



Test Report – FCC 15F Ultra_Wideband Operation

Applicant: SUBPAC Inc.

Approved for Release By:

Signature: Bruno Clavier

Name & Title: Bruno Clavier, General Manager

Date of Signature 4/11/2022

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(352) 472-5500 / testing@timcoengr.com

1. Customer Information

Applicant: SUBPAC Inc.
Address: 540 Howard Street
San Francisco, California, 94105, United States

1.1 Test Result Summary

The following test procedure was used ANSI C63.10-2013. 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.

Clauses	Description of the Requirements	Result (Pass, Fail or N/A)
15.503(a)	10dB Bandwidth	Pass
FCC 15.517(b)	UWB Bandwidth	Pass
FCC 15.517(c), 15.209(a), 15.205(a), (b)	Radiated Field Strength of Spurious Emissions	Pass
FCC 15.517(d)	Radiated Field Strength of Spurious Emissions	Pass
2.1046, FCC 15.503(d)	Radiated Field Strength of the Fundamental	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



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2.2 Testing was performed, reviewed by

Dates of Testing: 1/27/2022 – 2/4/2022

Signature:

Sr. EMC Engineer
EMC-003838-NE



Name & Title:

Tim Royer, EMC Engineer

Date of Signature

4/11/2022

Signature:

Name & Title:

Kristoffer Costa, EMC Technician

Date of Signature

4/11/2022



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

The test sample was received: 1/27/2022

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:	2AEJU-X1A
Brief Description	UWB X1 System with Subpac Mini Remote and BT
Model(s) #	SUBPAC X1
Firmware version	n/a
Software version	n/a
Serial Number	n/a

Technical Characteristics	
Technology	UWB X1 System with Subpac Mini Remote and BT
Frequency Range	6600 – 7800 MHz
Bandwidth & Emission Class	750 MHz
Device Category	Indoor UWB System
Antenna Connector	n/a
Voltage Rating (AC or Batt.)	5VDC USB Type C

Antenna Characteristics			
Antenna	Frequency Range	Mode / BW	Antenna Gain
1	n/a	n/a	0 dBi

- Note: Information such as antenna gain, firmware/software numbers are provide by manufacturer and cannot be validated by the test lab.



3.2 Configuration of EUT

Band (MHz)	Mode	Number of Ant.
6674.9 – 7475.9	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:

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.



4. Test methods & Applicable Regulatory Limits

4.1 Test methods/Standards/Guidance

The measurement was performed as per FCC 15F. Full test results are available in this report.

Limits and Regulatory Limits:

- 1) FCC 15F
- 2) KDB 393764 D01 UWB FAQ v02

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	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
Function Generator	Function Generator	Standford	DS340	25200	1/13/21	1/13/2024
Signal Generator	Signal Generator HP 8648C	HP	8648C	3847A04696	3/31/21	3/30/2024

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:

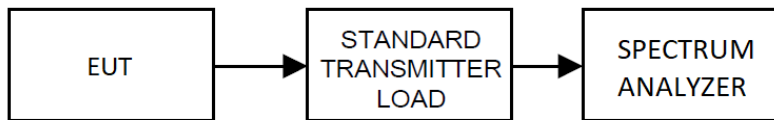
Freq (MHz)	Meter Reading	+ ACF	+CL	= FS
33	20 dB μ V	+ 10.36 dB/m	+0.40 dB	=30.36 dB μ V/m @ 3m

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

8.1 OCCUPIED BANDWIDTH

Limits from FCC 15.503(a) and test procedure from ANSI C63.10.

Setup



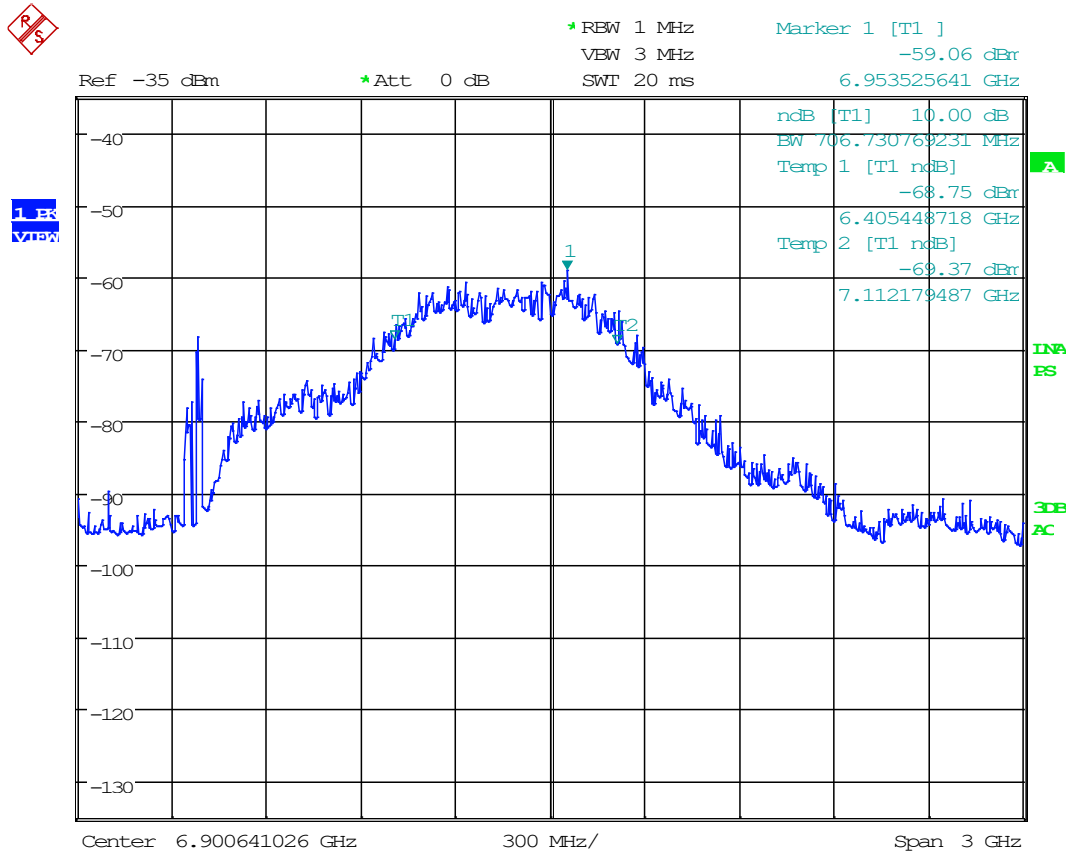
Tuned Frequency (MHz)	Measured 10 dB BW (MHz)	Occupied Bandwidth Limit (MHz)	Margin (MHz)
6674.6	706.73	> 500	206.73
7475.9	745.2	> 500	245.2
7741.9	750	> 500	250

