

FCC IC Test Report

Report No.: FCC_IC_RF_SL21021001-RIVIAN-005_BLE_Rev2.0

FCC ID: 2AW3A-1NAG20VAS

IC ID: 26958-1NAG20VAS

PMN: VAS External Antenna, VAS Fir Tree, VAS Screw Mount

Test Models: VAS BLE 1.0

Series Number: PT00039251-E (Fir Tree – internal antenna), PT00039252-E (Screw Mount – internal antenna), PT00039253-E (Screw Mount – External antenna)

Hardware Version: E

Software Version: 2.20

Received Date: 03/01/2021

Test Date: 03/01/2021-07/23/2021

Issued Date: 07/27/2021

Applicant: Rivian

Address: 2708 Orchard Pkwy Ste 10 San Jose, CA 95134

Manufacturer: Rivian

Address: 2708 Orchard Pkwy Ste 10 San Jose, CA 95134

Issued By: Bureau Veritas Consumer Products Services, Inc.

Lab Address: 775 Montague Expressway, Milpitas, CA 95035

Test Location (1): 775 Montague Expressway, Milpitas, CA 95035

FCC Registration /
540430

Designation Number:

ISED# / CAB identifier: 4842D



This report is for your exclusive use. Any copying or replication of this report to or for any other person or entity, or use of our name or trademark, is permitted only with our prior written permission. This report sets forth our findings solely with respect to the test samples identified herein. The results set forth in this report are not indicative or representative of the quality or characteristics of the lot from which a test sample was taken or any similar or identical product unless specifically and expressly noted. Our report includes all of the tests requested by you and the results thereof based upon the information that you provided to us. You have 60 days from date of issuance of this report to notify us of any material error or omission caused by our negligence, provided, however, that such notice shall be in writing and shall specifically address the issue you wish to raise. A failure to raise such issue within the prescribed time shall constitute your unqualified acceptance of the completeness of this report, the tests conducted and the correctness of the report contents. Unless specific mention, the uncertainty of measurement has been explicitly taken into account to declare the compliance or non-compliance to the specification. The report must not be used by the client to claim product certification, approval, or endorsement by A2LA or any government agencies.

Table of Contents

Release Control Record	4
1 Certificate of Conformity	5
2 Summary of Test Results	6
2.1 Measurement Uncertainty.....	6
2.2 Modification Record.....	6
3 General Information	7
3.1 General Description of EUT	7
3.2 Description of Test Modes	8
3.2.1 Test Mode Applicability and Tested Channel Detail	9
3.3 Duty Cycle of Test Signal	10
3.4 Description of Support Units	11
3.4.1 Configuration of System under Test	11
3.5 General Description of Applied Standards	11
4 Test Types and Results.....	12
4.1 Radiated Emission and Bandedge Measurement.....	12
4.1.1 Limits of Radiated Emission and Bandedge Measurement.....	12
4.1.2 Test Instruments	13
4.1.3 Test Procedures	14
4.1.4 Deviation from Test Standard.....	14
4.1.5 Test Setup.....	15
4.1.6 EUT Operating Conditions	16
4.1.7 Test Results	17
4.1.8 Test Results	21
4.2 Conducted Emission Measurement.....	43
4.2.1 Limits of Conducted Emission Measurement	43
4.2.2 Test Procedures	43
4.2.3 Deviation from Test Standard.....	43
4.2.4 Test Setup.....	43
4.2.5 EUT Operating Conditions	44
4.2.6 Test Results	44
4.3 6dB Bandwidth Measurement & 99% Bandwidth Measurement	45
4.3.1 Limits of 6dB Bandwidth Measurement.....	45
4.3.2 Test Setup.....	45
4.3.3 Test Instruments	45
4.3.4 Test Procedure.....	45
4.3.5 Deviation from Test Standard.....	45
4.3.6 EUT Operating Conditions	45
4.3.7 Test Result	46
Data Rate 1Mbps	46
Data Rate 2bps	46
4.4 Conducted Output Power Measurement.....	54
4.4.1 Limits of Conducted Output Power Measurement.....	54
4.4.2 Test Setup.....	54
4.4.3 Test Instruments	54
4.4.4 Test Procedures	54
4.4.5 Deviation from Test Standard.....	54
4.4.6 EUT Operating Conditions	54
4.4.7 Test Results	55
4.5 Power Spectral Density Measurement.....	59
4.5.1 Limits of Power Spectral Density Measurement.....	59
4.5.2 Test Setup.....	59
4.5.3 Test Instruments	59
4.5.4 Test Procedure.....	59

