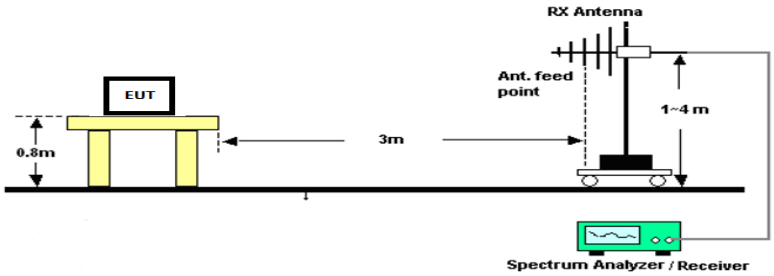
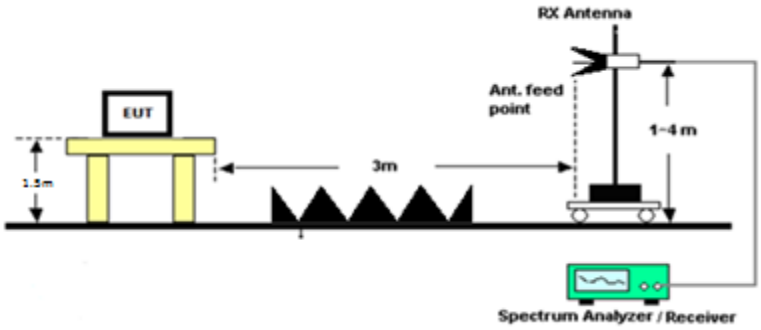
8.6 Radiated Emissions

Limits from FCC Parts 2.1053, 80.211 (f), 87.139 (a), and 90.210 (n); and test procedure from ANSI C63.26-2015.

Radiated Test Setup, 30 – 1000 MHz


Radiated Test Setup, Above 1000 MHz


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Radiated Emissions, Tabular Data

8.6.1 Radiated Emissions, 220.005 MHz

Tuned Frequency (MHz)	Emission Frequency (MHz)	Detector	Meter Reading (dBuV)	Antenna Polarity	Coax Loss (dB)	Antenna Correction Factor (dB/m)	Distance (m)	Field Strength (dBµV/m)	ERP (dBm)	Spurious Limit (dBm)	Margin (dB)
220.01	440.01	PK	40.44	H	2.40	15.70	3.00	58.54	-38.84	-25.00	13.84
220.01	440.01	PK	37.97	V	2.40	15.70	3.00	56.07	-41.31	-25.00	16.31
220.01	660.02	PK	27.07	H	3.00	19.40	3.00	49.47	-47.91	-25.00	22.91
220.01	660.02	PK	34.45	V	3.00	19.40	3.00	56.85	-40.53	-25.00	15.53
220.01	880.02	PK	21.30	H	3.54	22.60	3.00	47.44	-49.94	-25.00	24.94
220.01	880.02	PK	15.97	V	3.54	22.60	3.00	42.11	-55.27	-25.00	30.27
220.01	1100.03	PK	15.70	H	3.85	27.17	3.00	46.72	-50.66	-25.00	25.66
220.01	1100.03	PK	11.56	V	3.85	27.17	3.00	42.58	-54.80	-25.00	29.80
220.01	1320.03	PK	16.10	H	4.21	28.71	3.00	49.02	-48.35	-25.00	23.35
220.01	1320.03	PK	11.23	V	4.21	28.71	3.00	44.15	-53.22	-25.00	28.22
220.01	1540.04	PK	22.56	H	4.55	27.76	3.00	54.87	-42.51	-25.00	17.51
220.01	1540.04	PK	15.29	V	4.55	27.76	3.00	47.60	-49.78	-25.00	24.78
220.01	1760.04	PK	14.70	H	4.86	29.84	3.00	49.40	-47.98	-25.00	22.98
220.01	1760.04	PK	14.34	V	4.86	29.84	3.00	49.04	-48.34	-25.00	23.34
220.01	1980.05	PK	13.76	H	5.16	31.31	3.00	50.23	-47.15	-25.00	22.15
220.01	1980.05	PK	14.23	V	5.16	31.31	3.00	50.70	-46.68	-25.00	21.68
220.01	2200.05	PK	15.50	H	5.37	31.32	3.00	52.18	-45.19	-25.00	20.19
220.01	2200.05	PK	14.82	V	5.37	31.32	3.00	51.50	-45.87	-25.00	20.87