For a UWB device emission spectrum, the entire fundamental bandwidth (that portion of the spectrum between the outermost –10 dB points) must be fully contained within the authorized frequency band (3100 MHz and 10,600 MHz). As stated Q3 of KDB 393764 D01 UWB FAQ v02

$$f_L = 6.405448718 \text{ GHz}$$

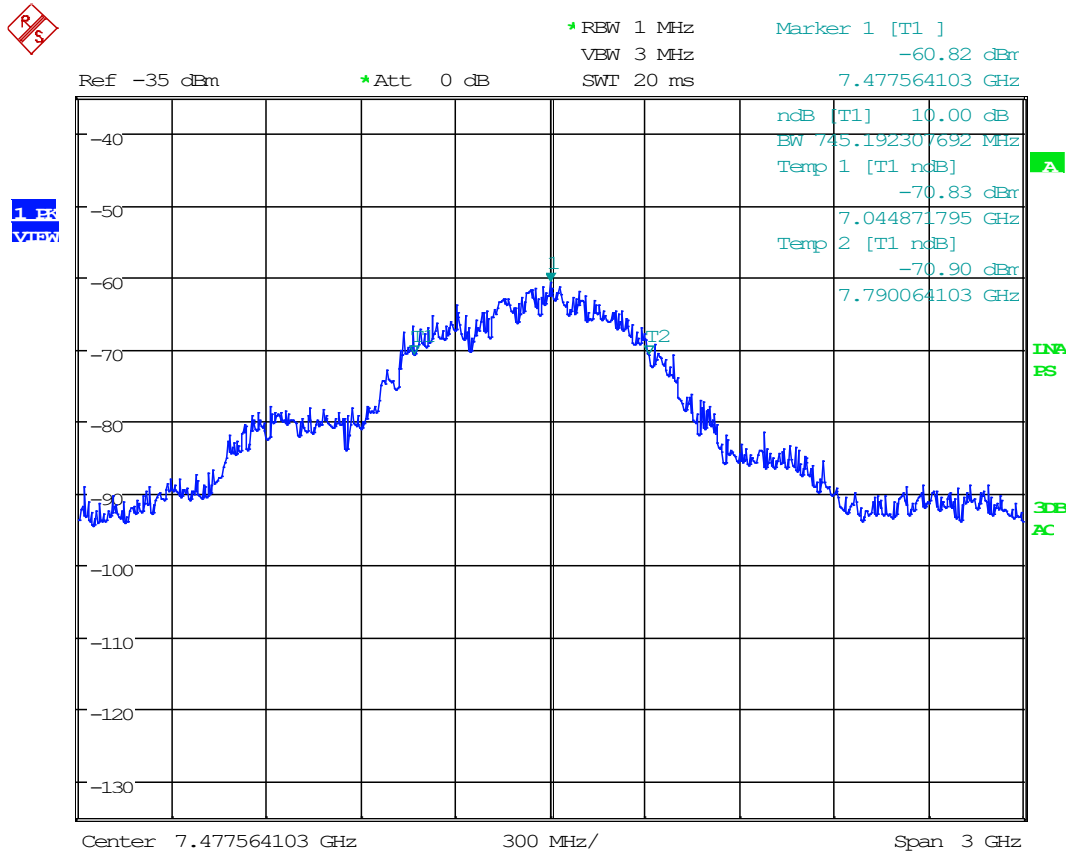
$$F_H = 8.266025641 \text{ GHz}$$

8.1.1 Test Data: 10 dB Occupied Bandwidth Measurement Plot, 6674.6 MHz



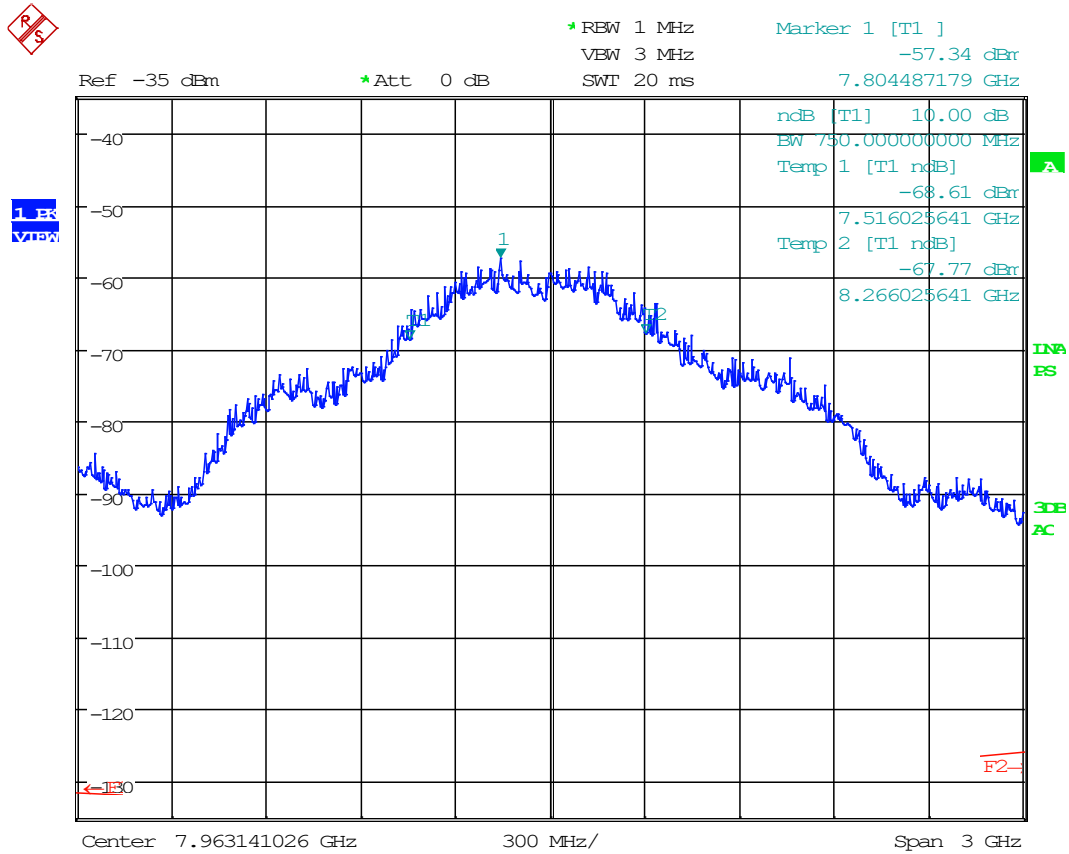
Date: 2.FEB.2022 14:13:12

8.1.2 Test Data: 10 dB Occupied Bandwidth Measurement Plot, 7475.9 MHz