4.5.5	Deviation from Test Standard	59
4.5.6	EUT Operating Condition	59
4.5.7	Test Results	60
4.6	Conducted Out of Band Emission Measurement	64
4.6.1	Limits of Conducted Out of Band Emission Measurement	64
4.6.2	Test Setup	64
4.6.3	Test Instruments	64
4.6.4	Test Procedure	64
4.6.5	Deviation from Test Standard	64
4.6.6	EUT Operating Condition	64
4.6.7	Test Results	65
5	Pictures of Test Arrangements.....	67
	Appendix – Information on the Testing Laboratories	68

Release Control Record

Issue No.	Description	Date Issued
FCC_IC_RF_SL21021001-RIVIAN-005_BLE	Original Release	03/24//2021
FCC_IC_RF_SL21021001-RIVIAN-005_BLE_Rev1.0	Update all test item	07/23//2021
FCC_IC_RF_SL21021001-RIVIAN-005_BLE_Rev2.0	Update Section 4.3, 4.4	07/27//2021

1 Certificate of Conformity

Product: Vehicle Access System BLE

Brand: Rivian

PMN: VAS External Antenna, VAS Fir Tree, VAS Screw Mount

Test Models: VAS BLE 1.0

Sample Status: Final Product

Applicant: Rivian

Test Date: 03/01/2021-07/23/2021

Standards: 47 CFR FCC Part 15, Subpart C (Section 15.247)

RSS 247 Issue2, February 2017

ANSI C63.10: 2013

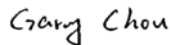
RSS Gen Issue5, March 2019

558074 D01 15.247 Meas Guidance v05r02

The above equipment has been tested by **Bureau Veritas Consumer Products Services, Inc., Milpitas Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.



Prepared by : _____, **Date:** 07/27/2021
Jude Semana / Test Engineer



Approved by : _____, **Date:** 07/27/2021
Gary Chou / Engineer Reviewer

2 Summary of Test Results

47 CFR FCC Part 15, Subpart C (SECTION 15.247) / ISSED RSS-247 RSS 247 Issue2, RSS Gen Issue5			
FCC/ IC Cluse	Test Item	Result	Remarks
15.207 RSS Gen 8.8	AC Power Conducted Emission	PASS	Meet the requirement of limit.
15.205 & 15.209 & 15.247(d) RSS 247 5.5C	Radiated Emissions and Band Edge Measurement	PASS	Meet the requirement of limit.
15.247(a)(2) RSS 247 5.2.1 RSS Gen 6.7	6dB bandwidth & 99% bandwidth	PASS	Meet the requirement of limit.
15.247(b) RSS 247 5.4.4	Conducted power	PASS	Meet the requirement of limit.
15.247(e) RSS 247 5.2.2	Power Spectral Density	PASS	Meet the requirement of limit.
15.203	Antenna Requirement	PASS	Internal antenna: permanently attached antenna (without connector) External antenna connector: FAKRA (Not standard connector) Both antenna are meet the requirement.

