TEST REPORT	
ELECTRONICS TESTING EMC TEST FACILITY	
TEST REPORT NUMBER	UFA 2213IND642-1-A2
TEST REPORT ISSUE DATE	17 October 2022
TEST REPORT VERSION	1.04
MANUFACTURER	TE CONNECTIVITY INDIA PVT. LTD,
EUT NAME	TE Connectivity's AMP Weld Smart E Controller
EUT MODEL	2388292-1
CONDITION OF EUT WHEN RECEIVED	Good
ISSUED TO : NAME AND CONTACT INFORMATION OF CUSTOMER	**TE CONNECTIVITY INDIA PVT.LTD,** SAHASRA SHREE FIRST FLOOR NO. 88P EXPORT PROMOTION INDL, WHITEFIELD ROAD, BANGALORE, 560066
ISSUED BY : NAME AND ADDRESS OF TEST LABORATORY	**Tarang Labs, Wipro Limited,** Sy. No. 69P, 71/4P, 78/8AP, 134P, 76P, 77P, 80P, 70P, 79/1P, Unit 1, Sarjapur Road, Doddakannelli Village, Varthur Hobli, Bengaluru (Bangalore) Rural, Karnataka - 560035 Tel: +91-80-30292929, Fax: +91-80-30298200 Email: tarang-planet@wipro.com Web: www.wipro.com

AMENDMENT HISTORY

Amendment Number	Amendment Date	Author of Amendment	Previous Report Version	Previous Report Date
01	11th Jul 2022	Venkatesha B S	1.0	6th Jul 2022
Amendment Details	'M18' prefix added to 'Red Lithium Battery' in the section 5.1.3 (Accessories/ Interfaces and Cable details)			
02	13th Oct 2022	Venkatesha B S	1.02	11th Jul 2022
Amendment Details	➢ In section 5.3.2.1, 5.3.2.2, 5.3.2.4 & 5.3.2.6 the reference section details for Conducted RF Output Power test as per FCC standard has been changed due to change in modulation technique from FHSS to DSSS. ➢ In section 5.3.2.2 & 5.3.2.5 the limit for Conducted RF Output Power test as per FCC standard has been changed due to change in modulation technique from FHSS to DSSS. ➢ The 6dB Bandwidth test is executed, test results and further details are added in section 5.3.3. ➢ The Power Spectral Density test is executed, test results and further details are added in section 5.3.4 ➢ 20dB Bandwidth, Number of Hopping Channels, Carrier Frequency Separation and Time of Occupancy (Dwell Time) tests details are removed from the test report.,			

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1 TEST REPORT SUMMARY

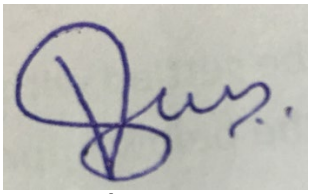
Applicant	TE CONNECTIVITY INDIA PVT. LTD,
Manufacturer	TE CONNECTIVITY INDIA PVT. LTD,
EUT Name	TE Connectivity's AMP Weld Smart E Controller
EUT Model	2388292-1
EUT Serial Number	TE-1639468569 and TE-1639040963
Date of receipt of test item	25 March 2022
EUT Category / Type of Equipment	Industrial/Table top
EUT Operating Voltage range	Battery operated (18VDC to 22VDC)
EUT Operating Frequency range	NA
EUT Power Rating	Steady State: 5.5Watts Peak: 660Watts
EUT Operating Current (max)	≤250milliAmpere
Date of Test	25 March 2022 to 26 September 2022
Venue of Test	Tarang Labs-EMC

Applicable Standard	**Applicable Test**	**Frequency range/ Test level**	**Applicable port**	**Results-Criterion**
CFR 47, FCC Part 15 sub part C (using ANSI C63.10:2013) (Section 15.209)	Radiated Emission Test	Frequency Range: 9kHz to 150kHz, 150kHz to 30MHz, 30MHz to 200MHz, 200MHz to 1GHz, 1GHz to 18GHz, 18GHz to 26.5GHz,	Enclosure	PASS
CFR 47, FCC Part 15 sub part C (using ANSI C63.10:2013) (Section 15.247b.3)	Conducted RF Output Power	2400 to 2483.5MHz band: 1watt	Antenna Port	Refer Section 5.3.2.6
CFR 47, FCC Part 15 sub part C (using ANSI C63.10:2013) (Section 15.247a.2)	6 dB Bandwidth	The minimum 6 dB bandwidth shall be at least 500 kHz	Antenna Port	Refer Section 5.3.3.6
CFR 47, FCC Part 15 sub part C (using ANSI C63.10:2013) (Section 15.247e)	Power Spectral Density	Not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission	Antenna Port	Refer Section 5.3.4.6
CFR 47, FCC Part 15 sub part C (using ANSI C63.10:2013) (Section 15.247d)	Emission on The Band Edge	<20dBc	Antenna Port	Refer Section 5.3.5.6
CFR 47, FCC Part 15 sub part C (using ANSI C63.10:2013) (Section 15.247d)	Conducted Spurious Emissions	9kHz to 150kHz 150kHz to 30MHz 30MHz to 1GHz 1GHz to 26.5GHz	Antenna Port	PASS

TE Connectivity's AMP Weld Smart E Controller was tested by Tarang Labs as per the standards that are listed in the table above. Based on the observations during the test and interpretations by Tarang labs, results have been indicated. The test results produced in this report shall apply only to the above sample that has been tested under the specific conditions and modes of testing as described in the report. Other similar equipment may not necessarily reproduce same result due to production tolerances and measurement uncertainties. Any measurement uncertainties listed in this report are for information purpose only.

The results shall stand invalid, in case there are any modifications / additions / removals to the hardware or software or end use atmosphere to the product tested. This report shall not be modified or in any way revised unless it is expressly permitted and endorsed by Tarang labs, through a duly authorized representative. Particulars on Manufacturer / Supplier / Product configuration / performance criteria, given in this report, are based on the information given by the customer, along with test request. Tarang labs does not assume any responsibility for the correctness of such information for the above-mentioned equipment under test.

Customer acknowledges that this is a test report and not a certificate to gain market access for the product. To gain market access, Customer needs appropriate clearance from the Government or authorized agency for the target market. For markets that allow self-declaration, customer needs to follow the procedure defined by the target market.

Prepared by	Reviewed by	Approved by
		
11th Apr 2022	12th Apr 2022	17th Oct 2022
Punith Gowda T	Magesh. S	Venkatesha B S
EMC Test Engineer	Lead EMC Test Engineer	Functional Head Authorized Signatory

2 GENERAL INFORMATION

2.1 ACCREDITATION DETAILS

Following are the accreditation and listing details for Tarang labs

Accreditation / Listing body	Registration / Company / Certificate Number
NABL, India	Certificate No: TC-5992 http://www.nabl-india.org/
TELECOMMUNICATION ENGINEERING CENTRE (TEC)	Certificate no 1: TEC/MRA/CAB/IND-D/7-II Certificate no 2: TEC/MRA/CAB/IND-D/67 http://www.tec.gov.in/list-of-cabs-designated-by-india/
American Association for Laboratory Accreditation	Certificate No: 5148.01 https://cabportal.touchstone.a2la.org/index.cfm?event=directory.index

2.2 MEASUREMENT UNCERTAINTY

The following measurement uncertainties are applicable to the relevant tests that are mentioned below:

Name of the test	Measurement Uncertainty (dB)
Radiated Emission from 9kHz to 30MHz at 3metres distance	±3.4966
Radiated Emission from 30MHz to 200MHz at 3metres distance	±4.6001
Radiated Emission from 200MHz to 1GHz at 3metres distance	±4.7326
Radiated Emission from 1GHz to 18GHz at 3metres distance	±3.5060
Radiated Emission from 18GHz to 26.5GHz at 3metres distance	±3.5789

3 INSTRUMENTATION AND CALIBRATION

3.1 TEST AND MEASURING EQUIPMENT

The list of following measuring equipment used for this testing conforms to the applicable standards. Performance of all test and measuring equipment including any accessories are checked periodically to ensure accuracy.

3.2 EQUIPMENT USED

Name of Equipment	Manufacturer	Model No.	Serial No.	Calibration Due
EMI Test Receiver	Rohde & Schwarz	ESU8	100324	14th Oct 2022
EMI Test Receiver	Rohde & Schwarz	ESR3	102073	20th Apr 2022
Bi-conical Antenna	Schwarz-beck Mess – Elektronik	VHBB 9124	9124-374	15th Sep 2022
Hybrid Log Periodic Antenna	TDK RF Solutions	HLP-3003C	131063	13th Jul 2022
Double Ridge Broad Band Horn Antenna	Schwarz-beck Mess – Elektronik	BBHA9120D	BBHA9120D-688	15th Jul 2022
Broad Band Horn Antenna	Schwarz-beck Mess – Elektronik	BBHA9170	336	8th Sep 2022
Pre-amplifier	Rohde & Schwarz	SCU-01	100626	21st Apr 2022
Pre-amplifier	Rohde & Schwarz	SCU-18	102275	25th Apr 2022
Pre-amplifier	TDK RF Solutions	PA-02-2	2007331 /2007	17th Dec 2022
RF Cables (Brown Receiver to wall Panel)	NA	NA	NA	21st Sep 2022
RF Cables (Panel to Pre Amplifier) 9 kHz To 1 GHz	NA	NA	NA	21st Sep 2022
RF Cables (Pre Amp to 3M) 9 kHz To 1 GHz	NA	NA	NA	21st Sep 2022
RF Cable (Pre-Amp to Antenna) 1-18 GHz	SUCOFLEX	106	507078/6	24th Nov 2022
RF Cable (Pre-Amp to Antenna) 18-40 GHz	SUCOFLEX	102	503350/2	24th Nov 2022

Table 1: List of equipment used for Radiated Emission test

Name of Equipment	Manufacturer	Model No.	Serial No.	Calibration Due
Spectrum Analyzer	Keysight	N9020A	MY54420183	24th Apr 2022
EMI Test Receiver	Rohde & Schwarz	ESU40	100510	06th Jun 2022
10dB Attenuator	Mini circuits	VAT 10	NA	#
RF Cable	Huber Suhner	NA	NA	#
# Verification done before start of the test				

Table 2: List of equipment used for Conducted RF test (Conducted RF output power, Emissions on the band edge & Conducted Spurious Emissions)

Name of Equipment	Manufacturer	Model No.	Serial No.	Calibration Due
Spectrum Analyzer	Keysight	N9020A	MY54420183	20th Apr 2023
10dB Attenuator	Mini circuits	VAT 10	NA	#
RF Cable	Huber Suhner	NA	NA	#
# Verification done before start of the test				

Table 3: List of equipment used for Conducted RF test (6dB Band width and Power Spectral Density)

3.3 SOFTWARE USED

Test Setup	Software Name	Software Developer	Software Version
Radiated Emissions	TDK Emissions Lab	TDK RF Solutions	10.93.0.4

4 EUT INFORMATION

4.1 DESCRIPTION OF THE EUT

TE-AMP Weld series is a battery powered handheld device with inbuilt wireless feature, designed with Nordic semiconductor nRF52833 SoC of low-power ARM® Cortex®-M4 processor with industry leading 2.4 GHz RF transceivers and Bluetooth 5.1 to controller the Welding operation.

4.2 SOFTWARE AND FIRMWARE DETAILS

Sl. No.	Description of Software/Firmware	Version	Comment
01	Amp_ Weld_ RADIO_TEST	V1.0.0	Test firmware used for RF (channel locking) test
02	Amp_ Weld_ DTM_ TEST	V1.0.0	Test firmware used for RF (Channel Hopping) test (*direct_test_mode_pca10100*.hex)
03	Firmware_ AMPWeld_ EMIEMC	V1.0.0	Test firmware used for RE
04	Mobile_ App_ AMPWeld_ EMIEMC	V1.0.0	NA

5 TEST DETAILS

5.1 EUT AND TEST SETUP

5.1.1 EUT CONFIGURATION DURING TEST

During the Test, the EUT should be turned ON using battery. For conducted RF test, the command will be sent to EUT using UART to perform Conducted RF output power, 6dB BW, Power Spectral Density, Band Edge measurement and Conducted Spurious Emissions as per FCC part 15 sub part C Standard.

The measurement level should be within the limit as per std.

5.1.2 TEST SETUP DETAILS

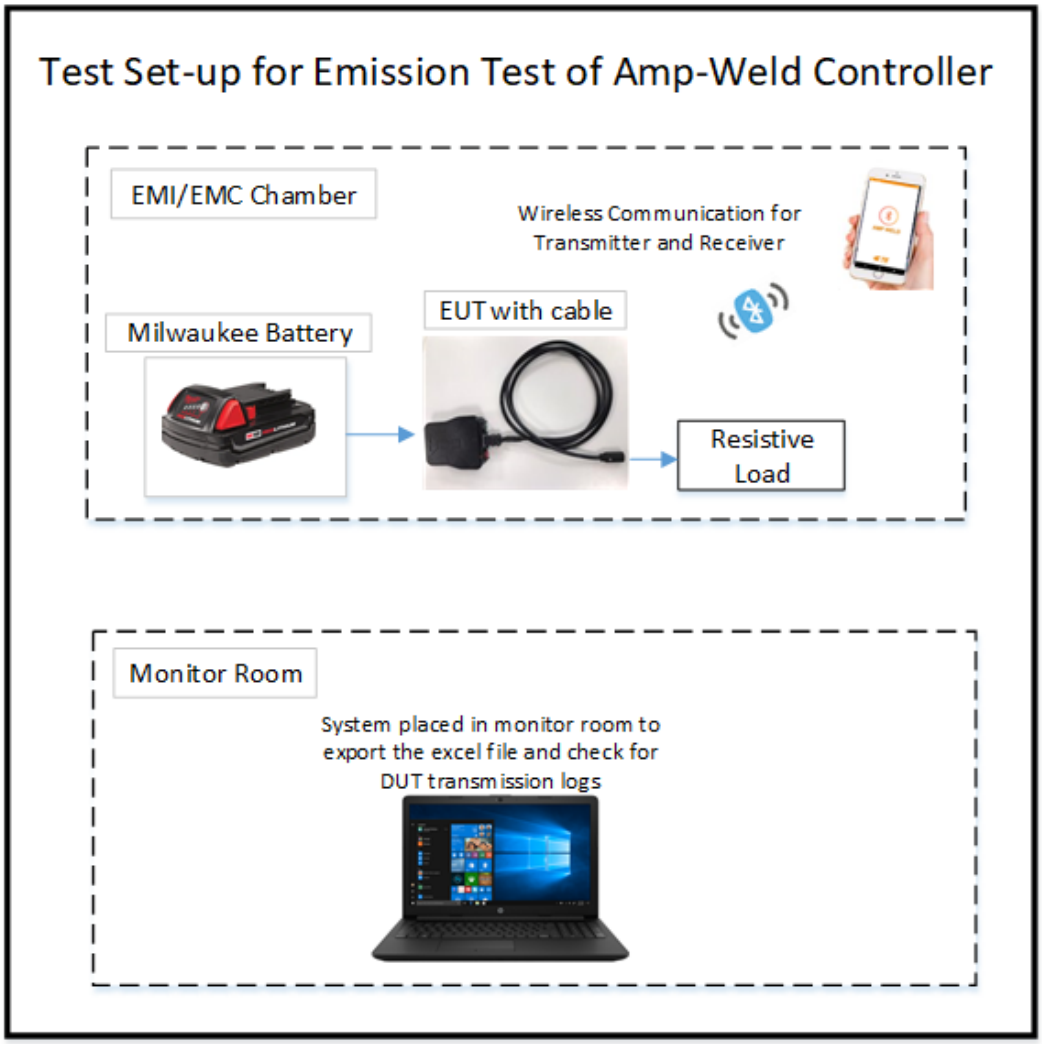


Figure 1: Block diagram of the EUT setup

5.1.3 ACCESSORIES/INTERFACES AND CABLE DETAILS

Sl. No.	Name of Accessories	Make	Model No	Serial No
1	AMP Weld Cord	TE CONNECTIVITY	2389716-1	NA
2	Resistive Load / LED	NA	NA	NA
3	M18 RED Lithium Battery	MILWAUKEE	CP2.0/XC3.0/XC4.0/XC5.0	NA
4	Android Mobile	Motorola	Moto g (6)	IMEI: 351868090555637
5	Laptop	Dell	Latitude 5420	NA