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8.6.2 Radiated Emissions, 221.995 MHz

Tuned Frequency (MHz)	Emission Frequency (MHz)	Detector	Meter Reading (dBuV)	Antenna Polarity	Coax Loss (dB)	Antenna Correction Factor (dB/m)	Distance (m)	Field Strength (dBµV/m)	ERP (dBm)	Spurious Limit (dBm)	Margin (dB)
222.00	443.99	PK	39.59	H	2.42	15.78	3.00	57.79	-39.58	-25.00	14.58
222.00	443.99	PK	36.79	V	2.42	15.78	3.00	54.99	-42.38	-25.00	17.38
222.00	665.99	PK	33.70	H	3.02	19.90	3.00	56.62	-40.76	-25.00	15.76
222.00	665.99	PK	36.90	V	3.02	19.90	3.00	59.82	-37.56	-25.00	12.56
222.00	887.98	PK	21.91	H	3.56	22.02	3.00	47.49	-49.89	-25.00	24.89
222.00	887.98	PK	17.56	V	3.56	22.02	3.00	43.14	-54.24	-25.00	29.24
222.00	1109.98	PK	14.76	H	3.86	27.20	3.00	45.82	-51.55	-25.00	26.55
222.00	1109.98	PK	13.69	V	3.86	27.20	3.00	44.75	-52.62	-25.00	27.62
222.00	1331.97	PK	16.18	H	4.23	28.73	3.00	49.14	-48.24	-25.00	23.24
222.00	1331.97	PK	14.65	V	4.23	28.73	3.00	47.61	-49.77	-25.00	24.77
222.00	1553.97	PK	22.59	H	4.57	27.78	3.00	54.94	-42.43	-25.00	17.43
222.00	1553.97	PK	13.89	V	4.57	27.78	3.00	46.24	-51.13	-25.00	26.13
222.00	1775.96	PK	12.05	H	4.87	30.02	3.00	46.94	-50.44	-25.00	25.44
222.00	1775.96	PK	14.63	V	4.87	30.02	3.00	49.52	-47.86	-25.00	22.86
222.00	1997.96	PK	11.43	H	5.17	31.31	3.00	47.92	-49.46	-25.00	24.46
222.00	1997.96	PK	13.98	V	5.17	31.31	3.00	50.47	-46.91	-25.00	21.91
222.00	2219.95	PK	16.66	H	5.39	31.28	3.00	53.33	-44.04	-25.00	19.04
222.00	2219.95	PK	14.70	V	5.39	31.28	3.00	51.37	-46.00	-25.00	21.00

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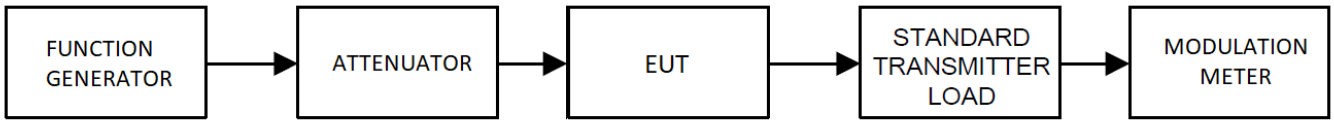
8.7 Modulation Characteristics

Limits from FCC Parts 2.1047, 80.213 (g), and 87.141; and test procedure from ANSI C63.26-2015