2.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

Measurement	Frequency	Expanded Uncertainty (k=2) ($\pm$)
Conducted Emissions at mains ports	150kHz ~ 30MHz	3.51dB
Radiated Emissions up to 1 GHz	30MHz ~ 1GHz	3.73dB
Radiated Emissions above 1 GHz	1GHz ~ 6GHz	4.64dB
	6GHz ~ 18GHz	4.82dB
	18GHz ~ 40GHz	4.91dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	Vehicle Access System BLE
PMN	VAS External Antenna, VAS Fir Tree, VAS Screw Mount
Test Models	BLE VAS 1.0
Series Number	PT00039251-E (Fir Tree – internal antenna), PT00039252-E (Screw Mount – internal antenna) & PT00039253-E (Screw Mount – External antenna)
Model Difference	All models have identical PCB
Status of EUT	Final Product
Power Input	Vehicle Battery Powered
Power Supply Rating	9-16 Vdc, 180ma
Modulation Type	GFSK
Modulation Technology	Bluetooth Low Energy
Transfer Rate	1 Mbps (LE 1M), and 2 Mbps (LE 2M)
Operating Frequency	2.402 ~ 2.480GHz
Number of Channel	40
Output Power	3.19 mW
Antenna Information	Chip Internal antenna Peak Gain 1.5 dBi / Patch External antenna Peak Gain -1.5 dBi
Antenna Connector	FAKRA

3.2 Description of Test Modes

40 channels are provided to this EUT:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
37	2402	9	2422	18	2442	28	2462
0	2404	10	2424	19	2444	29	2464
1	2406	38	2426	20	2446	30	2466
2	2408	11	2428	21	2448	31	2468
3	2410	12	2430	22	2450	32	2470
4	2412	13	2432	23	2452	33	2472
5	2414	14	2434	24	2454	34	2474
6	2416	15	2436	25	2456	35	2476
7	2418	16	2438	26	2458	36	2478
8	2420	17	2440	27	2460	39	2480

Channels Tested:

Channel	Frequency (MHz)	POWER SETTING
37	2402	5
17	2440	5
39	2480	5

3.2.1 Test Mode Applicability and Tested Channel Detail

EUT CONFIGURE MODE	APPLICABLE TO				DESCRIPTION
	RE $\geq$ 1G	RE<1G	PLC	APCM	
-	√	√	-	√	-

Where RE $\geq$ 1G: Radiated Emission above 1GHz & Bandedge Measurement
 RE<1G: Radiated Emission below 1GHz
 PLC: Power Line Conducted Emission
 APCM: Antenna Port Conducted Measurement

NOTE: The EUT had been pre-tested on the positioned of each 3 axis. The worst case was found when positioned on **Y-plane**.

NOTE: "-" means no effect.

Radiated Emission Test (Above 1GHz):

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE	DATA RATE (Mbps)
0 to 39	37,17,39	GFSK	1

Radiated Emission Test (Below 1GHz):

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE	DATA RATE (Mbps)
0 to 39	17	GFSK	1

Power Line Conducted Emission Test:

- ☐ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☐ Following channel(s) was (were) selected for the final test as listed below.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE	DATA RATE (Mbps)
0 to 39	17	GFSK	1

Antenna Port Conducted Measurement:

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE	DATA RATE (Mbps)
0 to 39	37,17,39	GFSK	1
0 to 39	37,17,39	GFSK	2

3.4 Description of Support Units

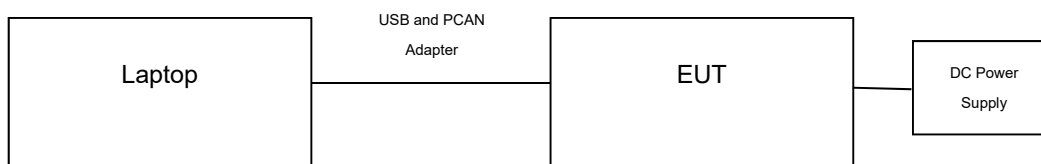
The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Laptop	Dell	Latitude 7840	2609NH2	N/A	Provided by Customer
B.	DC Power Supply	BK Precision	1665	245D19109	N/A	N/A
C.	USB PCAN Adapter	Phytools	IPEH-002021	N/A	N/A	Provided by Customer

Note: The core(s) is(are) originally attached to the cable(s).

From a Windows 10 laptop, installed with PCAN-View software (Version 4.3.0.596), and USB PCAN adapter, we can issue commands, on any authorized BLE channel, on any power level (we kept all at MAX 5dBm setting) and on any PHY BLE data rate. The f/w revision is S/W revision 2.20, for both normal and special test mode (i.e. special test mode is not available to customers at this junction and it's only enabled for compliance testing – the switch between different modes are a hard bit that has to be re-flashed; hence, no option is available to switch between the two modes at this junction).