Table 4: List of Accessories used for testing

Sl. No.	Cable /Name	No of Ports	Cable Color	Cable Length (Meters)	Power / Interconnection cable	Shielded / Unshielded
1	2389716-1	01	Black	2.0	Interconnection	Shielded

Table 5: List of cables connected to EUT

5.2 DECISION RULE

- When a statement of conformity (e.g. pass/fail, in-tolerance/out-of-tolerance) is requested, the decision rule followed by Tarang labs will be either of the following,
  - Decision rule as prescribed in the appropriate standard, where measurement results are governed by legal or regulatory standards or rules.
  - Decision rules governed by a published standard
  - Decision rules prescribed by the customer

- When no statement of conformity (e.g. pass/fail, in-tolerance/out-of-tolerance) is requested, then Tarang labs will,
  - Report the measured result and the uncertainty

5.3 TEST RESULT AND TEST SETUP PHOTOS

5.3.1 RADIATED EMISSIONS TEST

5.3.1.1 TEST SPECIFICATION

Test Standard	CFR 47, FCC Part 15 sub part C (Section 15.209)			
Test Procedure	ANSI C63.10:2013			
Product / Generic Standard	NA			
Class / Group	NA			
Frequency Range	9kHz to 150 kHz	150kHz to 30 MHz	30MHz to 200 MHz, 200MHz to 1 GHz	1GHz to 18GHz, 18GHz to 26.5 GHz
Resolution Bandwidth	200Hz	9kHz	120kHz	1MHz
Video Bandwidth	500Hz	30kHz	500kHz	3MHz
Step size	100Hz	4kHz	40kHz	500kHz
Pre Scan Measurement Time	20 ms	20 ms	20 ms	5 ms
Final Measurement Time	1 second	1 second	1 second	1 second
Attenuation	10 dB	10 dB	10 dB	10 dB
Test Distance	3 meters	3 meters	3 meters	3 meters
Polarization	Horizontal and Vertical	Horizontal and Vertical	Horizontal and Vertical	Horizontal and Vertical
Detector	Peak & Quasi-peak	Peak & Quasi-peak	Peak & Quasi-peak	Peak & Average
EUT Type	Table Top			
Input Voltage	Battery operated (18VDC to 22VDC)			
Input Frequency	NA			
Temperature	23.4 ºC			
Relative Humidity	58.6 %			
Tested By	Manohara K			
Test Date	25 March 2022			

5.3.1.2 DEVIATION FROM THE STANDARD

NA

5.3.1.3 LIMITS

Maximum permissible level of Radiated Emissions at 3meters distance as per CFR 47, FCC Part 15 sub part C (Section 15.209) is as shown below:

Frequency (Hz)	Quasi-peak (dBµV/m)
0.009M to 0.490M	128.52 to 93.8
0.490M to 1.705M	73.8 to 62.97
1.705M to 30M	69.54
30M to 88M	40
88M to 216M	43.52
216M to 960M	46.02
Above 960	53.98

Frequency (Hz)	Average (dBµV/m)
1000M to 26500M	53.98

5.3.1.4 TEST SETUP

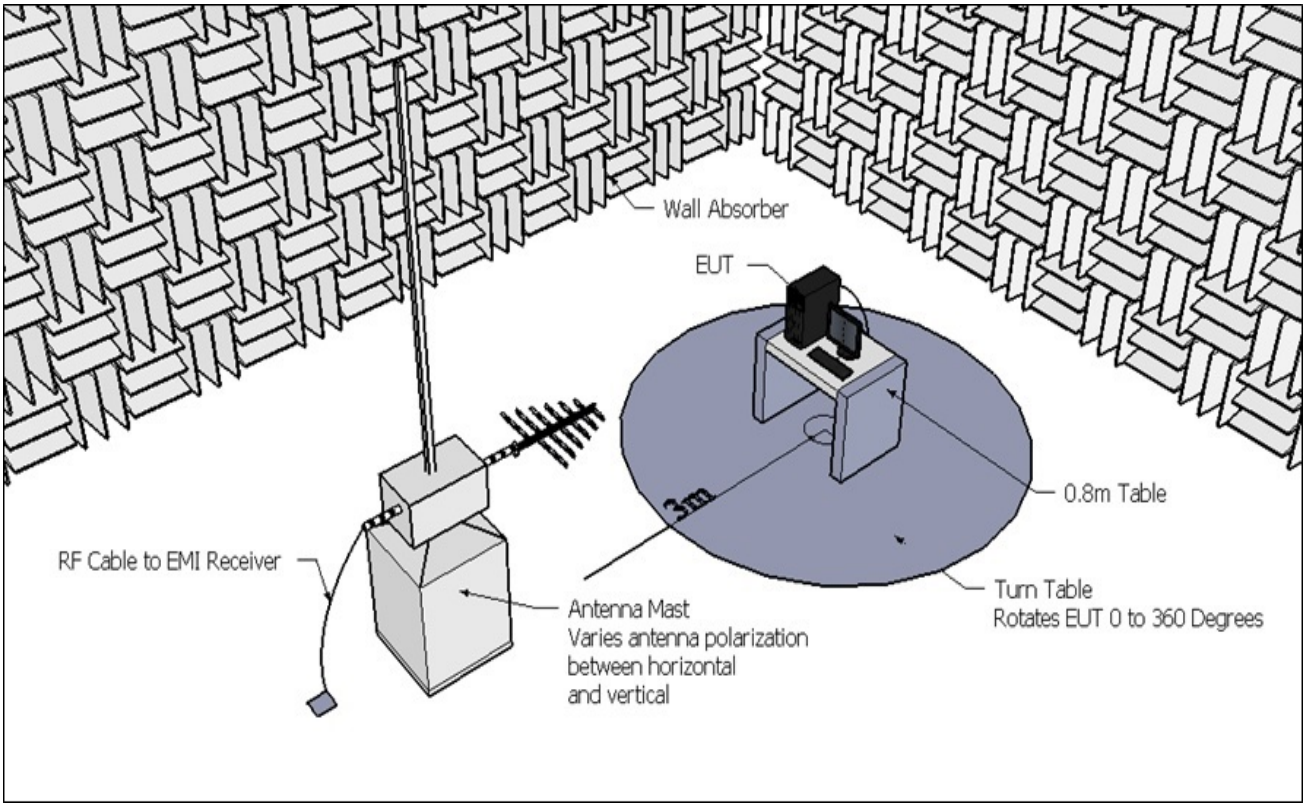


Figure 2: Sample RE test setup for table top equipment at 3metres distance from 9kHz to 1GHz

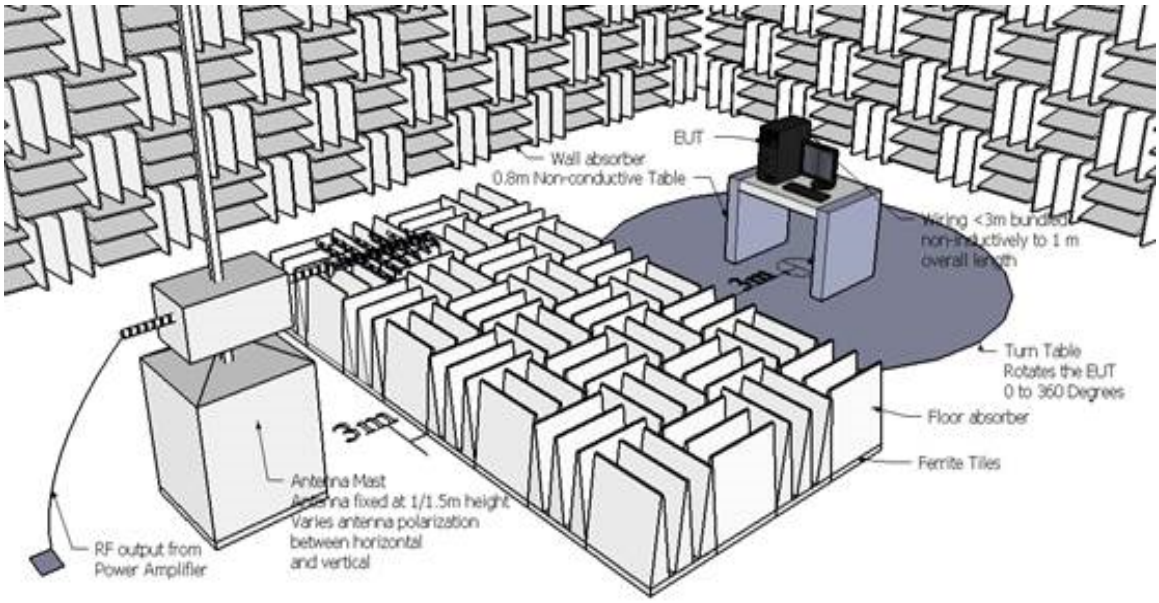


Figure 3: Sample RE test setup for table top equipment at 3metres distance from 1GHz to 26.5GHz

5.3.1.5 TEST PROCEDURE

The test procedure was in accordance with ANSI C63.10:2013.

9kHz to 30MHz

The Table Top equipment was tested in a Semi-Anechoic chamber. The EUT was placed on non-conductive table of 0.8metre height which was in turn placed on a turn table to enable 0º to 360º rotation as per standard. The distance between the edge of the EUT and receiving antenna was 3metres. The receiving antenna was mounted on tripod with a height of 1metre above the ground plane.

Pre-scan (Peak) was measured by varying the azimuth angle in 22.5º steps and antenna height of 1metre, in 3 orientations (Parallel to the ground plane, parallel to the EUT & perpendicular to the EUT). The measurement was carried out in max-hold mode and maximum amplitude of radiated emissions from the EUT was plotted in the graph. The dominant peaks at various frequencies, closer to and above the limit line were identified using peak search option and listed. Quasi-peak measurement was carried out for the listed frequencies to get the maximized readings by rotating the turntable 0 to 360 degree. The maximized reading was compared with the limit specified in the standard.

30MHz to 1GHz

The Table Top equipment was tested in a Semi-Anechoic chamber. The EUT was placed on non-conductive table of 0.8metre height which was in turn placed on a turn table to enable 0º to 360º rotation as per standard. The distance between the edge of the EUT and receiving antenna was 3metres. The receiving antenna was mounted on antenna mast to enable height variation from 1 to 4metres above the ground plane.

Pre-scan (Peak) was measured by varying the azimuth angle in 22.5º steps and antenna height from 1 to 4metres in 1metre steps, in both horizontal and vertical polarization of the antenna. The measurement was carried out in max-hold mode and maximum amplitude of radiated emissions from the EUT was plotted in the graph. The dominant

peaks at various frequencies, closer to and above the limit line were identified using peak search option and listed. Quasi-peak measurement was carried out for the listed frequencies to get the maximized readings by rotating the turntable 0 to 360 degree and varying the antenna height from 1 to 4metres. The maximized reading was compared with the limit specified in the standard.

1GHz to 26.5GHz

The Table Top equipment was tested in a Semi-Anechoic chamber. The EUT was placed on non-conductive table of 0.8m height which was in turn placed on a turn table to enable 0º to 360º rotation as per standard. The distance between the edge of the EUT and receiving antenna was 3metres. The receiving antenna was mounted on antenna mast to enable height variation from 1 to 2metres above the ground plane.

Pre-scan (Peak & Average) was measured by varying the azimuth angle in 15º steps and antenna height fixed at 1metre, in both horizontal and vertical polarization of the antenna. The measurement was carried out in max-hold mode and maximum amplitude of radiated emissions from the EUT was plotted in the graph. The dominant peaks at various frequencies, closer to and above the limit line were identified using peak search option and listed. Peak and Average measurement was carried out for the listed frequencies to get the maximized readings by rotating the turntable 0 to 360 degree and varying the antenna height from 1metre to 2metres. The maximized reading was compared with the limit specified in the standard.

Formula used for calculating Peak, QP and Avg EMI and Margin are as listed below;

- *QP EMI (dBµV/m) = QP Trace (dBµV) + Cable (dB) + Transducer (dB/m) – Preamp (dB)*
- *QP Margin (dB) = QP EMI (dBµV/m) – QP Limit (dBµV/m)*

- *PEAK EMI (dBµV/m) = PEAK Trace (dBµV) + Cable (dB) + Transducer (dB/m) – Preamp (dB)*
- *PEAK Margin (dB) = PEAK EMI (dBµV/m) – PEAK Limit (dBµV/m)*

- *AVG EMI (dBµV/m) = AVG Trace (dBµV) + Cable (dB) + Transducer (dB/m) – Preamp (dB)*
- *AVG Margin (dB) = AVG EMI (dBµV/m) – AVG Limit (dBµV/m)*

5.3.1.6 MEASUREMENT DATA

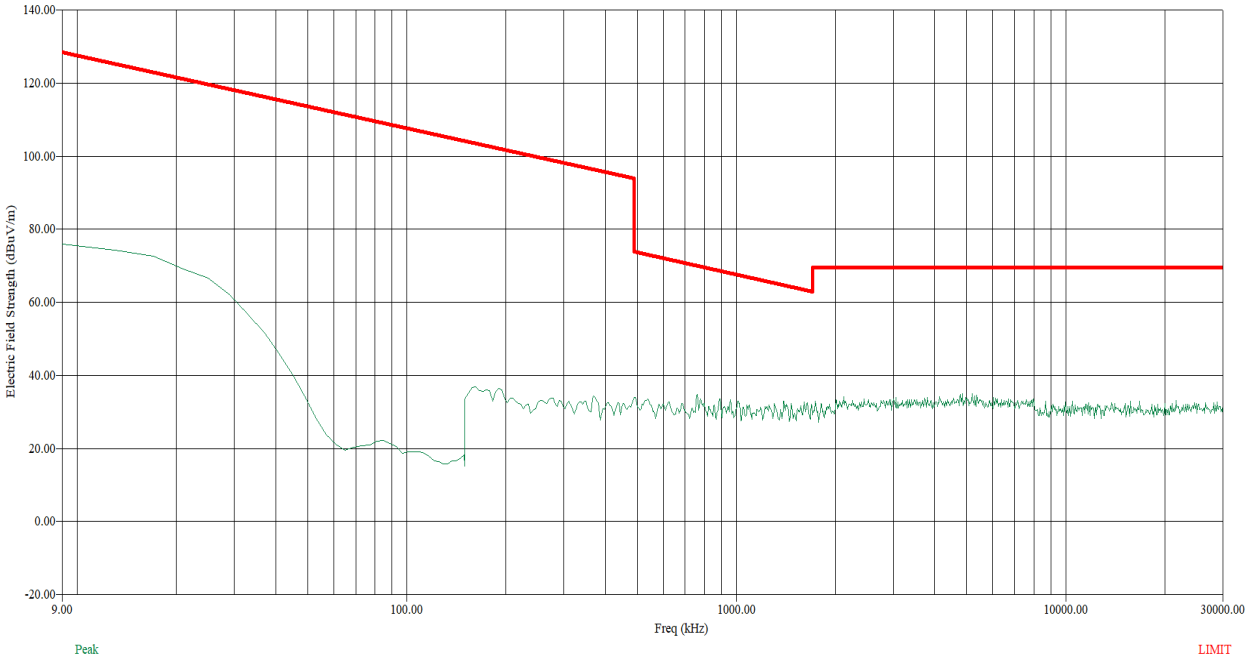


Figure 4: RE graph using Peak detector from 9kHz to 30MHz_Parallel to EUT

Freq (MHz)	Freq (Max) (MHz)	EUT Ttbl Agl (deg)	(QP) Trace (dBuV)	Cable (dB)	Transducer (dB/m)	(QP) EMI (dBuV/m)	Limit (dBuV/m)	(QP) Margin (dB)
0.009	0.009	61.60	-3.13	0.32	18.27	15.45	128.48	-113.03
0.162	0.170	95.20	8.28	0.26	19.90	28.44	102.99	-74.56
4.850	4.854	219.50	1.96	-0.03	19.92	21.84	69.54	-47.70
5.202	5.202	159.10	2.06	-0.04	19.92	21.94	69.54	-47.60