Date: 2.FEB.2022 14:10:05

8.1.3 Test Data: 10 dB Occupied Bandwidth Measurement Plot, 7741.9 MHz



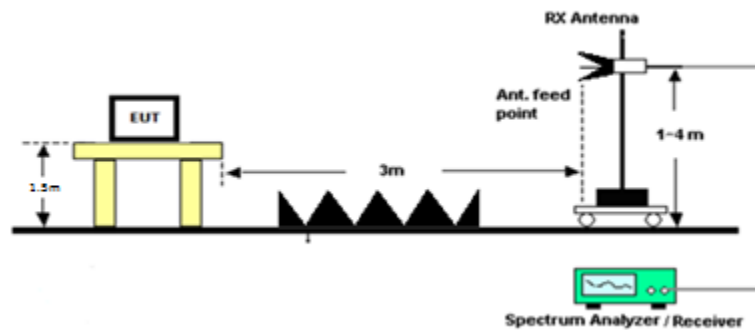
Date: 2.FEB.2022 14:07:40

8.1 UWB BANDWIDTH

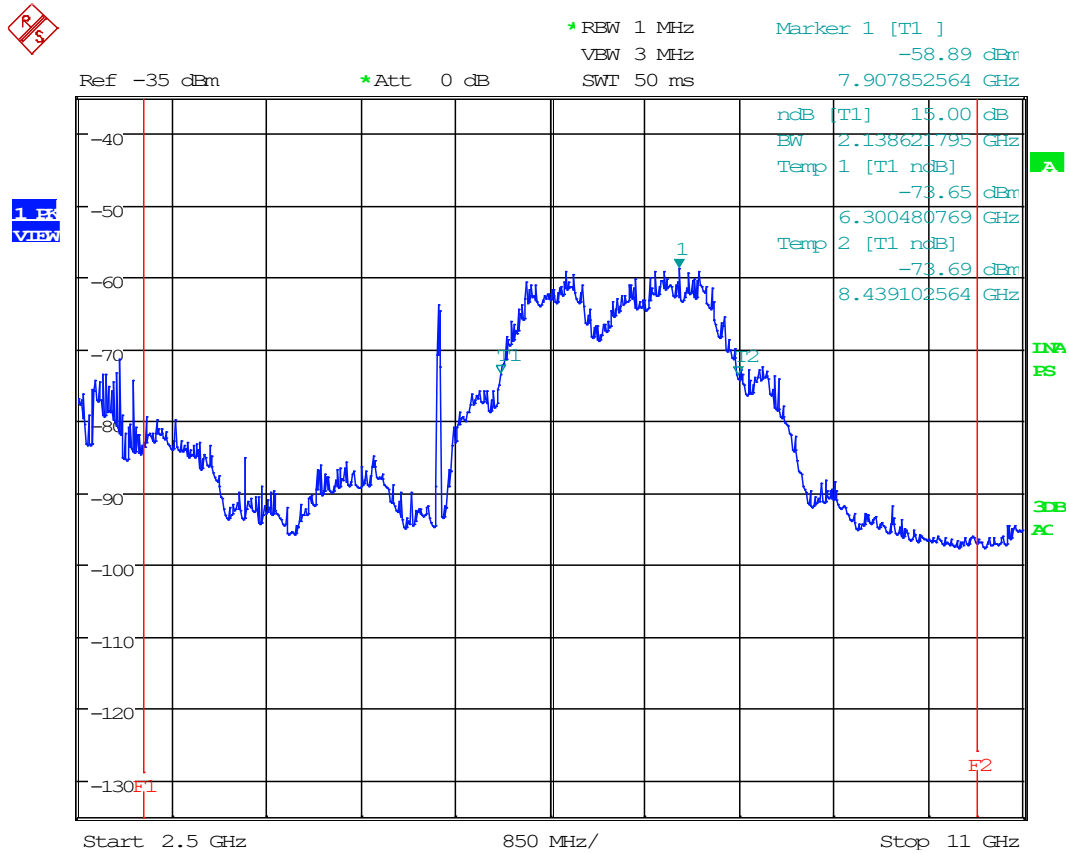
Limits from FCC 15.517(b) and test procedure from ANSI C63.10.

Setup

Radiated Test Setup, Above 1000 MHz



8.1.1 Test Data: UWB Bandwidth Measurement Plot

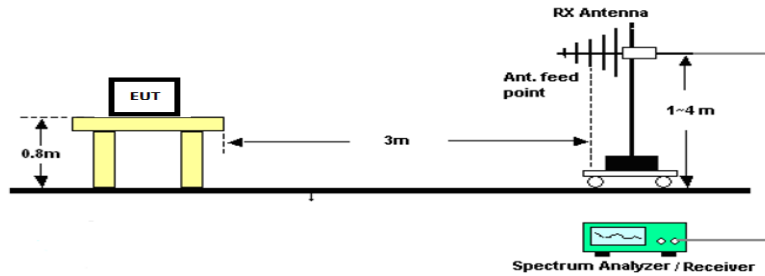


Date: 2.FEB.2022 14:02:09

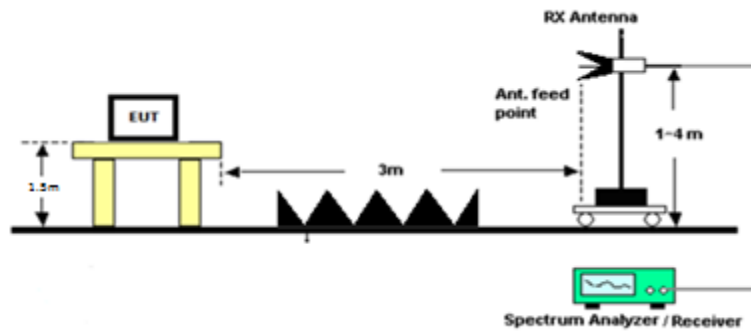
8.2 Radiated Field Strength of Spurious Emissions