3.4.1 Configuration of System under Test



3.5 General Description of Applied Standards

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

47 CFR FCC Part 15, Subpart C (Section 15.247)
RSS 247 Issue2, February 2017
ANSI C63.10: 2013
RSS Gen Issue5, March 2019
558074 D01 15.247 Meas Guidance v05r02

All test items have been performed and recorded as per the above standards.

4 Test Types and Results

4.1 Radiated Emission and Bandedge Measurement

4.1.1 Limits of Radiated Emission and Bandedge Measurement

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table. Other emissions shall be at least 20dB below the highest level of the desired power:

Frequencies (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 ~ 0.490	2400/F(kHz)	300
0.490 ~ 1.705	24000/F(kHz)	30
1.705 ~ 30.0	30	30
30 ~ 88	100	3
88 ~ 216	150	3
216 ~ 960	200	3
Above 960	500	3

NOTE:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.

4.1.2 Test Instruments

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	DATE OF CALIBRATION	DUE DATE OF CALIBRATION
EMI Receiver (Rohde and Schwarz)	ESW44	1328.4100K-101662-MH	10/23/2020	10/23/2021
Biconilog Antenna (Sunol)	JB6	A111717	9/4/2020	9/4/2021
Horn Antenn (ETS-Lindgren)	3117	218554	07/24/2020	7/24/2021
Pre-Amplifier (RF-Lambda)	RAMP00M50GA	18040300055	10/1/2020	10/1/2021
Hon Antenna DRG	SAS-574	579	08/05/2020	08/05//2022
PXA Signal Analyzer (Keysight)	N9030B	MY57140100	07/22/2020	07/22/2022
SMA Fixed Attenuator (50ohms, 2w, 30dB, DC-6GHz)	VAT-03W2+	n/a	07/21/2020	07/21/2022
FSB Antenna Cable, 0.5m (Microwave Town)	FSB360PK-KMKM-00.50M	201906110002	10/1/2020	10/1/2021
FSB Antenna Cable, 4m (Microwave Town)	FSB360PK-KMKM-400M	21030447-002	10/1/2020	10/1/2021
10m Semi-Anechoic Chambe (ETS-Lindgren)	S2010BL8X8	1462	07/21/2020	07/21/2022
Notch Filters MICRO-TRONICS	BRM50702	G242	07/21/2020	07/21/2022

4.1.3 Test Procedures

For Radiated emission below 30MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. Both Parallel, perpendicular, and ground-parallel orientations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

For Radiated emission above 30MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
- f. The test-receiver system was set to peak and average detects function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

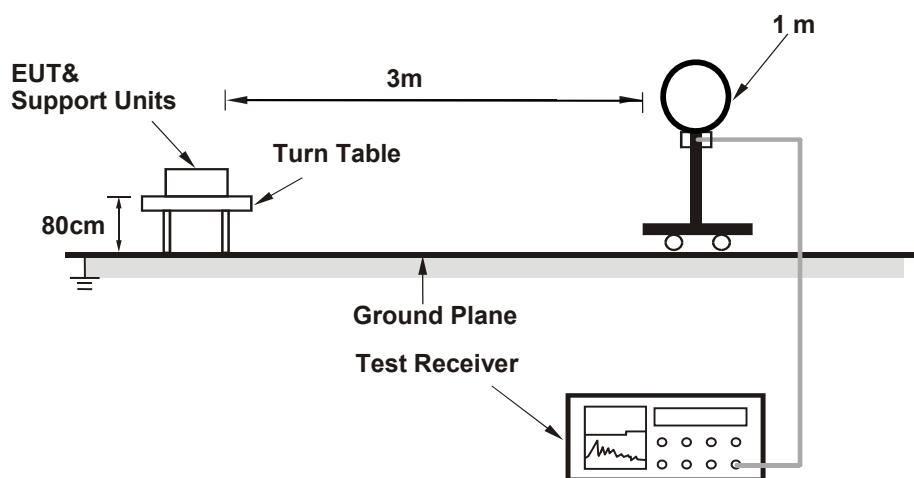
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is $\geq 1/T$ (Duty cycle < 98%) or 10Hz (Duty cycle $\geq 98\%$) for Average detection (AV) at frequency above 1GHz.
4. All modes of operation were investigated and the worst-case emissions are reported.