Table 6: RE Quasi-peak measurement table from 9kHz to 30MHz_Parallel to EUT

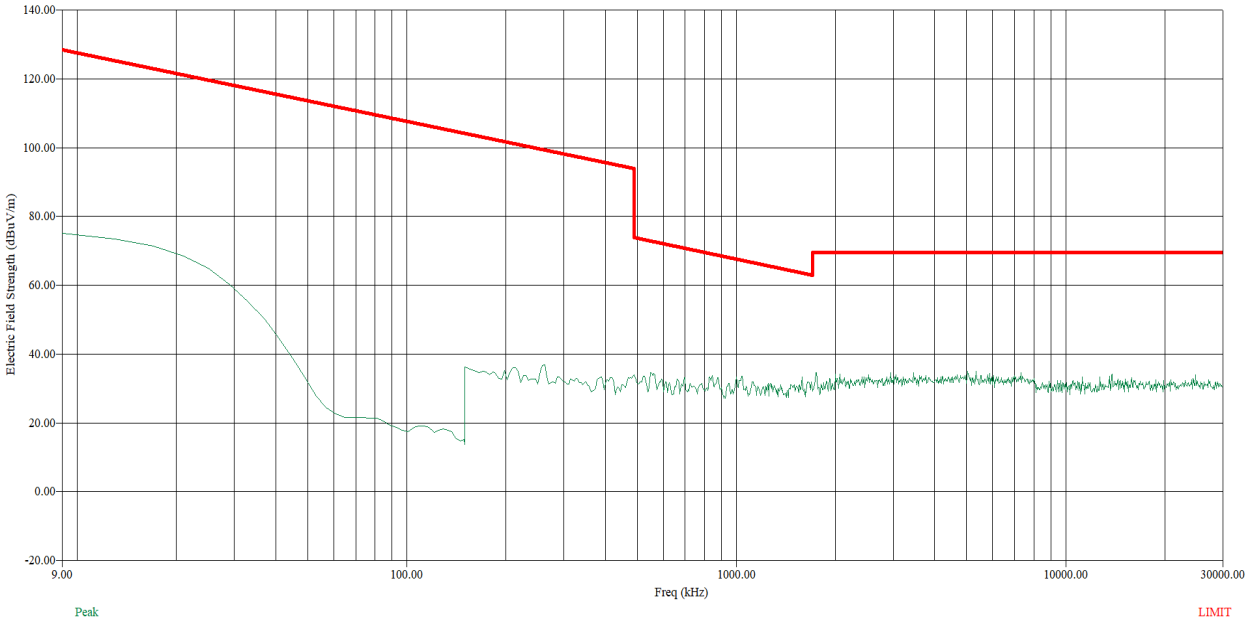


Figure 5: RE graph using Peak detector from 9kHz to 30MHz_Parallel to Ground

Freq (MHz)	Freq (Max) (MHz)	EUT Ttbl Agl (deg)	(QP) Trace (dBuV)	Cable (dB)	Transducer (dB/m)	(QP) EMI (dBuV/m)	Limit (dBuV/m)	(QP) Margin (dB)
0.009	0.009	179.90	-3.02	0.30	18.25	15.53	128.28	-112.74
0.262	0.246	56.00	7.76	0.25	19.88	27.88	99.77	-71.89
5.034	5.035	37.60	2.05	-0.04	19.92	21.93	69.54	-47.61
7.302	7.305	350.40	2.55	-0.06	19.93	22.42	69.54	-47.12

Table 7: RE Quasi-peak measurement table from 9kHz to 30MHz_Parallel to Ground

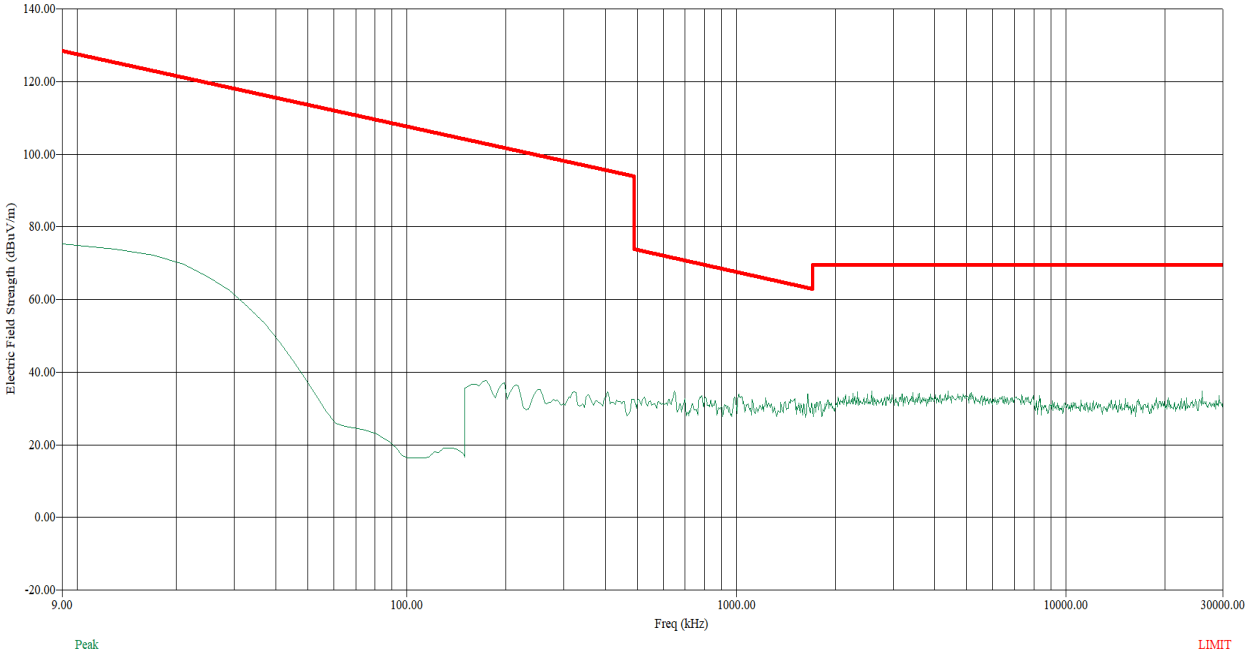


Figure 6: RE graph using Peak detector from 9kHz to 30MHz_Perpendicular to EUT

Freq (MHz)	Freq (Max) (MHz)	EUT Ttbl Agl (deg)	(QP) Trace (dBuV)	Cable (dB)	Transducer (dB/m)	(QP) EMI (dBuV/m)	Limit (dBuV/m)	(QP) Margin (dB)
0.009	0.009	114.00	-3.44	0.30	18.26	15.12	128.29	-113.18
0.174	0.177	218.40	8.38	0.28	19.90	28.56	102.65	-74.09
2.574	2.578	354.50	2.79	0.13	19.88	22.79	69.54	-46.75
25.986	25.974	278.60	0.82	0.44	19.73	20.99	69.54	-48.55

Table 8: RE Quasi-peak measurement table from 9kHz to 30MHz Perpendicular to EUT

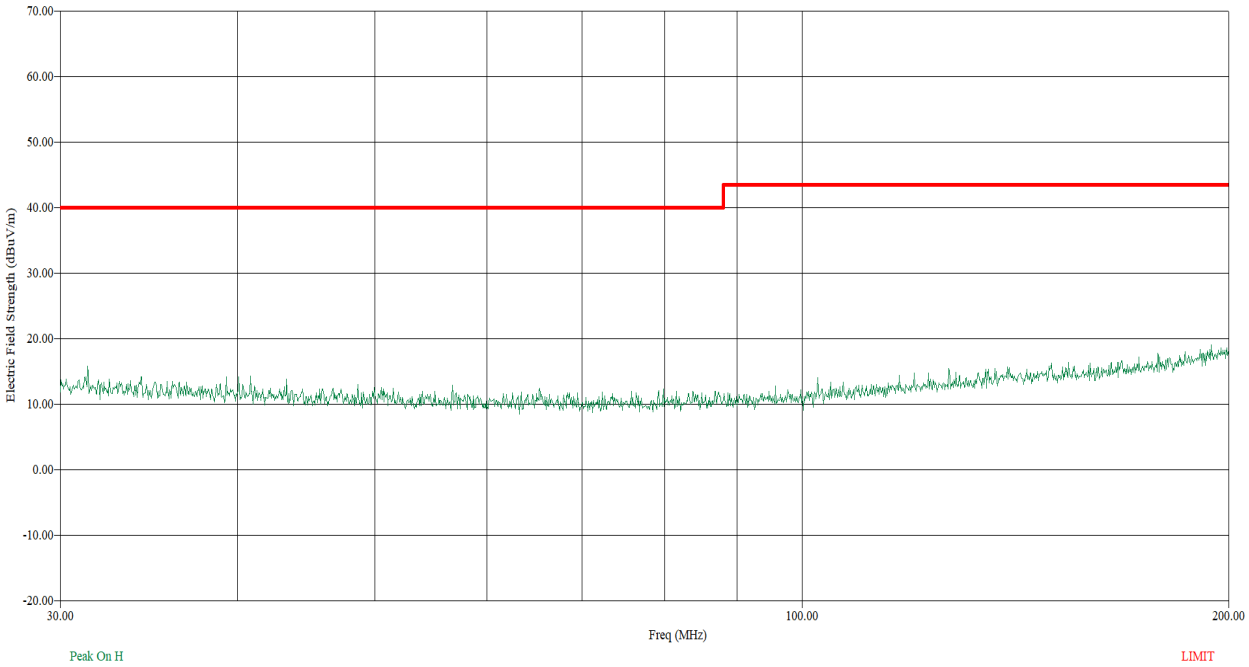


Figure 7: RE graph using Peak detector on Horizontal polarization from 30MHz to 200MHz

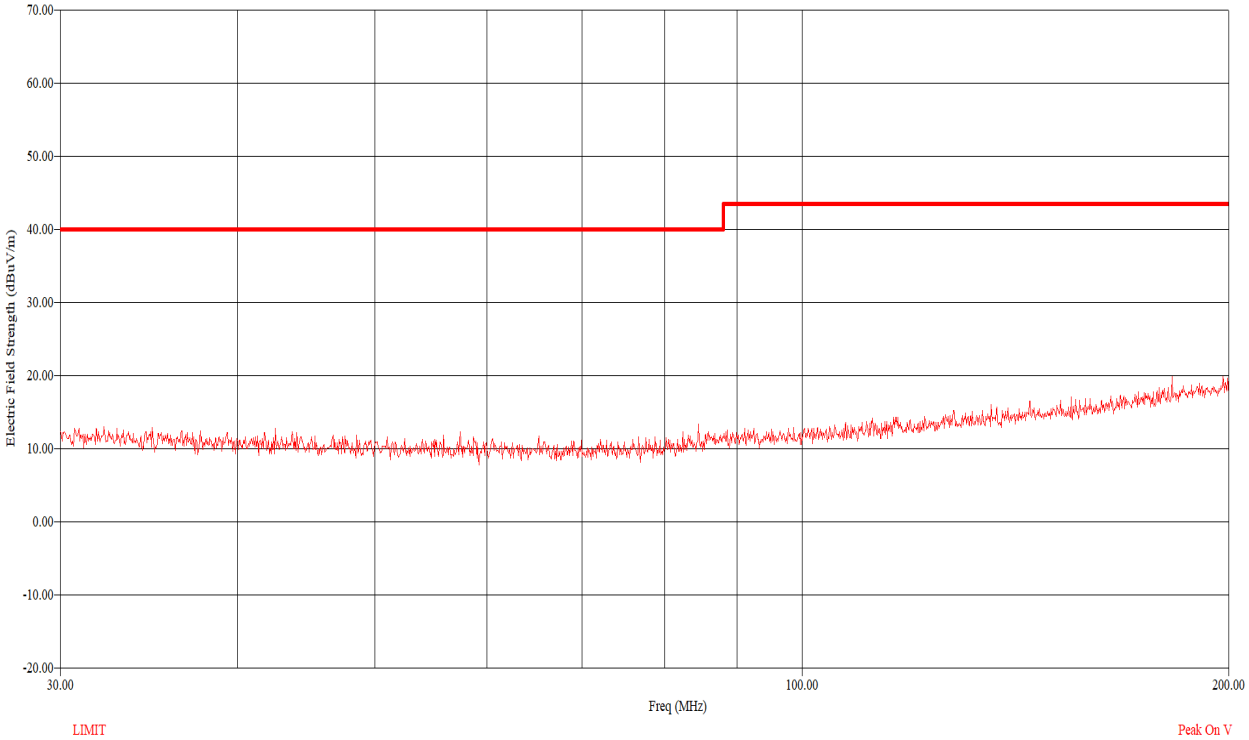


Figure 8: RE graph using Peak detector on Vertical polarization from 30MHz to 200MHz

Freq (MHz)	Freq (Max) (MHz)	Pol	EUT Ttbl Agl (deg)	Twr Ht (cm)	(QP) Trace (dBuV)	Cable (dB)	Transducer (dB/m)	Preamp (dB)	(QP) EMI (dBuV/m)	Limit (dBuV/m)	(QP) Margin (dB)
31.36	31.30	H	319.50	169.10	31.53	1.59	20.03	43.55	9.60	40.00	-30.40
135.96	135.91	V	17.50	106.50	31.61	4.33	17.99	43.46	10.48	43.52	-33.04
154.12	154.02	H	117.00	194.90	31.59	4.55	18.01	43.45	10.70	43.52	-32.82
154.80	154.83	V	331.50	386.60	31.54	4.56	18.73	43.45	11.37	43.52	-32.15
178.28	178.28	H	108.60	120.40	31.47	4.80	19.11	43.44	11.94	43.52	-31.58
182.36	182.22	V	103.90	242.30	31.53	4.84	20.53	43.44	13.46	43.52	-30.06