Conducted Test Setup


N/A

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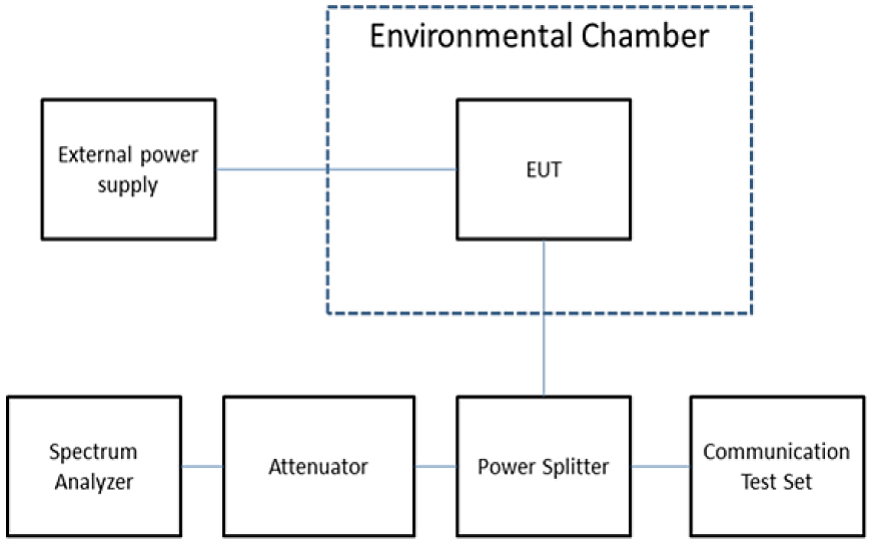
8.8 Frequency Stability

Limits from FCC Parts 2.1055, and 90.213; and test procedure from ANSI C63.26-2015.

Test Setup



Test Results, Mode 1		
Tuned Frequency (MHz)	Max Deviation (kHz)	Limit (Hz)
220.005	-0.080	330.008

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Frequency Stability, Tabular Data

8.8.1 Frequency Stability Data

FCC Part 90 Limit	1.5	ppm
FCC Part 90 Limit, as ppb	1500	ppb (Parts per Billion)
FCC Part 90 Limit, as %	0.00015	%
Strictest Combined Limit, as Hz	330.008	Hz
Combined Lower Limit	220.004670	MHz
Combined Upper Limit	220.005330	MHz
Rated Supply Voltage	12.5	○ AC ◉ DC

Temperature / Voltage Variation

Temperature (°C)	Supplied Voltage (V)	Frequency (MHz)	Deviation (kHz)
-30	12.5	220.005010	-0.010
-20	12.5	220.005070	-0.070
-10	12.5	220.005050	-0.050
0	12.5	220.005000	0.000
+10	12.5	220.004980	0.020
+20 (reference)	12.5	220.005000	0.000
+20	10.6	220.004990	0.010
+20	14.4	220.004990	0.010
+30	12.5	220.005080	-0.080
+40	12.5	220.005070	-0.070
+50	12.5	220.005050	-0.050