4.1.4 Deviation from Test Standard

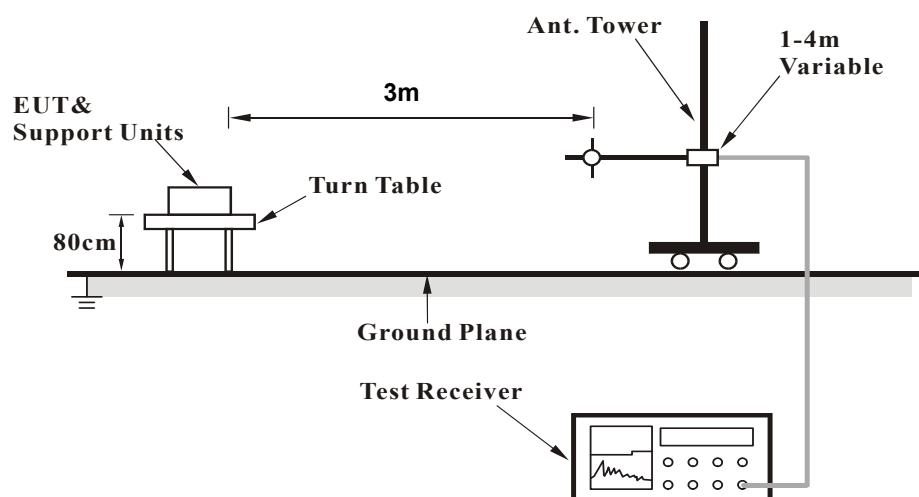
No deviation.

4.1.5 Test Setup

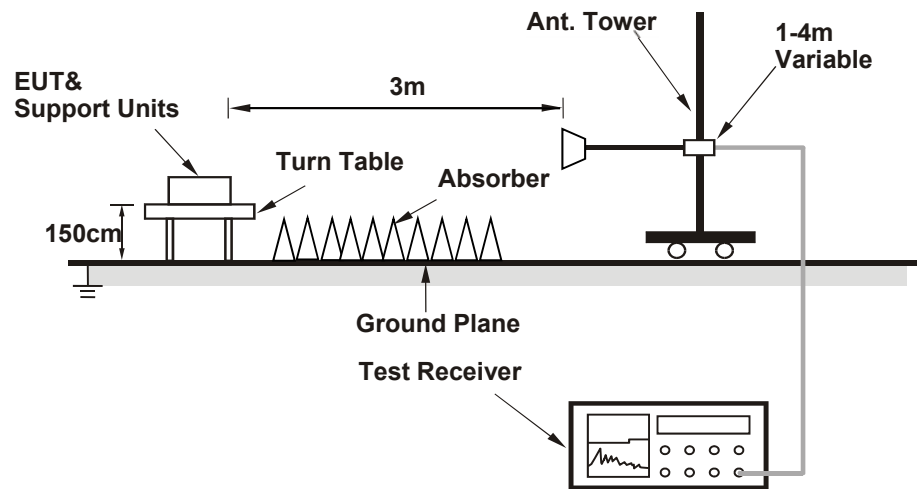
For Radiated emission below 30MHz



For Radiated emission 30MHz to 1GHz



For Radiated emission above 1GHz



For the actual test configuration, please refer to the attached file (Test Setup Photo).