Table 9: RE Quasi-peak measurement table from 30MHz to 200MHz

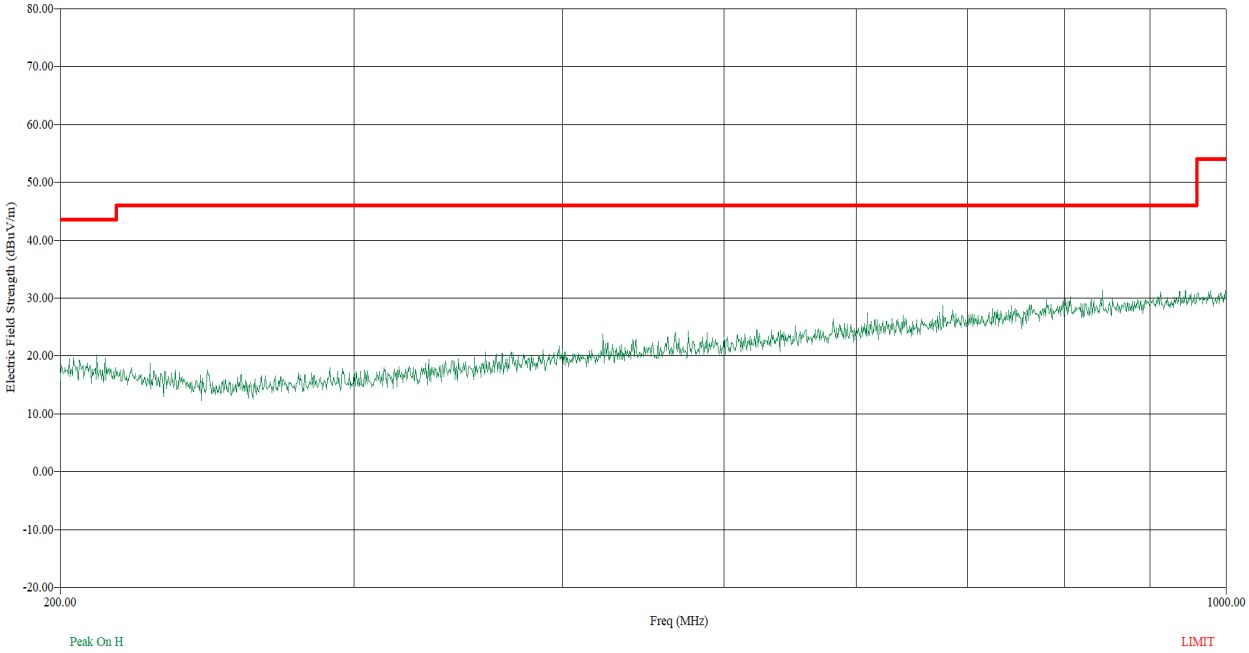


Figure 9: RE graph using Peak detector on Horizontal polarization from 200MHz to 1GHz

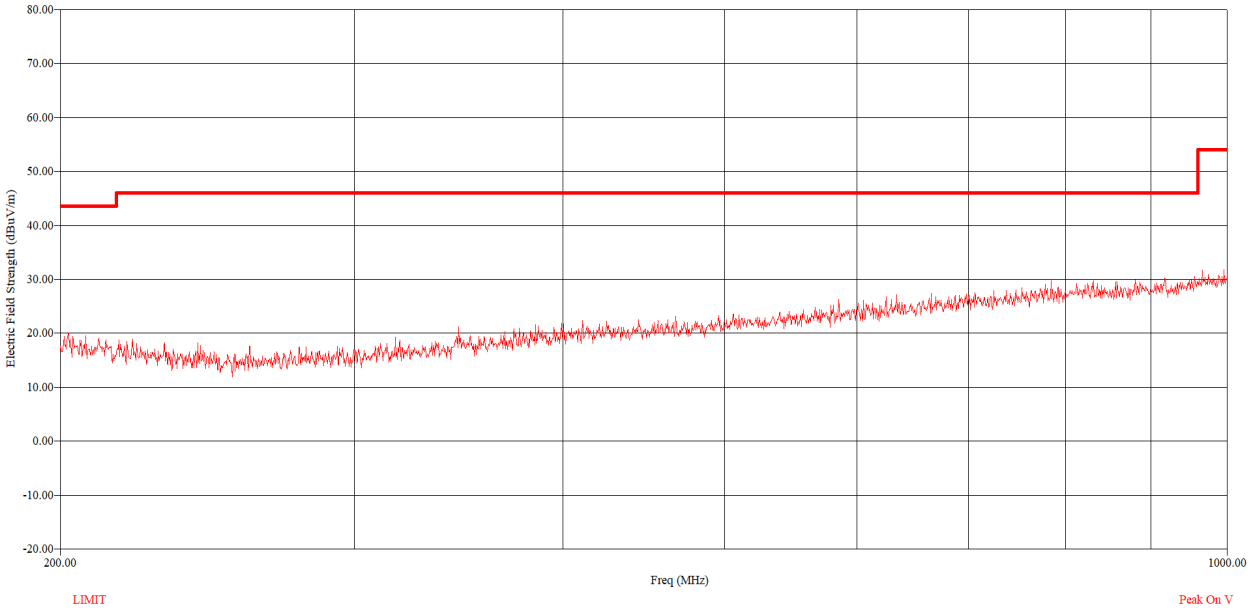


Figure 10: RE graph using Peak detector on Vertical polarization from 200MHz to 1GHz

Freq (MHz)	Freq (Max) (MHz)	Pol	Ttbl Agl (deg)	Twr Ht (cm)	(QP) Trace (dBuV)	Cable (dB)	Transducer (dB/m)	Preamp (dB)	(QP) EMI (dBuV/m)	Limit (dBuV/m)	(QP) Margin (dB)
202.28	202.16	V	-9.90	122.70	31.53	5.02	23.10	43.44	16.21	43.52	-27.31
210.36	210.44	H	-169.20	244.10	34.58	5.11	22.17	43.45	18.41	43.52	-25.11
467.16	467.20	H	-151.70	194.40	30.87	7.29	23.64	43.19	18.61	46.02	-27.41
676.28	676.22	H	-67.50	121.10	30.14	8.59	26.62	42.43	22.93	46.02	-23.09
881.04	881.08	V	-134.80	384.80	30.16	9.71	27.72	42.76	24.83	46.02	-21.19
966.80	966.80	V	-76.70	359.10	30.13	10.21	28.78	42.66	26.46	53.98	-27.52

Table 10: RE Quasi-peak measurement table from 200MHz to 1GHz

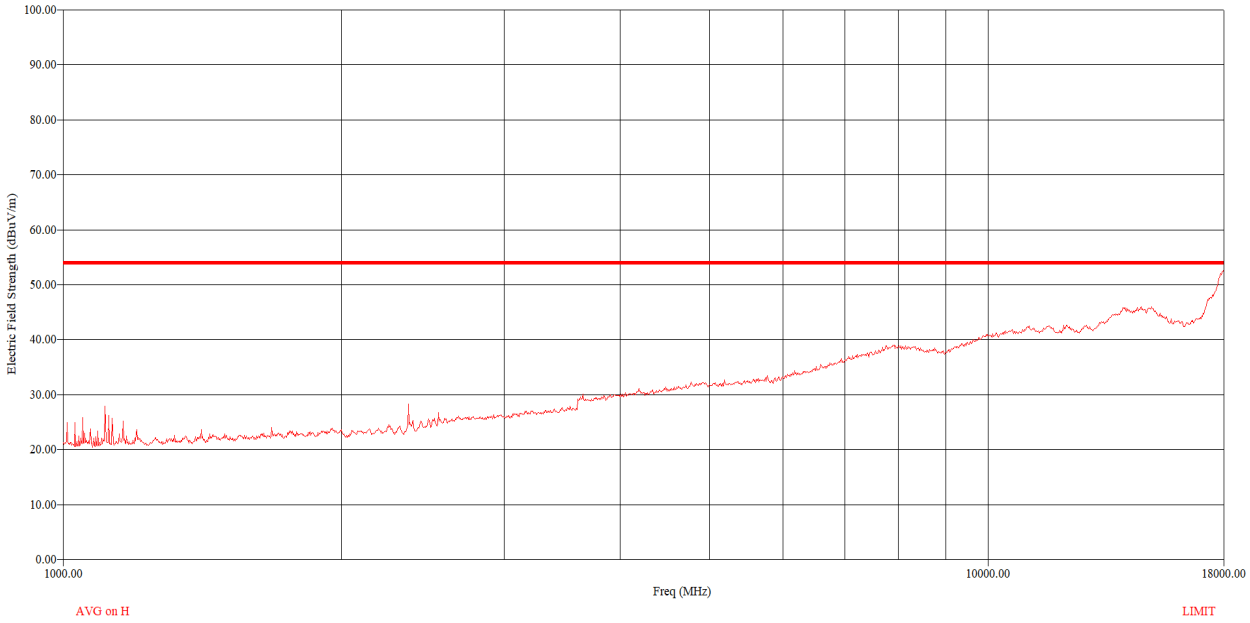


Figure 11: RE graph using Average detector on Horizontal polarization from 1GHz to 18GHz

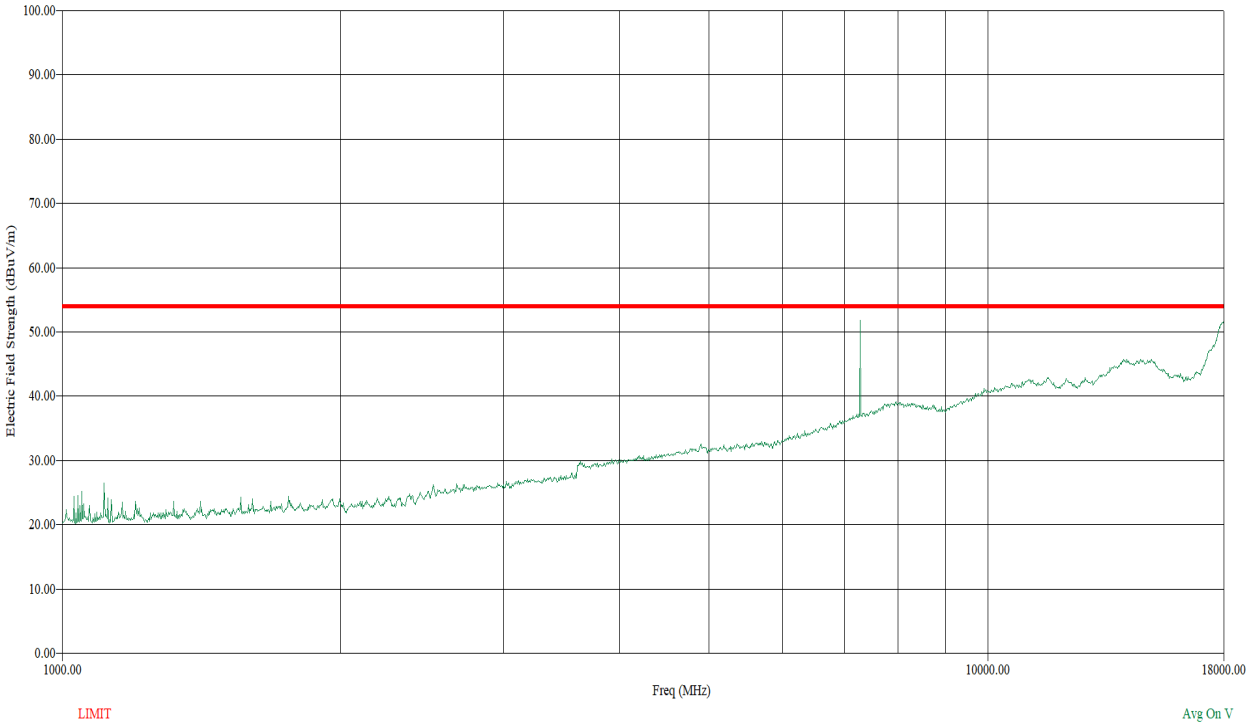


Figure 12: RE graph using Average detector on Vertical polarization from 1GHz to 18GHz

Freq (MHz)	Freq (Max) (MHz)	Pol	Ttbl Agl (deg)	Twr Ht (cm)	(AVG) Trace (dBuV)	Cable (dB)	Transducer (dB/m)	Preamp (dB)	(AVG) EMI (dBuV/m)	(AVG) Limit (dBuV/m)	(AVG) Margin (dB)
7277.20	6717.96	V	77.90	156.90	32.33	5.45	34.94	42.66	30.07	53.98	-56.25
14559.20	13914.95	H	166.10	177.00	30.49	8.37	41.39	42.32	37.93	53.98	-46.54
14930.00	15182.23	V	70.60	178.90	30.22	8.10	40.36	42.30	36.38	53.98	-47.82
1049.00	1010.80	H	-54.90	105.40	37.18	1.97	24.63	43.18	20.61	54.00	-33.39
1110.00	1110.35	H	94.30	116.70	41.22	2.08	24.87	43.13	25.03	54.00	-28.97
1110.00	1109.64	V	11.60	107.20	38.88	2.08	24.65	43.13	22.47	54.00	-31.53
7277.20	6624.21	V	-142.90	194.90	32.08	5.41	34.68	42.65	29.53	54.00	-24.47
14559.20	14374.44	H	-121.90	114.80	29.59	8.26	41.41	42.31	36.96	54.00	-17.04
14930.00	14993.72	V	-91.50	190.20	29.49	8.00	40.99	42.35	36.13	54.00	-17.87

Table 11: RE Average measurement table from 1GHz to 18GHz

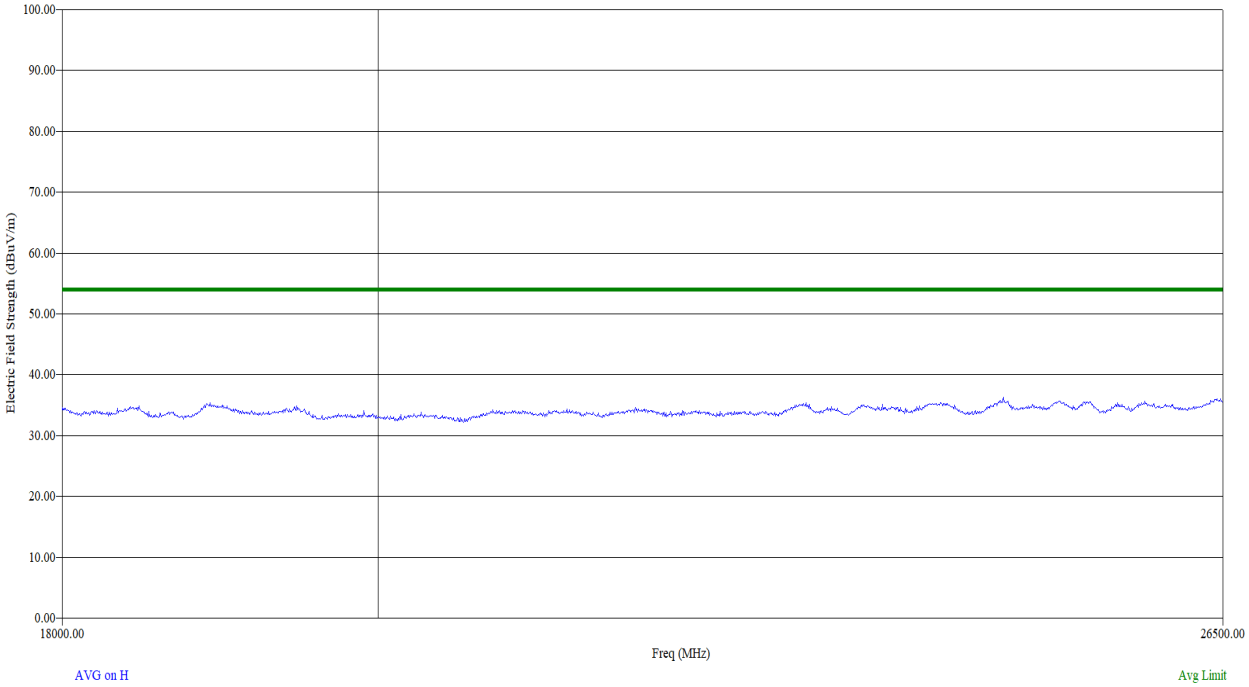


Figure 13: RE graph using Average detector on Horizontal polarization from 18GHz to 26.5GHz