Limits from FCC 15.517(c) & 15.209 and test procedure from ANSI C63.10

Radiated Test Setup, 30 – 1000 MHz



Radiated Test Setup, Above 1000 MHz





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8.2.1 Radiated Emissions, 6674.6 MHz

Tuned Frequency (MHz)	Emission Frequency (MHz)	15.205 Restricted Band	15.205, 15.35, 15.247(d) Detector	Meter Reading (dBμV)	Antenna Polarity	Coax Loss (dB)	Duty Cycle Correction (dB)	Antenna Correction Factor (dB/m)	Distance (m)	Field Strength (dBμV/m)	ERP (dBm)	Spurious Limit (dBm)	Margin (dB)
6674.60	13349.20	X	AVG	-31.10	H	12.67	0.00	39.67	3.00	21.24	-76.13	-51.30	24.83
6674.60	13349.20	X	AVG	-30.60	V	12.67	0.00	39.67	3.00	21.74	-75.63	-51.30	24.33
6674.60	20023.80	X	AVG	-29.80	H	16.55	0.00	44.35	3.00	31.11	-66.27	-51.30	14.97
6674.60	20023.80	X	AVG	-29.40	V	16.55	0.00	44.35	3.00	31.51	-65.87	-51.30	14.57
6674.60	26698.40		AVG	-29.30	H	18.68	0.00	46.56	3.00	35.94	-61.44	-51.30	10.14
6674.60	26698.40		AVG	-26.65	V	18.68	0.00	46.56	3.00	38.59	-58.79	-51.30	7.49
6674.60	33373.00		AVG	-31.40	H	21.58	0.00	49.51	3.00	39.69	-57.69	-51.30	6.39
6674.60	33373.00		AVG	-31.50	V	21.58	0.00	49.51	3.00	39.59	-57.79	-51.30	6.49



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8.2.2 Radiated Emissions, 7475.9 MHz

Tuned Frequency (MHz)	Emission Frequency (MHz)	15.205 Restricted Band	15.205, 15.35, 15.247(d) Detector	Meter Reading (dBμV)	Antenna Polarity	Coax Loss (dB)	Duty Cycle Correction (dB)	Antenna Correction Factor (dB/m)	Distance (m)	Field Strength (dBμV/m)	ERP (dBm)	Spurious Limit (dBm)	Margin (dB)
7475.90	14951.80		AVG	-32.10	H	13.60	0.00	40.29	3.00	21.79	-75.59	-51.30	24.29
7475.90	14951.80		AVG	-32.41	V	13.60	0.00	40.29	3.00	21.48	-75.90	-51.30	24.60
7475.90	22427.70	X	AVG	-32.90	H	16.98	0.00	44.83	3.00	28.90	-68.47	-51.30	17.17
7475.90	22427.70	X	AVG	-32.15	V	16.98	0.00	44.83	3.00	29.65	-67.72	-51.30	16.42
7475.90	29903.60		AVG	-24.80	H	20.09	0.00	46.31	3.00	41.60	-55.78	-51.30	4.48
7475.90	29903.60		AVG	-25.00	V	20.09	0.00	46.31	3.00	41.40	-55.98	-51.30	4.68
7475.90	37379.50		AVG	-32.70	H	22.08	0.00	45.89	3.00	35.27	-62.11	-51.30	10.81
7475.90	37379.50		AVG	-33.06	V	22.08	0.00	45.89	3.00	34.91	-62.47	-51.30	11.17



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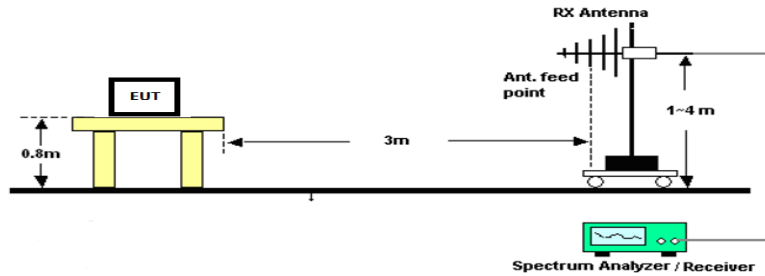
8.2.3 Radiated Emissions, 7741.9 MHz

Tuned Frequency (MHz)	Emission Frequency (MHz)	15.205 Restricted Band	15.205, 15.35, 15.247(d) Detector	Meter Reading (dBμV)	Antenna Polarity	Coax Loss (dB)	Duty Cycle Correction (dB)	Antenna Correction Factor (dB/m)	Distance (m)	Field Strength (dBμV/m)	ERP (dBm)	Spurious Limit (dBm)	Margin (dB)
7741.90	15483.80	X	AVG	-33.60	H	14.06	0.00	41.39	3.00	21.85	-75.53	-51.30	24.23
7741.90	15483.80	X	AVG	-33.60	V	14.06	0.00	41.39	3.00	21.85	-75.53	-51.30	24.23
7741.90	23225.70		AVG	-31.90	H	17.85	0.00	45.15	3.00	31.10	-66.28	-51.30	14.98
7741.90	23225.70		AVG	-31.80	V	17.85	0.00	45.15	3.00	31.20	-66.18	-51.30	14.88
7741.90	30967.60		AVG	-26.80	H	20.09	0.00	47.02	3.00	40.32	-57.06	-51.30	5.76
7741.90	30967.60		AVG	-26.70	V	20.09	0.00	47.02	3.00	40.42	-56.96	-51.30	5.66
7741.90	38709.50	X	AVG	-33.50	H	22.72	0.00	45.84	3.00	35.07	-62.31	-51.30	11.01
7741.90	38709.50	X	AVG	-33.50	V	22.72	0.00	45.84	3.00	35.07	-62.31	-51.30	11.01

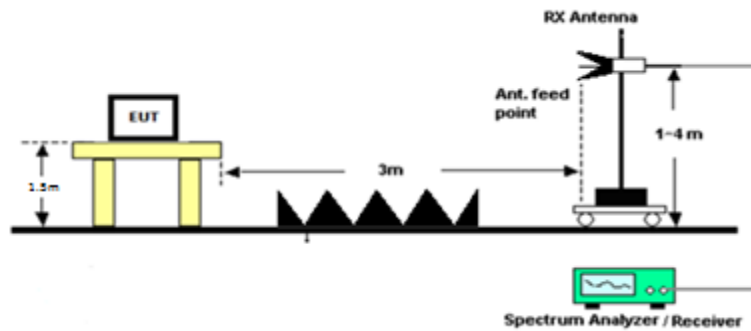
8.3 Radiated Field Strength of Spurious Emissions