4.1.6 EUT Operating Conditions

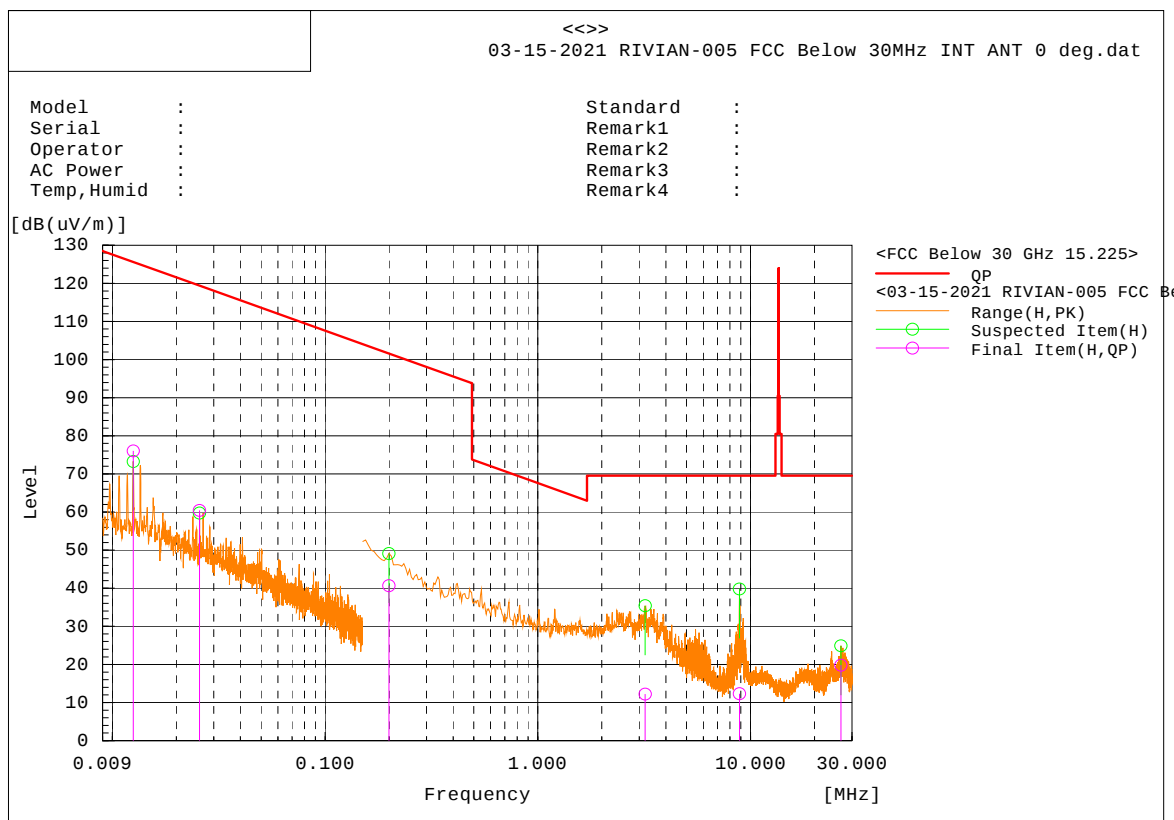
- Connected the EUT with the Notebook Computer which is placed on remote site.
- Controlling software has been activated to set the EUT on specific status.

4.1.7 Test Results

BELOW 30GHz WORST-CASE DATA:
(Unit with Internal Antenna, Data Rate 1Mbps)