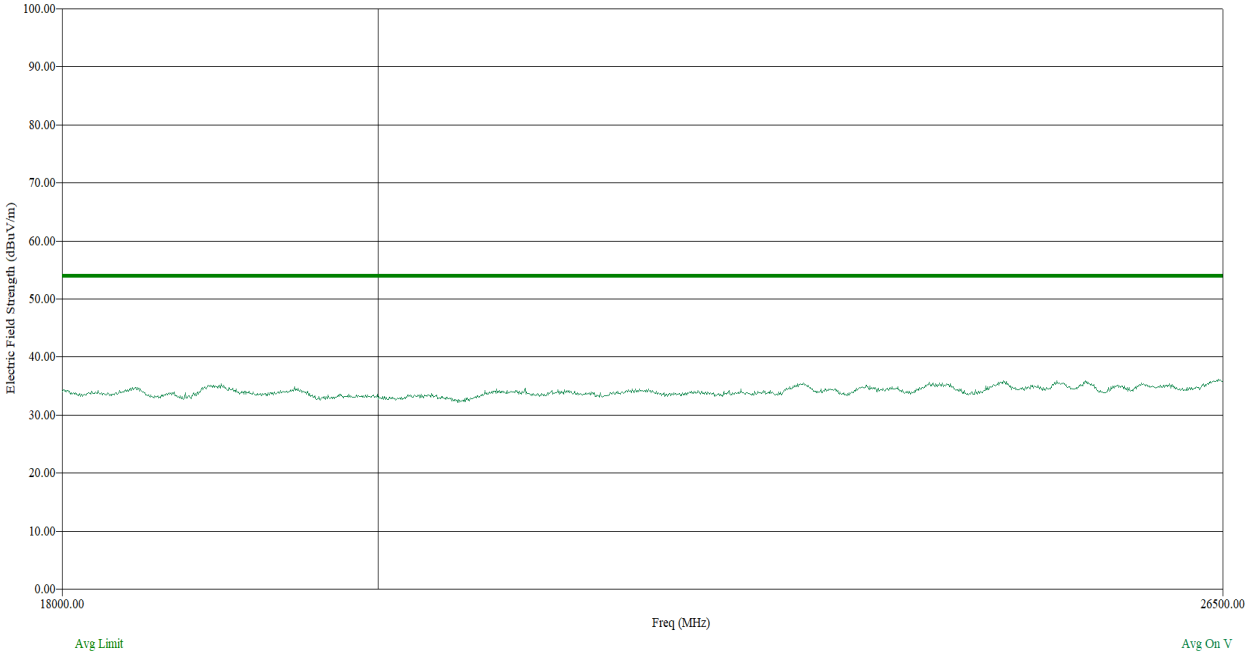


Figure 14: RE graph using Average detector on Vertical polarization from 18GHz to 26.5GHz

Freq (MHz)	Freq (Max) (MHz)	Pol	EUT Ttbl Agl (deg)	Ttbl Agl (deg)	(AVG) Trace (dBuV)	Cable (dB)	Transducer (dB/m)	Preamp (dB)	(AVG) EMI (dBuV/m)	(AVG) Limit (dBuV/m)	(AVG) Margin (dB)
18923.10	18923.10	V	119.90	119.90	34.21	9.89	37.82	47.57	34.35	53.98	-19.63
19632.50	19632.50	H	77.70	77.70	32.57	9.57	37.76	46.80	33.10	53.98	-20.88
21177.40	21177.40	H	177.40	177.40	31.55	9.78	37.96	45.50	33.79	53.98	-20.19
23034.30	23034.30	V	177.10	177.10	32.62	10.16	38.82	47.09	34.51	53.98	-19.47
23543.60	23543.60	H	60.70	60.70	33.60	10.42	38.88	47.61	35.29	53.98	-18.69
24666.70	24666.70	V	50.30	50.30	32.80	10.74	39.14	47.20	35.48	53.98	-18.50

Table 12: RE Average measurement table from 18GHz to 26.5GHz

5.3.1.7 RESULT

Radiated Emissions from the EUT as per CFR 47, FCC Part 15 sub part C (using ANSI C63.10:2013), Section 15.209) limit: PASS.

Decision Rule Followed: Decision rule as prescribed in the appropriate standard, where measurement results are governed by legal or regulatory standards or rules.

5.3.2 CONDUCTED RF OUTPUT POWER

5.3.2.1 TEST SPECIFICATION

Test Standard	CFR 47, FCC Part 15 sub part C (Section 15.247 b.3)
Test Procedure	ANSI C63.10:2013
Product / Generic Standard	NA
Frequency Range	2400 to 2483.5MHz
Operating Frequency	2402MHz, 2442MHz, 2480MHz
Resolution Bandwidth	3MHz
Video Bandwidth	8MHz
Span	10MHz
Sweep time	1 ms
Detector	Peak
External Attenuation	10dB
Temperature	22.6°C
Humidity	53.0%
Tested By	Magesh S
Test Date	1 April 2022

5.3.2.2 LIMITS

According to CFR 47, FCC Part 15 sub part C (Section 15.247 b.3) requirement. For digital modulation in the 2400 to 2483.5MHz band: The maximum conducted output power shall be less than 1Watt.

5.3.2.3 TEST SETUP

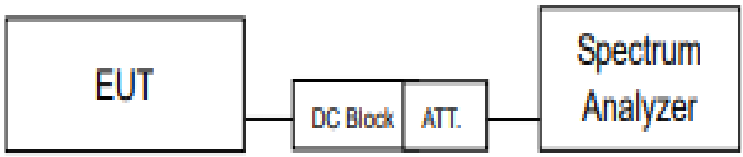


Figure 15: Typical test setup for Conducted RF Test

5.3.2.4 TEST PROCEDURE

The Conducted RF Output Power test was performed according to using the Spectrum Analyzer. Measurement was done as per CFR 47, FCC Part 15 sub part C (Section 15.247 b.3)/ANSI C63.10-2013. The Conducted RF Output Power test was performed for low, mid & high channel with normal temperature with the data rate of 1Mbps.

Configure the EUT to its maximum output power level and connect the power measuring head to the RF output port of EUT, read the value and then add the loss calculated above to calculate the true level of power.

Measure the power of modulated transmission burst and record all measurements and observations.

5.3.2.5 MEASUREMENT DATA

Channel	Frequency	Conducted RF Output Power		Limit	Margin	Result
	Hz	dBm	mW	dBm	dB	
1	2402M	-5.271	0.297	30	-35.271	PASS
21	2442M	-7.106	0.194	30	-37.106	PASS
40	2480M	-7.612	0.173	30	-37.612	PASS

Table 13: Conducted RF Output Power

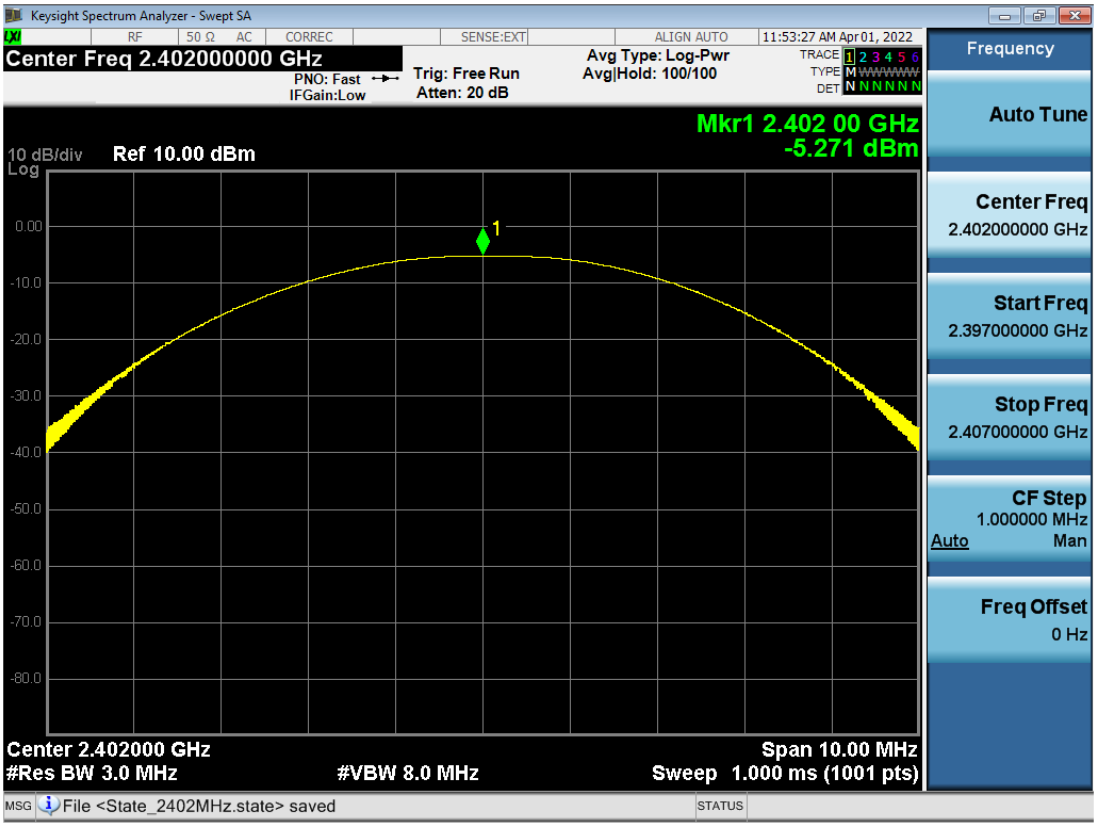


Figure 16: Conducted RF Output Power_2402MHz (Low channel)

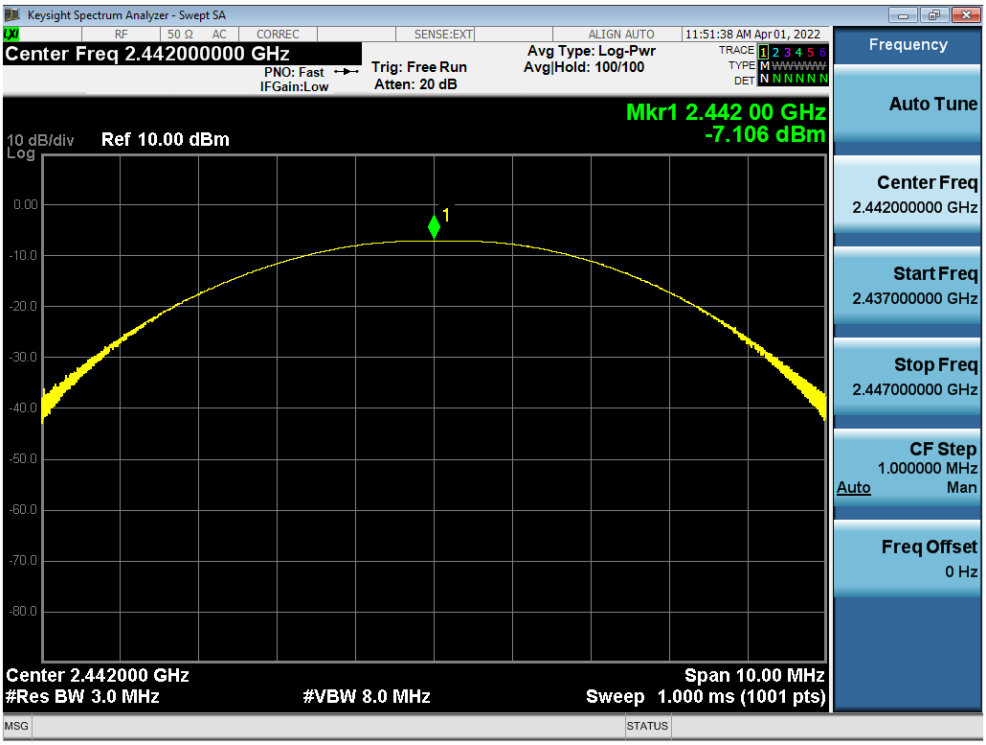


Figure 17: Conducted RF Output Power_2442MHz (Mid channel)

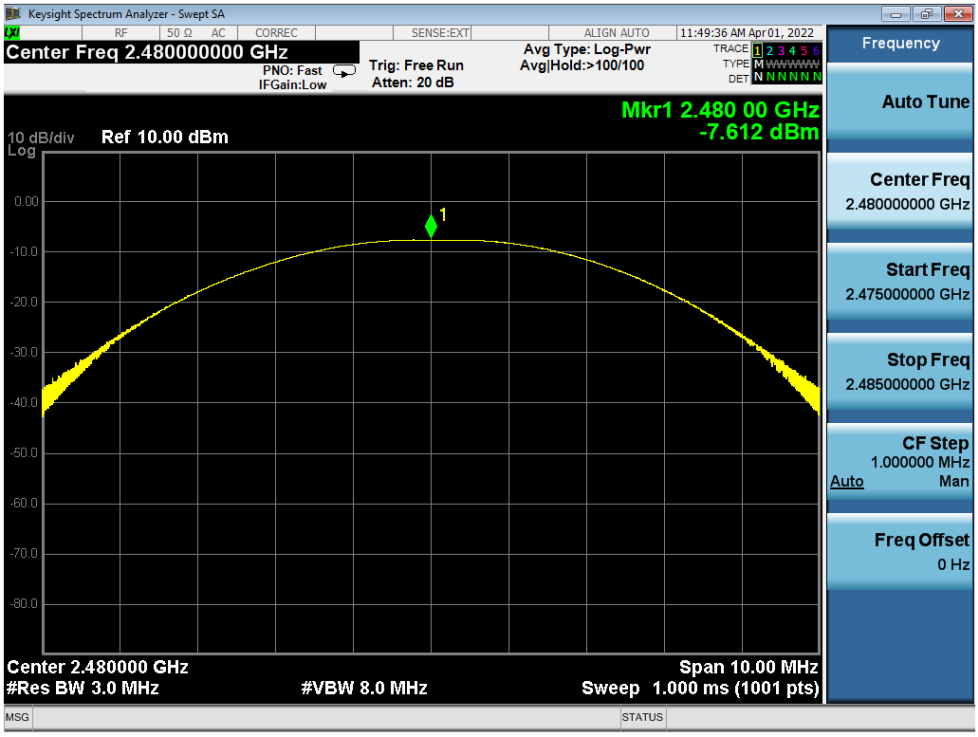


Figure 18: Conducted RF Output Power_2480MHz (High channel)

5.3.2.6 RESULT

The RF conducted output power is **within the specified limit** as per CFR 47, FCC Part 15 sub part C standard, Section 15.247 b.3.

Decision Rule Followed: Decision rule as prescribed in the appropriate standard, where measurement results are governed by legal or regulatory standards or rules.