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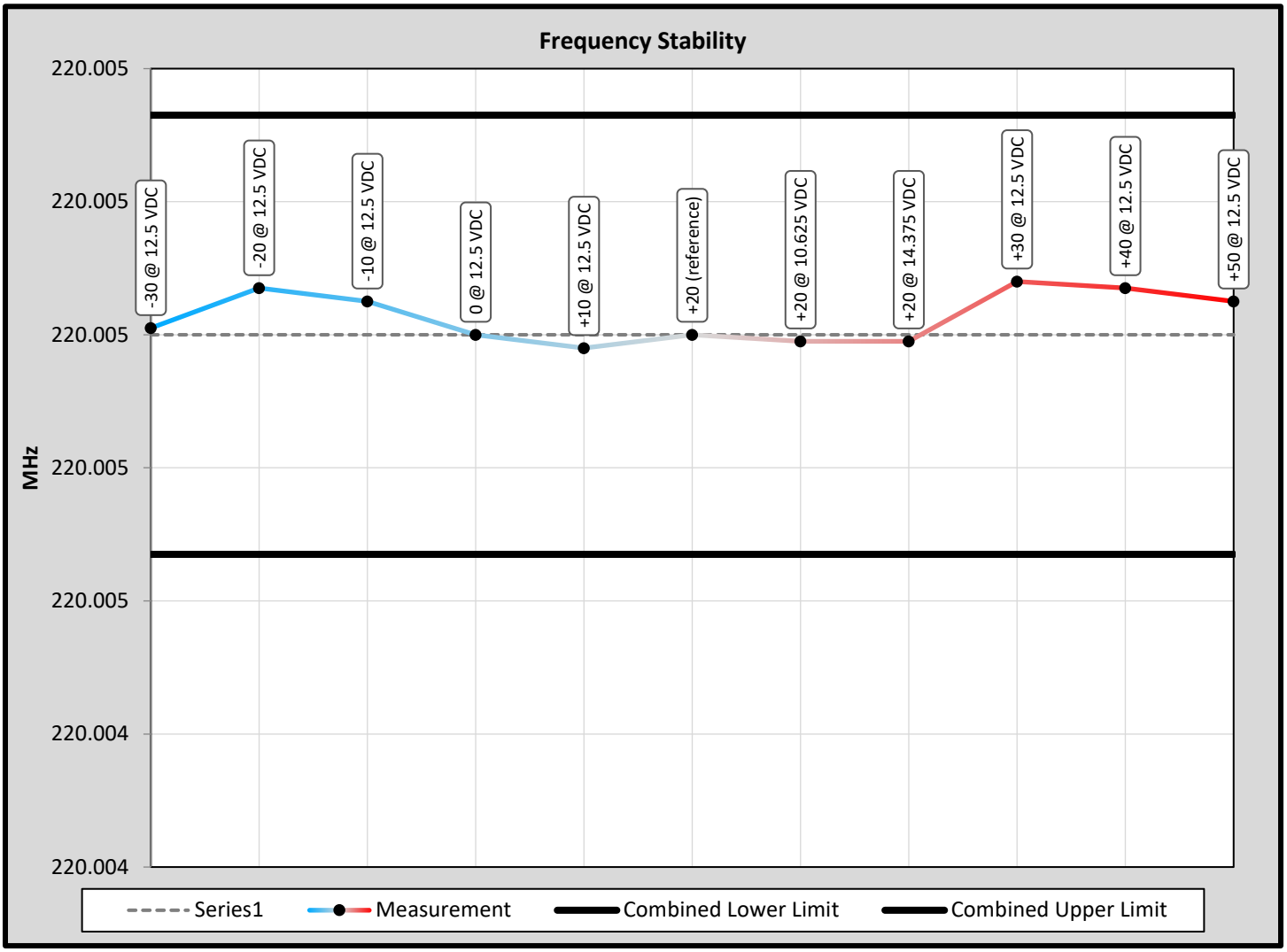
8.8.2 Frequency Stability Plot