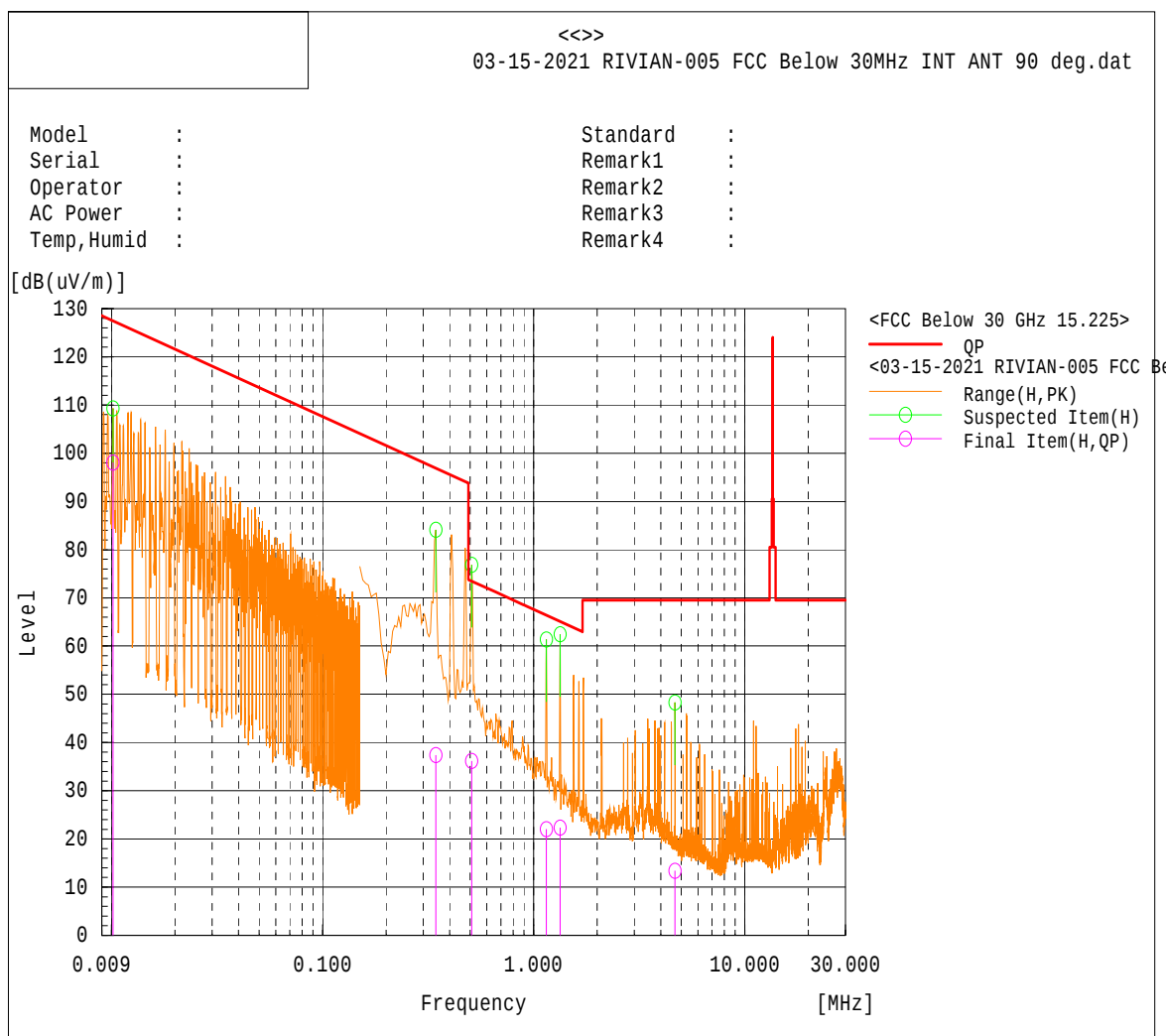
CHANNEL	TX Channel 17	DETECTOR FUNCTION	Quasi Peak
FREQUENCY RANGE	.009-30MHz		

ANTENNA POLARITY & test distance: 0 Degree at 3 m										
No	Freq.	Raw	Factor	Level	Measurement Type	Hgt	Azt	Limit	Margin	Pass /Fail
	[MHz]	(dBuV)	(dB1/m)	(dBuV/m)		(cm)	Deg	(dBuV/m)	(dB)	
1	0.013	25	51	76	Quasi Max	100	317.2	125.6	-49.6	Pass
2	0.026	15.6	44.8	60.4	Quasi Max	100	154.4	119.4	-59	Pass
3	0.2	14.5	26.2	40.7	Quasi Max	100	0	101.6	-60.9	Pass
4	3.195	7.6	4.6	12.2	Quasi Max	100	261.2	69.5	-57.3	Pass
5	8.866	10	2.3	12.3	Quasi Max	100	127.8	69.5	-57.2	Pass
6	26.602	17.9	1.9	19.8	Quasi Max	100	269.1	69.5	-49.7	Pass