Limits from FCC 15.517(d) and test procedure from ANSI C63.10

Radiated Test Setup, 30 – 1000 MHz

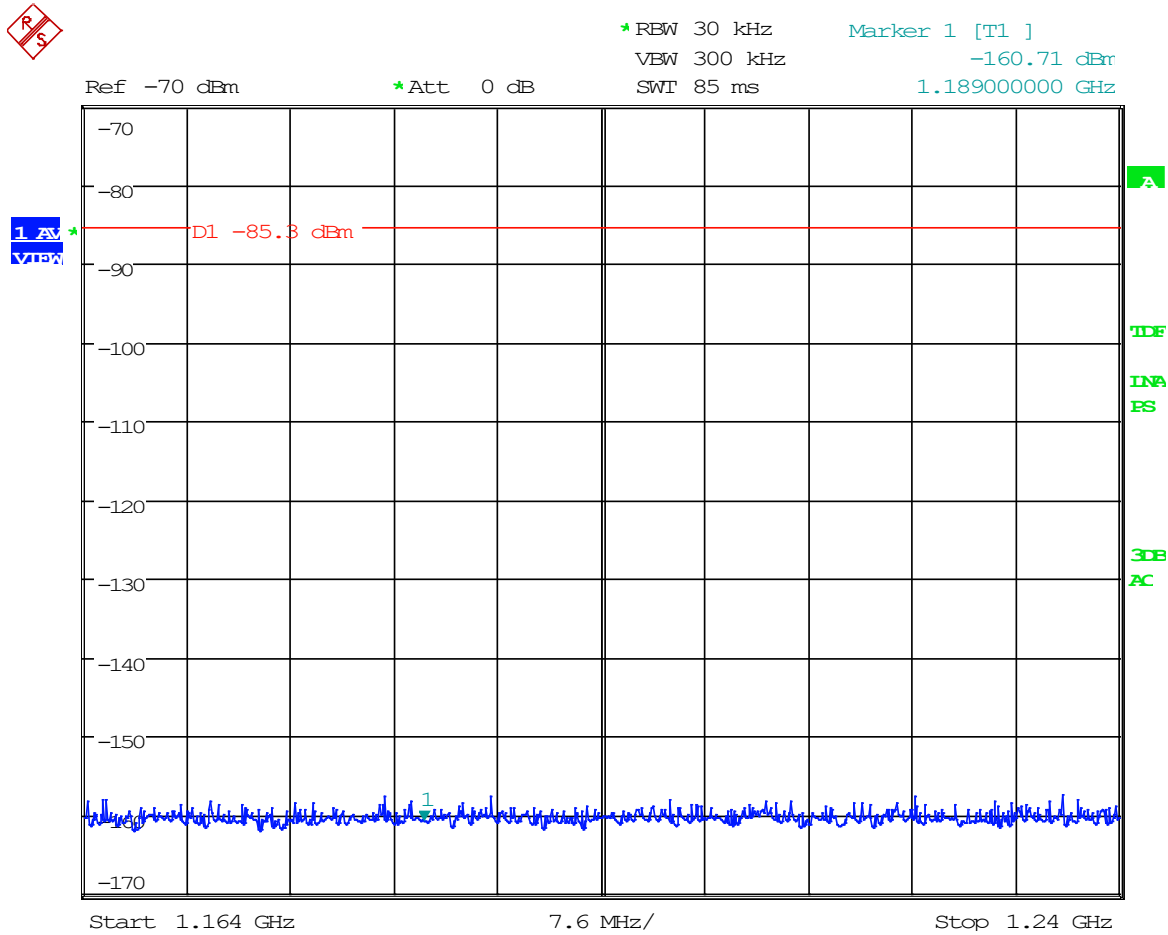


Radiated Test Setup, Above 1000 MHz



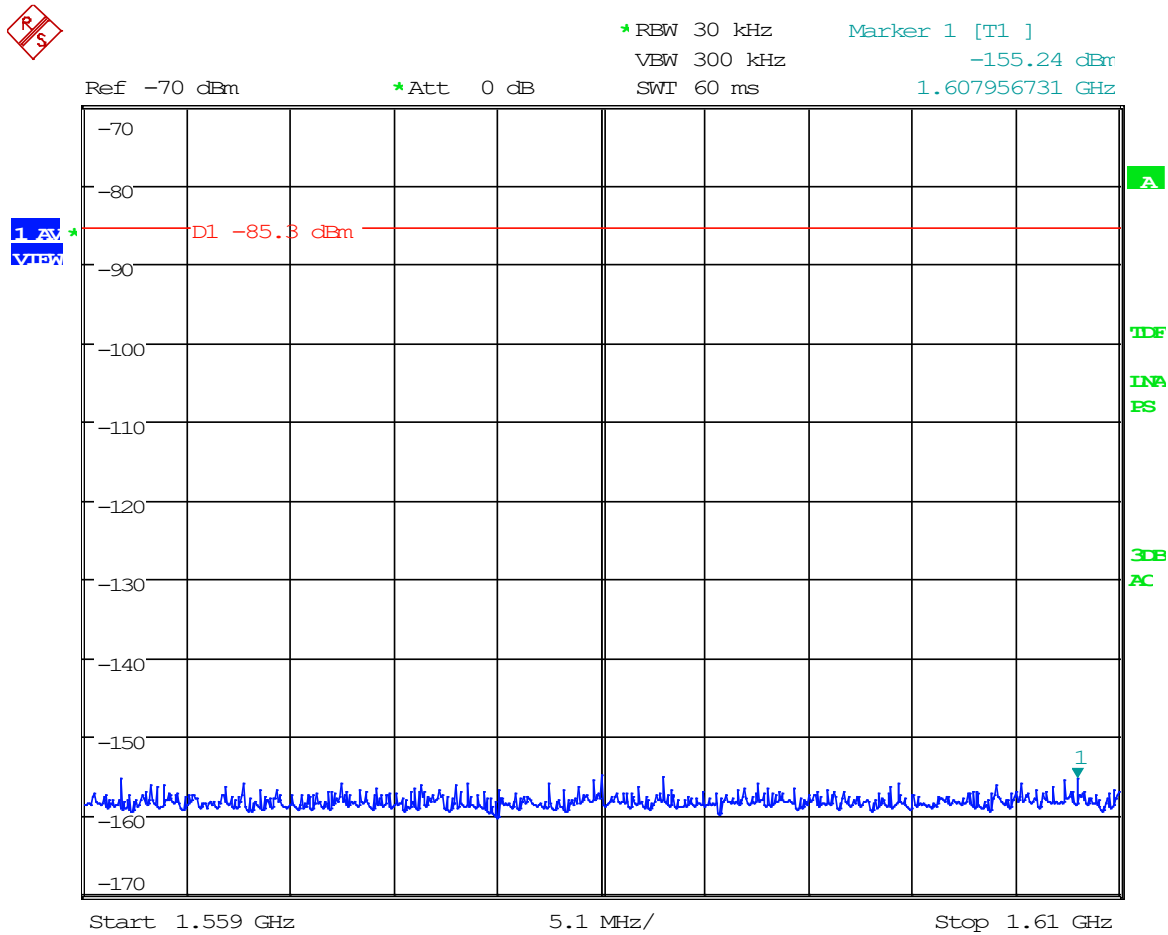