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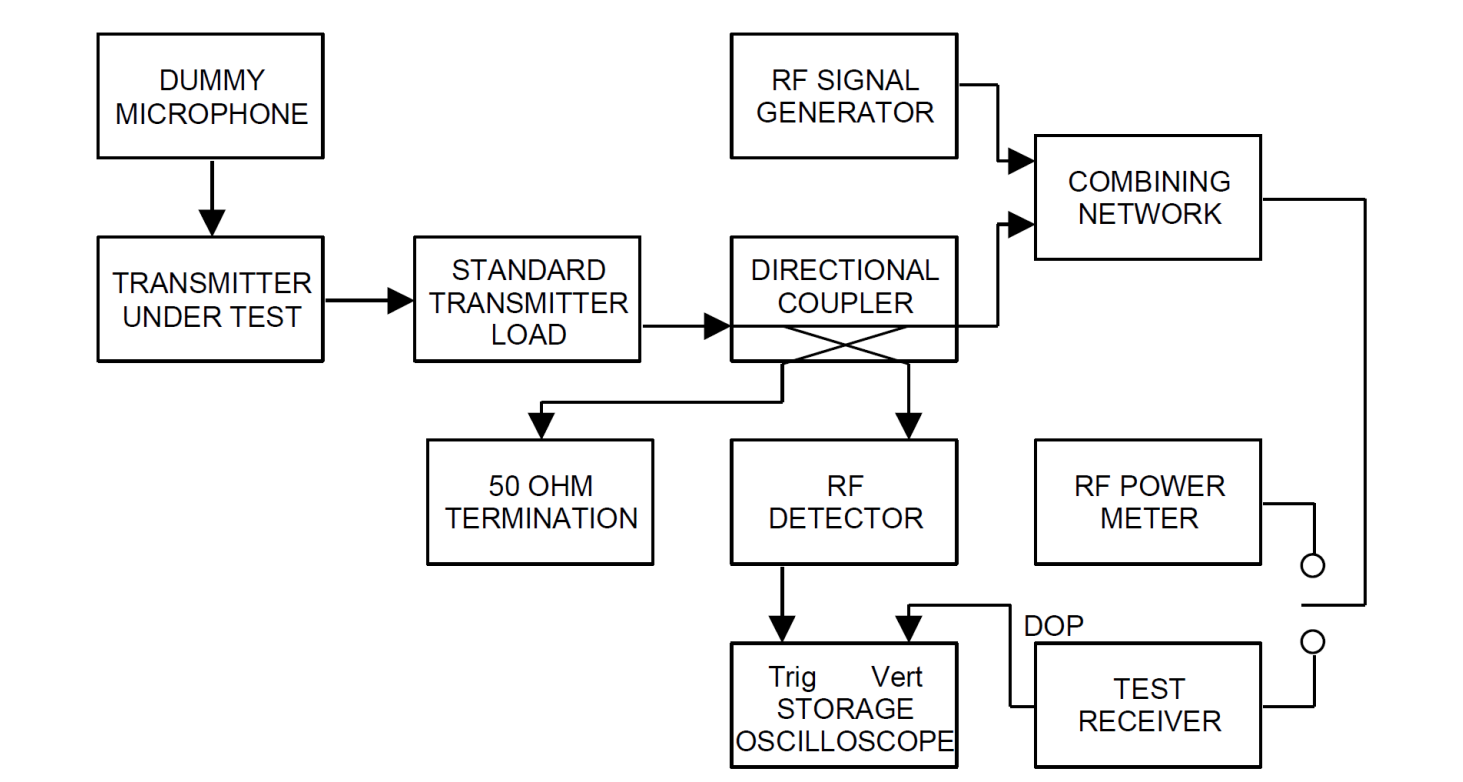
8.9 Transient Frequency Behavior

Limits from FCC Part 90.214; and test procedure from ANSI C63.26-2015.

Conducted Test Setup



N/A

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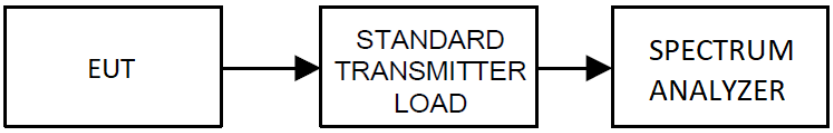
8.10Adjacent channel power limits

Limits from FCC Part 90.221, and test procedure from ANSI C63.26-2015.

Conducted Test Setup


n/a. The EUT does not operate in a band requiring ACP.

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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 separate supplementary documents labelled EXTERNAL PHOTOS and INTERNAL PHOTOS.

10. ANNEX-B – Test Setup Photographs

Test setup photographs are located in a separate supplementary ANNEX-B document.

11. History of Test Report Changes

Test Report #	Revision #	Description	Date of Issue
TR_3915-21_FCC_PT90_	1	Initial release	8/11/2021
	2	Sections 3.2, 8.5 & 8.6	8/25/2021
	3	Updated Page 17 Authorized Bandwidth Limits	8/26/2021

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END OF TEST REPORT

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