5.3.3 6DB BANDWIDTH

5.3.3.1 TEST SPECIFICATION

Test Standard	CFR 47, FCC Part 15 sub part C (Section 15.247a.2)
Test Setup	ANSI C63.10:2013
Product / Generic Standard	NA
Frequency Range	2400 to 2483.5MHz
Operating Frequency	2402MHz, 2442MHz, 2480MHz
Resolution Bandwidth	100kHz
Video Bandwidth	300kHz
Span	10MHz
Sweep time	1 ms
Detector	Peak
External Attenuation	10dB
Temp	23.9 ºC
Humidity	56.0 %
Tested By	Magesh. S
Test Date	26 September 2022

5.3.3.2 LIMITS

According to CFR 47, FCC Part 15 sub part C (Section 15.247a.2) requirement: 6dB bandwidth was measured at Low, Mid, High channels and minimum 6 dB bandwidth shall be at least 500 kHz.

5.3.3.3 TEST SETUP

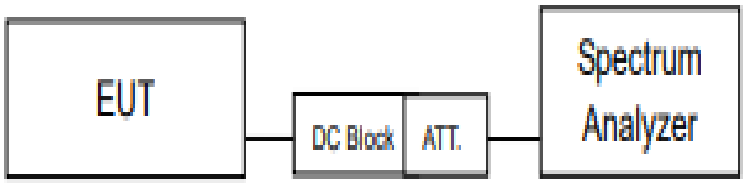


Figure 19: Typical test setup for 6dB Bandwidth

5.3.3.4 TEST PROCEDURE

The 6dB Bandwidth test was performed using the spectrum analyzer. Measurement was done as per the CFR 47, FCC Part 15 sub part C (Section 15.247a.2)/ANSI C63.10:2013. The RF output of the EUT was connected to the input port of the Spectrum Analyzer.

The 6dB Bandwidth was performed with nominal ambient temperature with the data rate of 1Mbps.

Note: *Considered cable loss and attenuator loss as correction factors in the test results.*

5.3.3.5 MEASUREMENT DATA

Frequency (Hz)	Measured 6dB Bandwidth (Hz)	Limit (Hz)	Results
2402M	735.7k	>500k	PASS
2442M	771.6k	>500k	PASS
2480M	727.6k	>500k	PASS

Table 14: 6dBBandwidth measurement readings

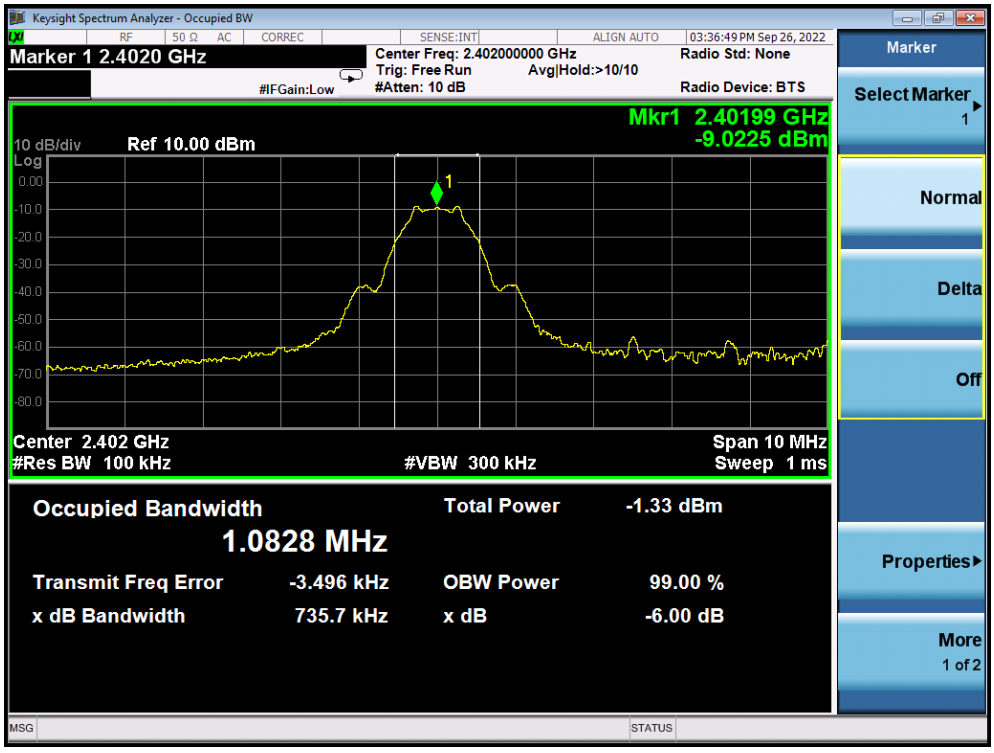


Figure 20: 6dB Bandwidth_2402MHz (Low channel)

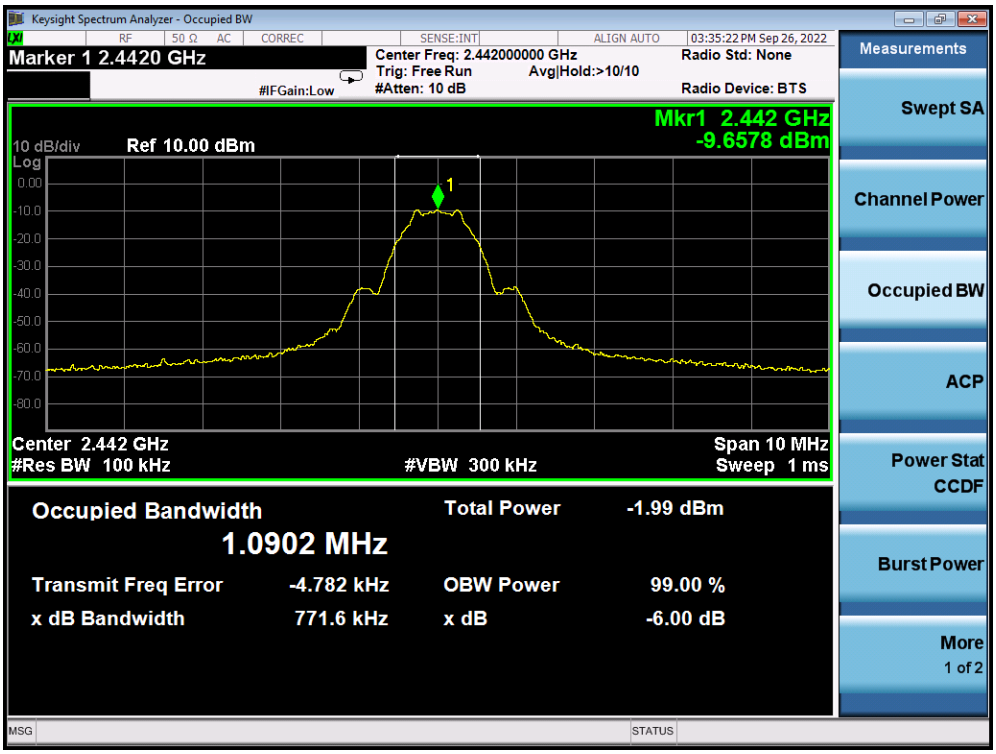


Figure 21: 6dB Bandwidth_2442MHz (Mid channel)

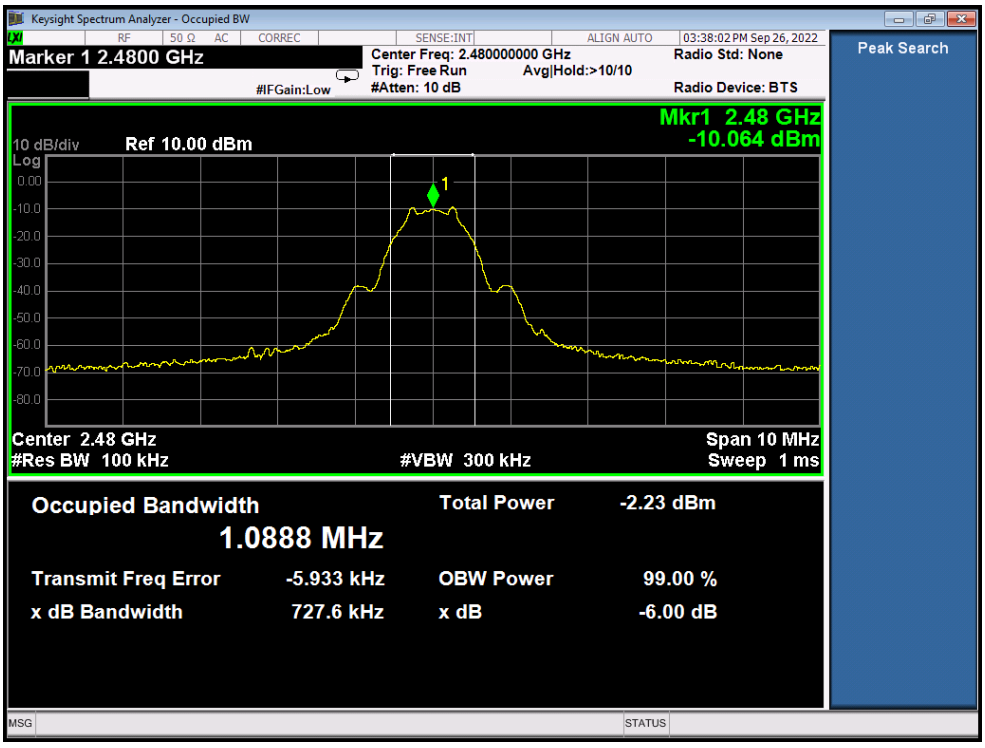


Figure 22: 6dB Bandwidth_2480MHz (High channel)

5.3.3.6 RESULT

The 6dB Bandwidth measurement is **within the specified limit** as per CFR 47, FCC Part 15 sub part C standard, Section 15.247 a.2.

Decision Rule Followed: Decision rule as prescribed in the appropriate standard, where measurement results are governed by legal or regulatory standards or rules.

5.3.4 POWER SPECTRAL DENSITY

5.3.4.1 TEST SPECIFICATION

Test Standard	CFR 47, FCC Part 15 sub part C (Section 15.247e)
Test Setup	ANSI C63.10:2013
Product / Generic Standard	NA
Frequency Range	2400 to 2483.5MHz
Resolution Bandwidth	100kHz
Video Bandwidth	300kHz
Span	2MHz
Sweep time	1ms
Detector	Peak
External Attenuation	10dB
Temp	23.9ºC
Humidity	56.0 %
Tested By	Magesh. S
Test Date	26 September 2022

5.3.4.2 LIMITS

According to CFR 47, FCC Part 15 sub part C (Section 15.247e) requirement: For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. .

5.3.4.3 TEST SETUP

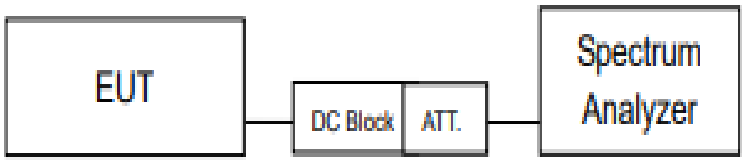


Figure 23: Typical test setup for Power Spectral Density

5.3.4.4 TEST PROCEDURE

The Power Spectral Density test was performed using the spectrum analyzer. Measurement was done as per the CFR 47, FCC Part 15 sub part C (Section 15.247e)/ANSI C63.10:2013. The RF output of the EUT was connected to the input port of the Spectrum Analyzer.

The Power Spectral Density test was performed with nominal ambient temperature with the data rate of 1Mbps.

Note: *Considered cable loss and attenuator loss as correction factors in the test results.*

5.3.4.5 MEASUREMENT DATA

Frequency (Hz)	PSD (dBm)	Limit (dBm/3kHz)	RESULT
2402M	-9.1031	8	PASS
2442M	-10.186	8	PASS
2480M	-10.125	8	PASS