8.3.1 Radiated Emissions of 1164 - 1240 MHz for 6674.6 MHz Fundamental



Date: 9.FEB.2022 13:40:08

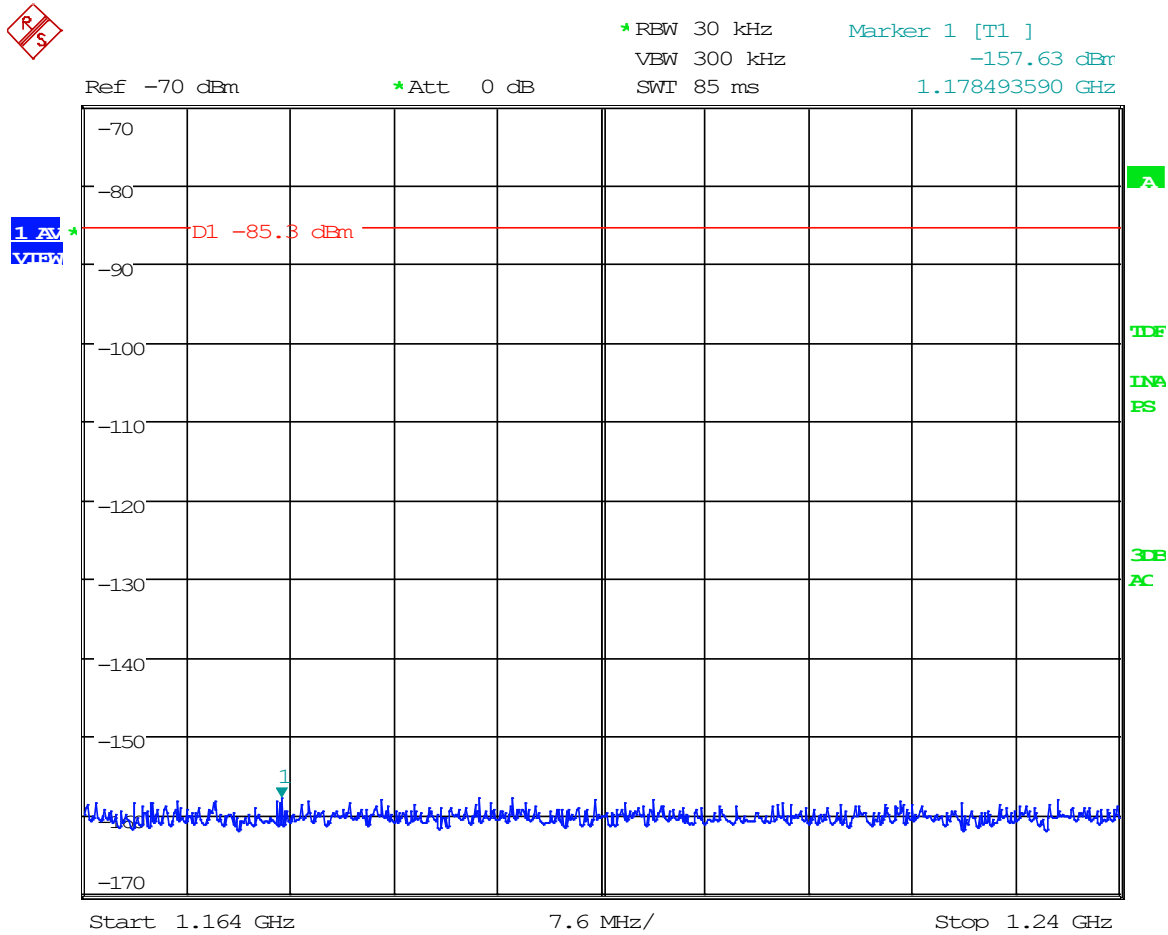
8.3.2 Radiated Emissions, 1559 - 1610 MHz for 6674.6 MHz fundamental