Table 15: Number of hopping channels readings

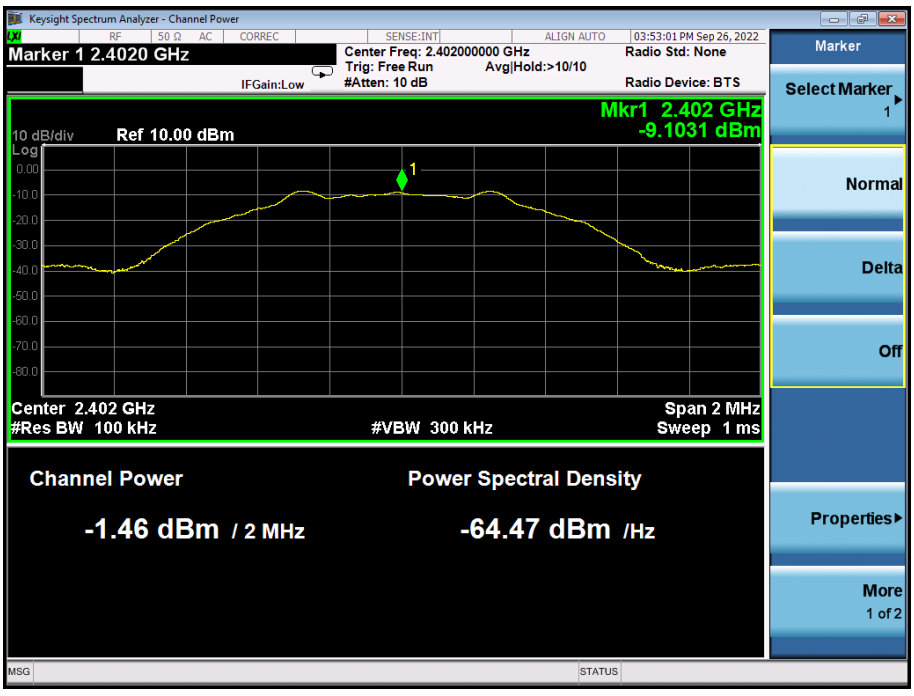


Figure 24: Power Spectral Density test_ Low channel

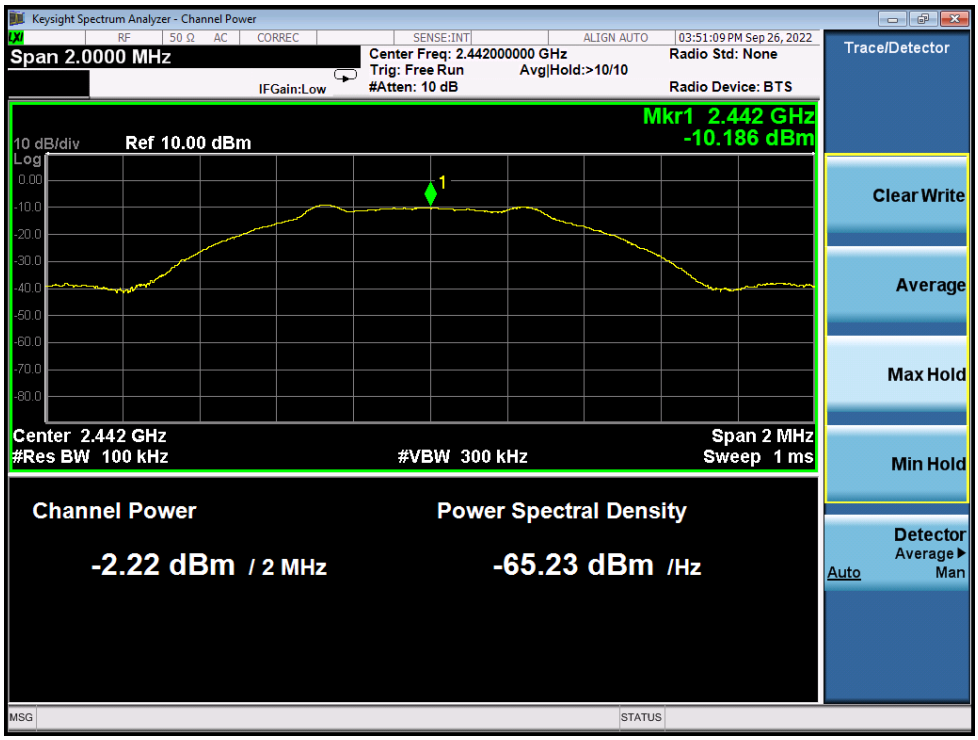


Figure 25: Power Spectral Density test_ mid channel

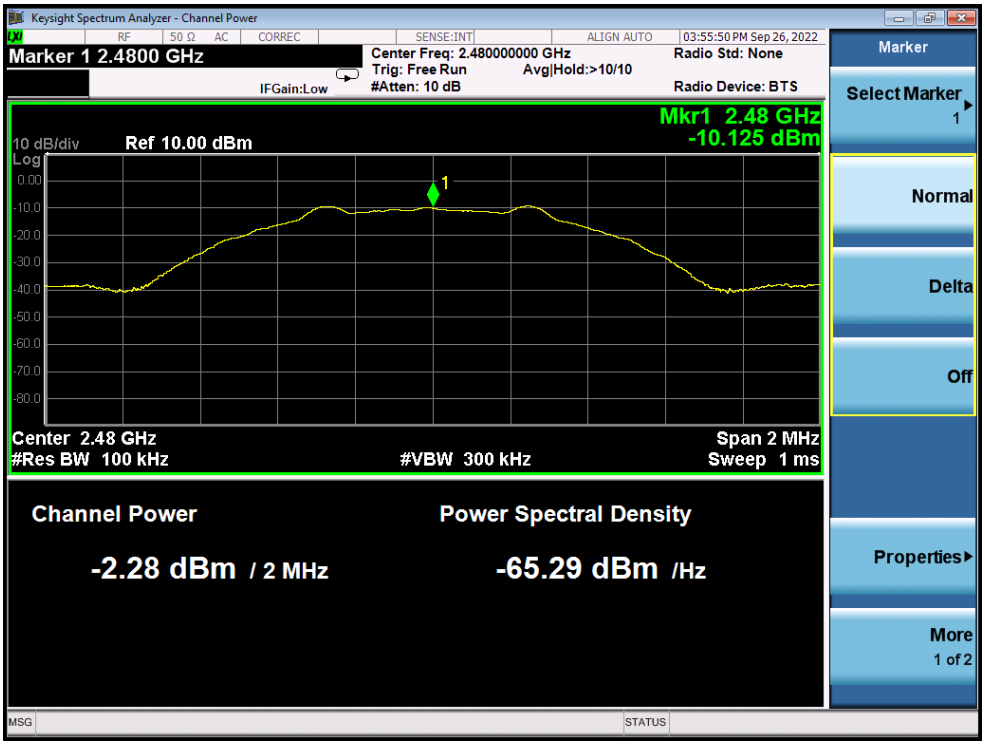


Figure 26: Power Spectral Density test_ high channel

5.3.4.6 RESULT

The Power Spectral Density test **met** the specified limit as per CFR 47, FCC Part 15 sub part C (Section 15.247e).

Decision Rule Followed: Decision rule as prescribed in the appropriate standard, where measurement results are governed by legal or regulatory standards or rules.

5.3.5 EMISSIONS ON THE BAND EDGE

5.3.5.1 TEST SPECIFICATION

Test Standard	CFR 47, FCC Part 15 sub part C (Section 15.247d)
Test Setup	ANSI C63.10:2013
Product / Generic Standard	NA
Frequency Range	2400 to 2483.5MHz
Operating Frequency	2402MHz, 2480MHz
Resolution Bandwidth	100kHz
Video Bandwidth	300kHz
Span	10MHz
Sweep time	10ms
Detector	Peak
External Attenuation	10dB
Temp	22.6 ºC
Humidity	53.0 %
Tested By	Gopala Krishna M R
Test Date	1 April 2022

5.3.5.2 LIMITS

According to CFR 47, FCC Part 15 sub part C (Section 15.247d) requirement: the peak output power measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 20 dBc).

5.3.5.3 TEST SETUP

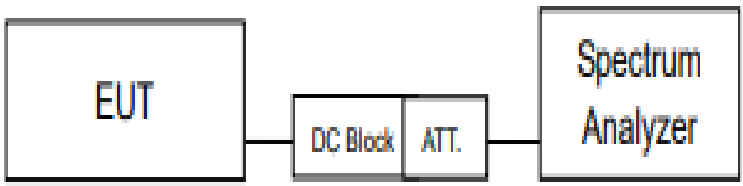


Figure 27: Typical test setup for Emission on Band Edge

5.3.5.4 TEST PROCEDURE

The Emission on the Band Edge test was performed using the spectrum analyzer. Measurement was done as per the CFR 47, FCC Part 15 sub part C (Section 15.247d)/ANSI C63.10:2013. The RF output of the EUT was connected to the input port of the Spectrum Analyzer.

The Emission on the Band edge test was performed with nominal ambient temperature with the data rate of 1Mbps.

Note: *Considered cable loss and attenuator loss as correction factors in the test results.*

5.3.5.5 MEASUREMENT DATA

Frequency (Hz)	Limit	RESULT
2400 to 2483.5M	20dBc	PASS

Table 16: Emission on the Band Edge (Low Channel)) readings

Frequency (Hz)	Limit	RESULT
2400 to 2483.5M	20dBc	PASS

Table 17: Emission on the Band Edge (High Channel)) readings

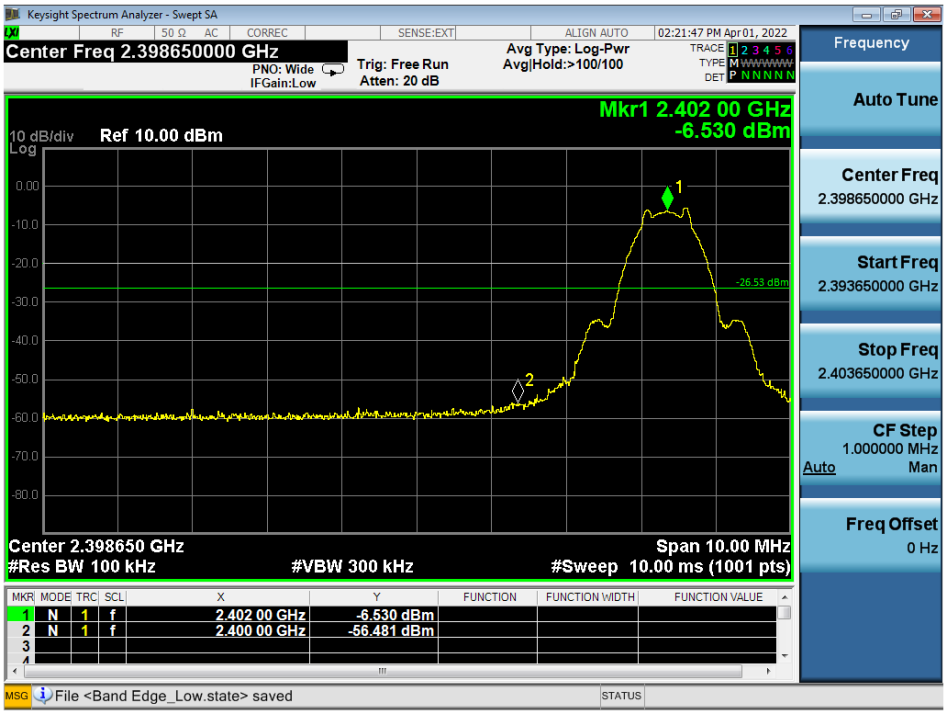


Figure 28: Emission on the Band Edge (Low Channel)

Figure 29: Emission on the Band Edge (High Channel)

5.3.5.6 RESULT

The Emission on the Band Edge test results are **met** the specified limit as per CFR 47, FCC Part 15 sub part C (Section 15.247d).

Decision Rule Followed: Decision rule as prescribed in the appropriate standard, where measurement results are governed by legal or regulatory standards or rules.

5.3.6 CONDUCTED SPURIOUS EMISSIONS

5.3.6.1 TEST SPECIFICATION

Test Standard	CFR 47, FCC Part 15 sub part C (Section 15.247d)			
Test Setup	ANSI C63.10:2013			
Product / Generic Standard	NA			
Frequency Range	2400 to 2483.5MHz			
Operating Frequency	2402 MHz, 2480MHz			
Test Frequency range	9kHz to 150kHz	150kHz to 30MHz	30MHz to 1GHz	1GHz to 18GHz
Resolution Bandwidth	200Hz	9.1kHz	100kHz	1MHz
Video Bandwidth	620Hz	30kHz	300kHz	3MHz
Sweep time	71.53 ms	7.46 ms	3.2 ms	150 ms
Detector	Peak			
External Attenuation	10dB			
Temp	22.6 ºC			
Humidity	53.0 %			
Tested By	Gopala Krishna M R			
Test Date	1 April 2022			

5.3.6.2 LIMITS

According to CFR 47, FCC Part 15 sub part C (Section 15.247d) requirement: the peak output power measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100kHz (i.e., 20 dBc).

5.3.6.3 TEST SETUP

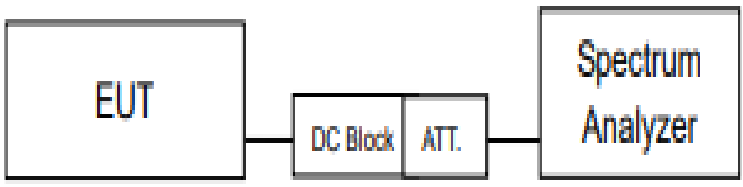


Figure 30: Typical test setup for Conducted Spurious Emission

5.3.6.4 TEST PROCEDURE

The Conducted Spurious Emission test was performed using the spectrum analyzer. Measurement was done as per the CFR 47, FCC Part 15 sub part C (Section 15.247d)/ANSI C63.10:2013. The RF output of the EUT was connected to the input port of the Spectrum Analyzer.

The Conducted Spurious Emission test was performed with nominal ambient temperature with the data rate of 1Mbps.

Note: *Considered cable loss and attenuator loss as correction factors in the test results.*

5.3.6.5 MEASUREMENT DATA

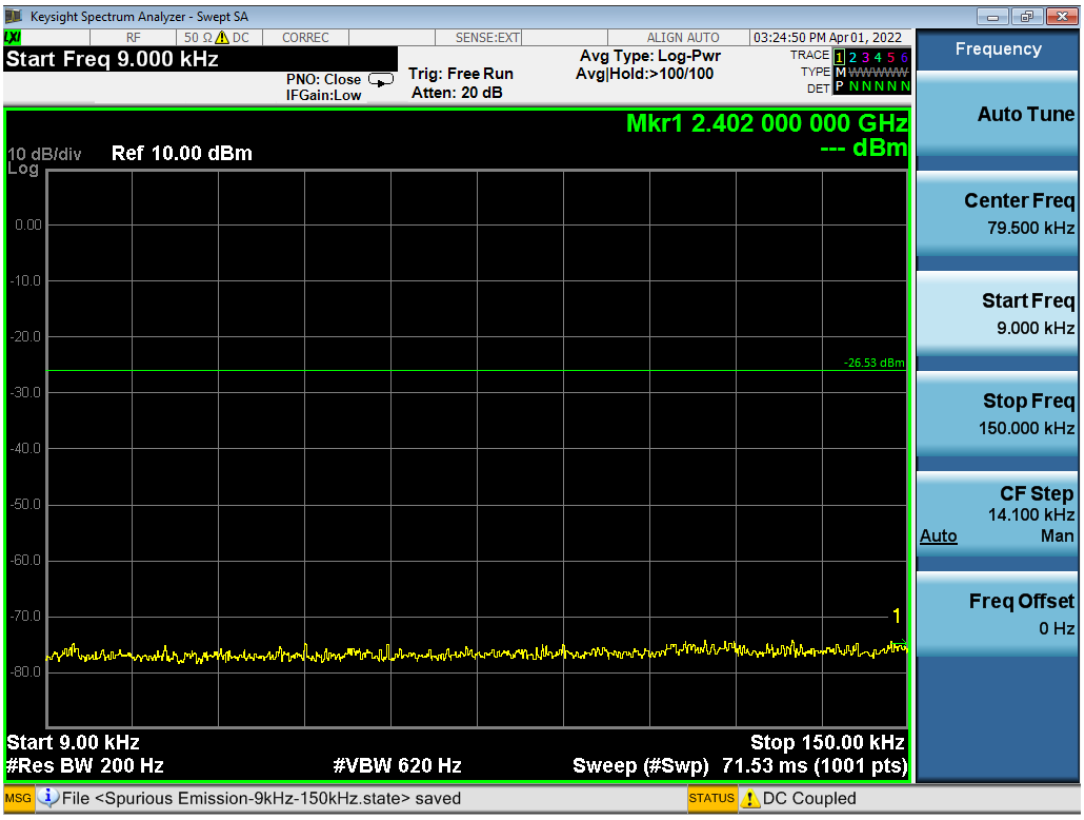


Figure 31: Conducted spurious Emission (Low Channel) 9kHz to 150kHz

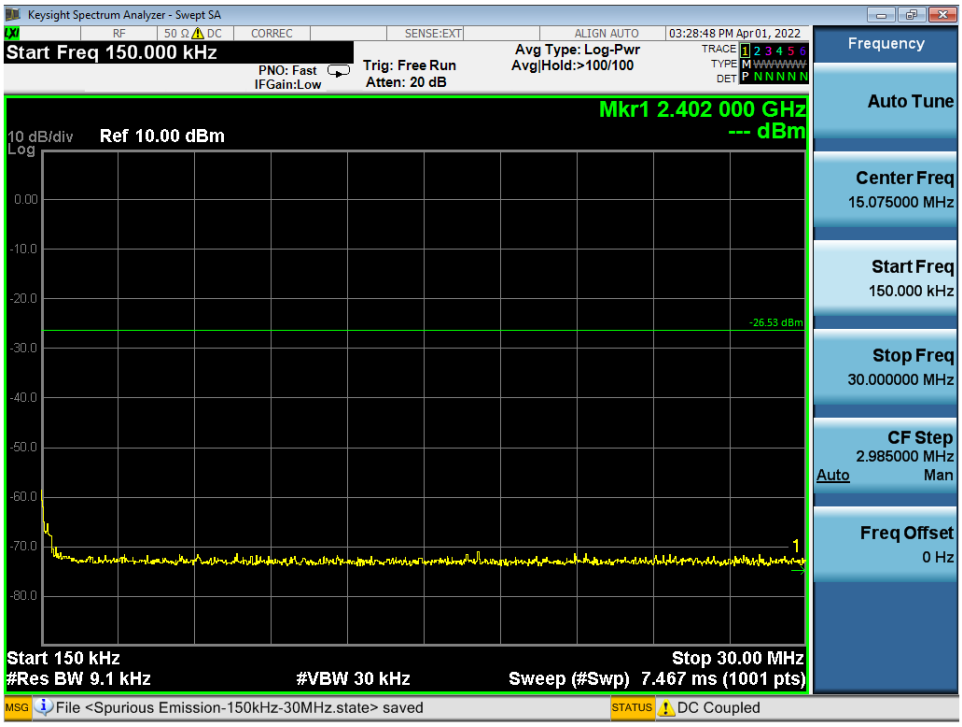


Figure 32: Conducted Spurious Emission (Low Channel) 150kHz to 30MHz

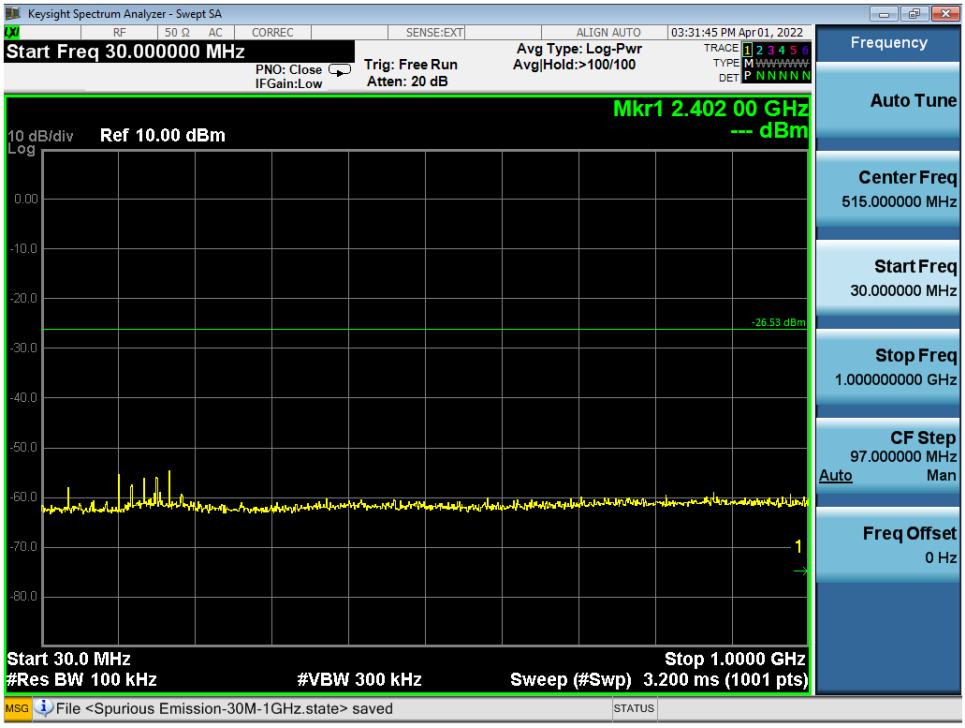


Figure 33: Conducted Spurious Emission (Low Channel) 30MHz to 1GHz

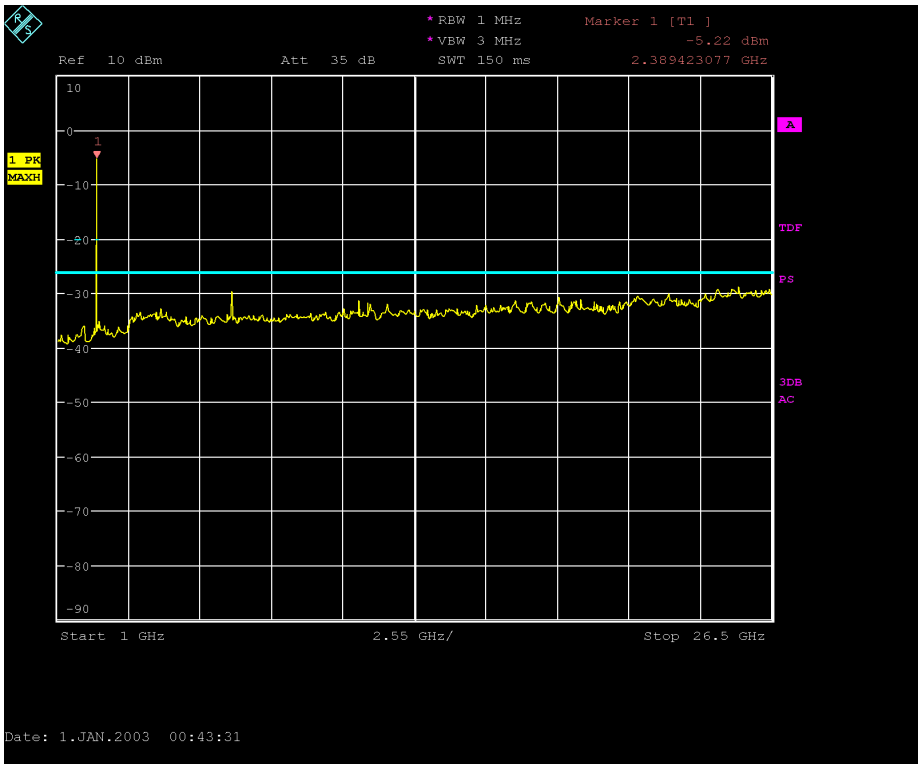


Figure 34: Conducted Spurious Emission (Low Channel) 1GHz to 26.5GHz

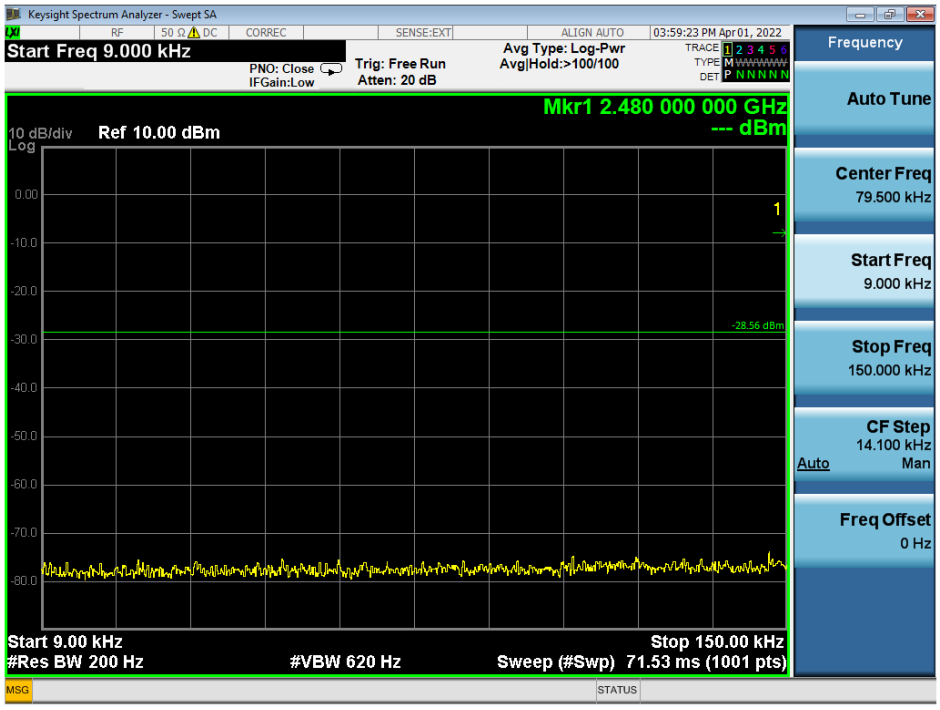


Figure 35: Conducted Spurious Emission (High Channel) 9kHz to 150kHz

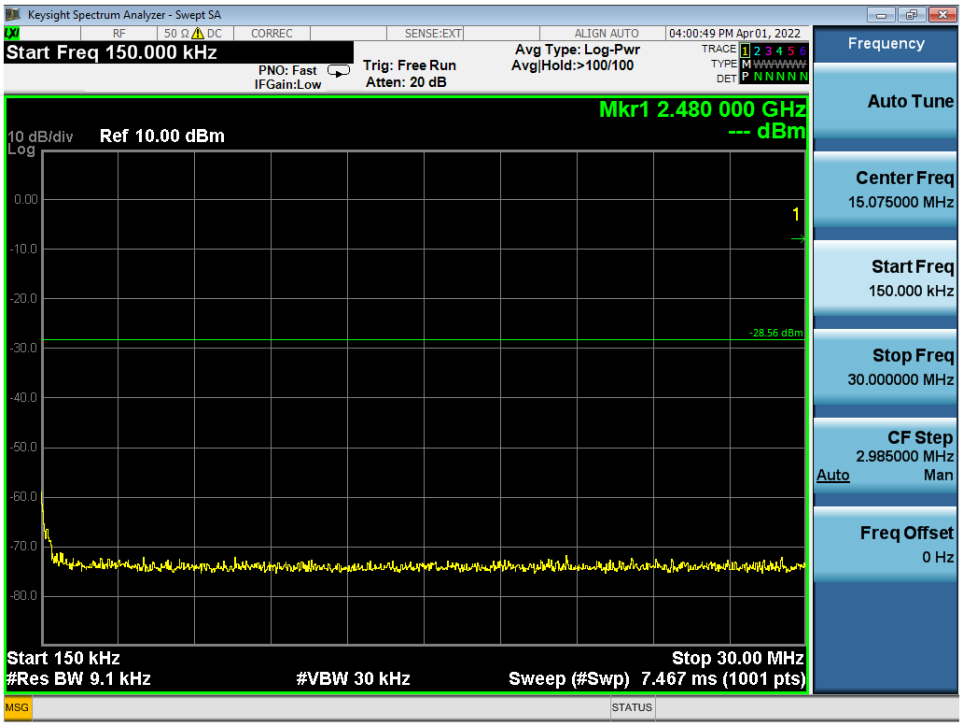


Figure 36: Conducted Spurious Emission (High Channel) 150kHz to 30MHz

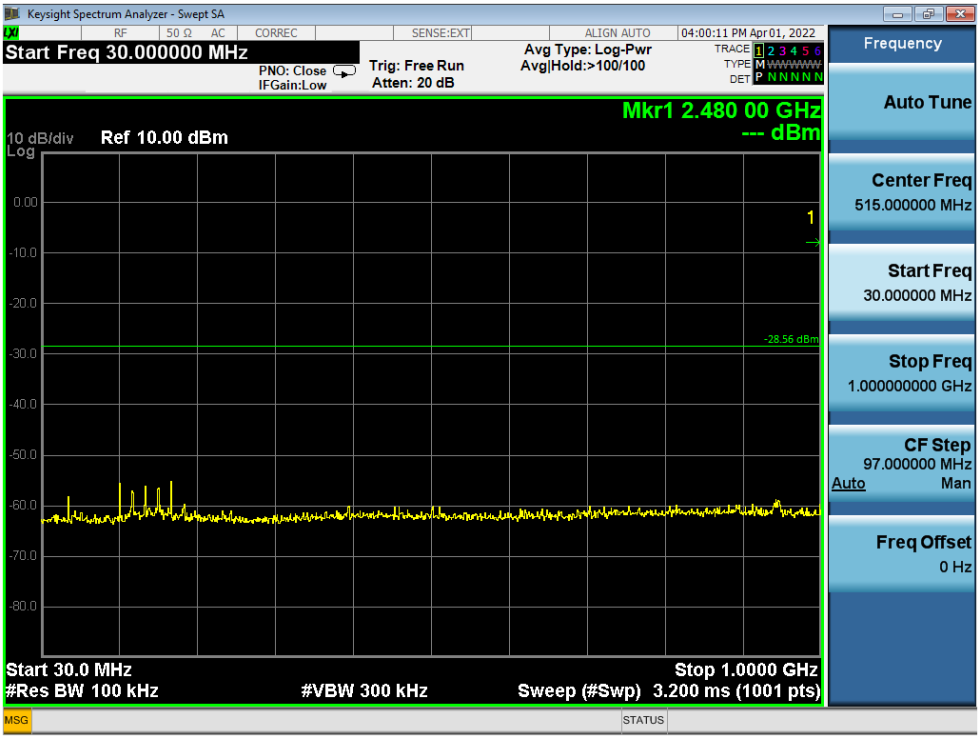


Figure 37: Conducted Spurious Emission (High Channel) 30MHz to 1GHz

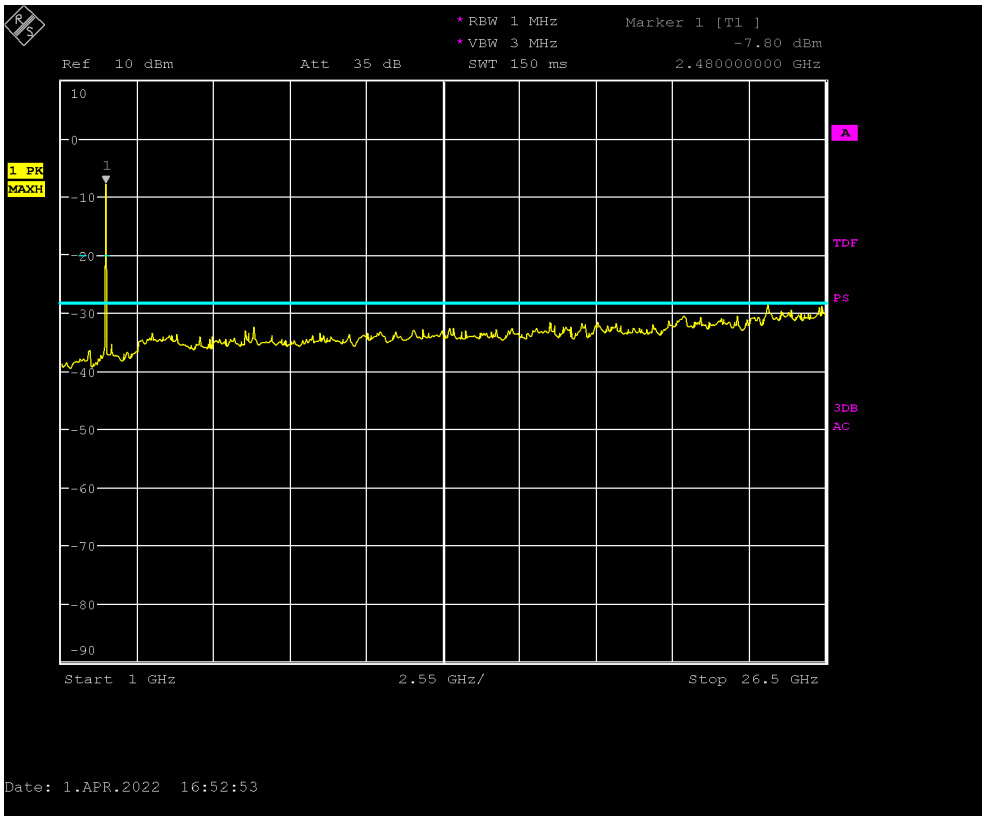


Figure 38: Conducted Spurious Emission (High Channel) 1GHz to 26.5GHz

5.3.6.6 RESULT

The Conducted Spurious Emission test results are **within** the specified limit as per CFR 47, FCC Part 15 sub part C (Section 15.247d).

Decision Rule Followed: Decision rule as prescribed in the appropriate standard, where measurement results are governed by legal or regulatory standards or rules.

ANNEXURE I: EUT AND ACCESSORIES PHOTOGRAPHS

Refer report number UFA 2213IND642-2

ANNEXURE II: ANY OTHER ADDITIONAL INFORMATION

NA

ANNEXURE III: ACRONYMS

CE	Conducted Emissions
dB	Decibel
EMC	Electromagnetic Compatibility
EMI	Electro Magnetic Interference
EUT	Equipment Under Test
GRP	Ground Reference Plane
Hz	Hertz
kHz, MHz, GHz	Kilo Hertz, Mega Hertz, Giga Hertz
ms, ns	Milli second, nano second
NA	Not Applicable
RE	Radiated Emissions
TEC	Telecommunication Engineering Center
NABL	National Accreditation Board for Testing and Calibration Laboratories

END OF REPORT