Date: 9.FEB.2022 13:41:10



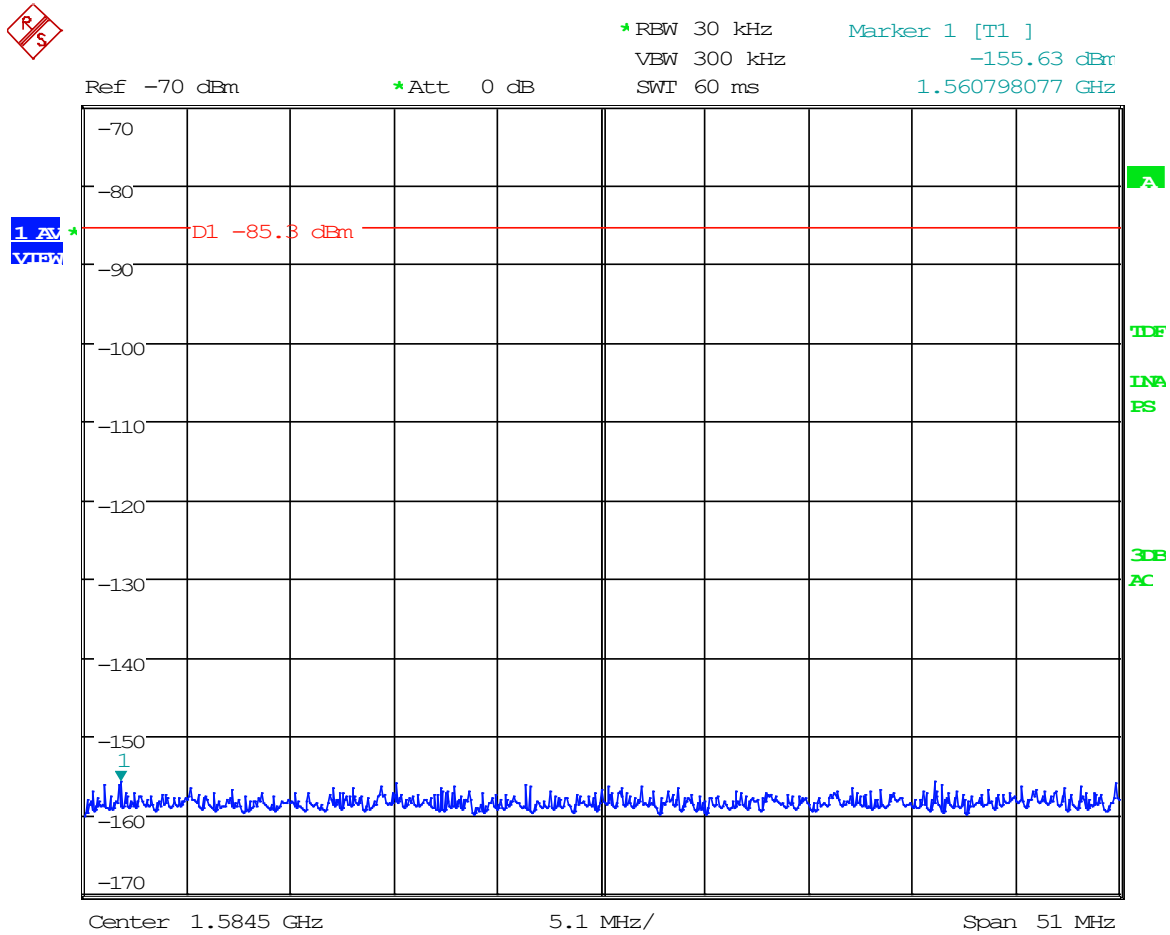
8.3.3 Radiated Emissions of 1164 - 1240 MHz for 7475.9 MHz Fundamental



Date: 9.FEB.2022 13:43:00



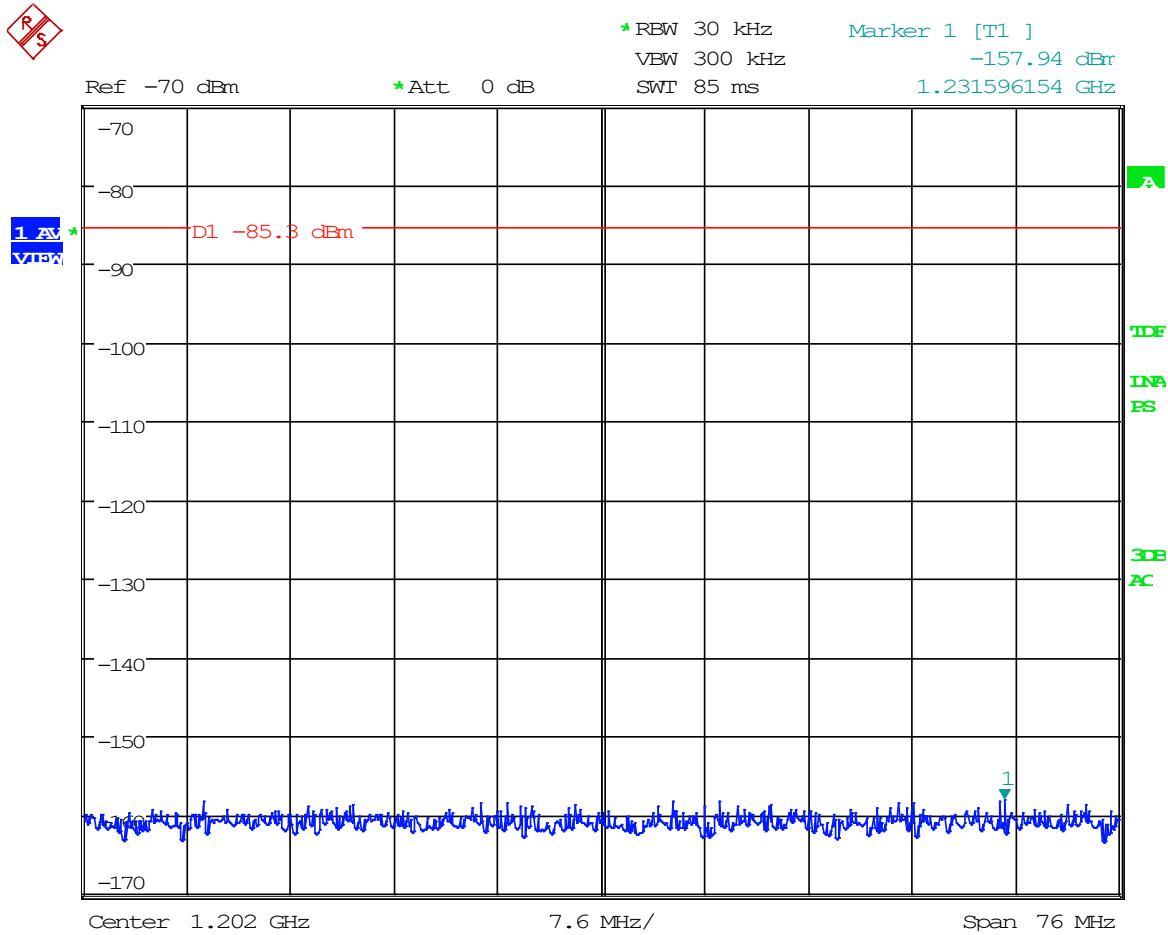
8.3.4 Radiated Emissions, 1559 - 1610 MHz for 7475.9 MHz fundamental



Date: 9.FEB.2022 13:42:40



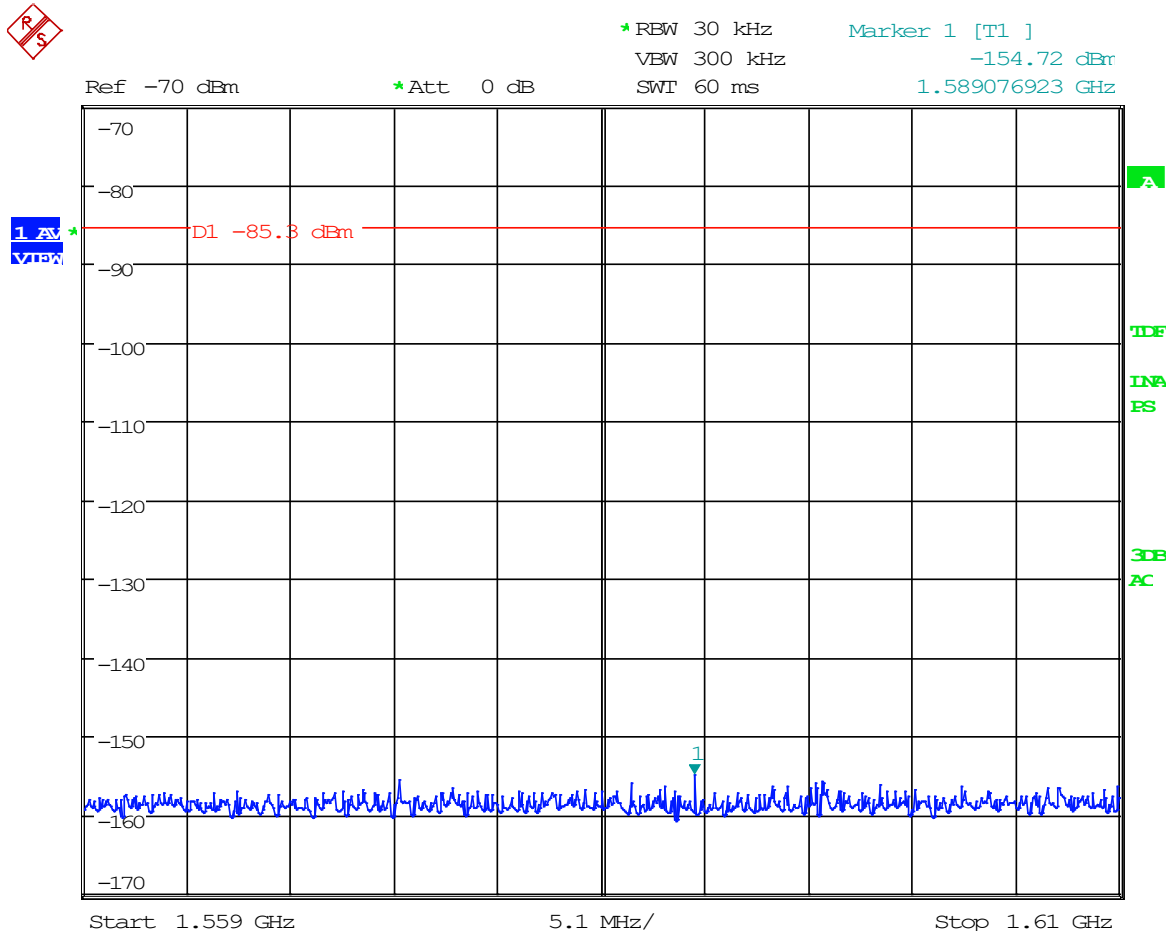
8.3.5 Radiated Emissions of 1164 - 1240 MHz for 7741.9 MHz Fundamental



Date: 9.FEB.2022 13:46:08



8.3.6 Radiated Emissions, 1559 - 1610 MHz for 7741.9 MHz fundamental

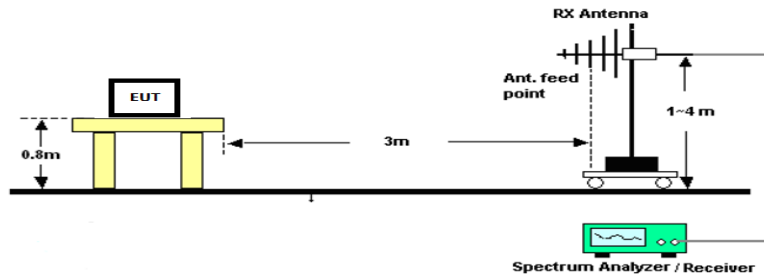


Date: 9.FEB.2022 13:46:28

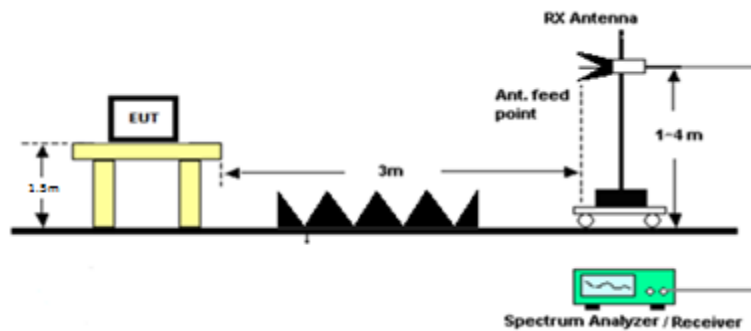
8.4 Radiated Field Strength of the Fundamental

Limits from FCC 15.503(d) and test procedure from ANSI C63.10

Radiated Test Setup, 30 – 1000 MHz



Radiated Test Setup, Above 1000 MHz





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8.4.1 Radiated Emissions, 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)	ERP (dBm)	Spurious Limit (dBm)	Margin (dB)
6674.60	PK	49.43	H	9.14	35.69	3.00	94.26	-3.12	0.00	3.12
6674.60	PK	49.76	V	9.14	35.69	3.00	94.59	-2.79	0.00	2.79
7475.90	PK	49.61	H	9.63	35.97	3.00	95.21	-2.17	0.00	2.17
7475.90	PK	47.94	V	9.63	35.97	3.00	93.54	-3.84	0.00	3.84
7741.90	PK	46.88	H	10.12	35.87	3.00	92.87	-4.50	0.00	4.50
7741.90	PK	47.65	V	10.12	35.87	3.00	93.64	-3.73	0.00	3.73



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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_0493-22_FCC_15F Ultra_Wideband Operation_	1	Initial release	2/9/2022
	3	Revised Pages 3,28,18-20	3/28/2022
	4	3,6,8,10,11,14,16,20,27	4/11/2022



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

END OF TEST REPORT