CHANNEL	TX Channel 17	DETECTOR FUNCTION	Quasi Peak
FREQUENCY RANGE	.009-30MHz		

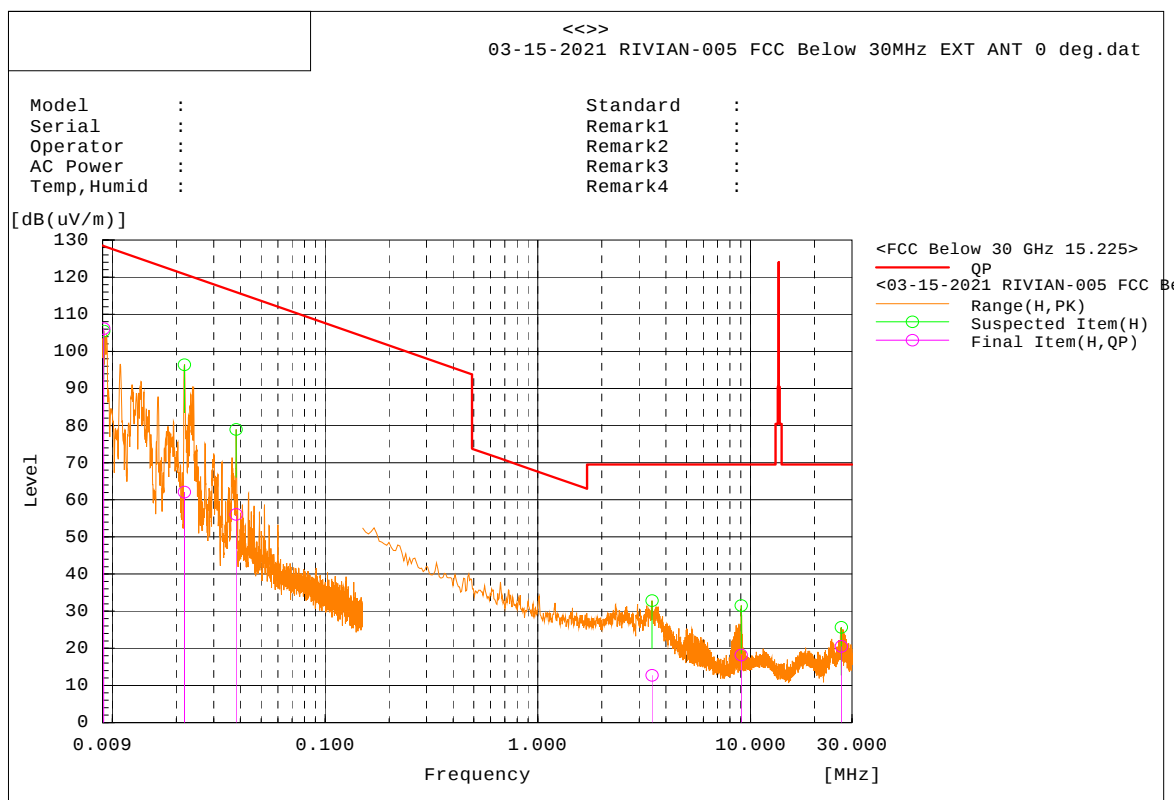
ANTENNA POLARITY & test distance: 90 Degree at 3 m										
No	Freq.	Raw	Factor	Level	Measurement Type	Hgt	Azt	Limit	Margin	Pass /Fail
	[MHz]	(dBuV)	(dB1/m)	(dBuV/m)		(cm)	Deg	(dBuV/m)	(dB)	
1	0.01	46.7	51.4	98.1	Quasi Max	100	326	127.5	-29.4	Pass
2	0.508	17.9	18.3	36.2	Quasi Max	100	197.7	73.5	-37.3	Pass
3	1.334	11.5	10.8	22.3	Quasi Max	100	197.2	65.1	-42.8	Pass
4	1.15	10.1	11.9	22	Quasi Max	100	197.1	66.4	-44.4	Pass
5	4.672	11.5	1.9	13.4	Quasi Max	100	256.1	69.5	-56.1	Pass
6	0.344	15.8	21.6	37.4	Quasi Max	100	214.6	96.9	-59.5	Pass



BELOW 30GHz WORST-CASE DATA:
(Unit with External Antenna, Data Rate 1Mbps)

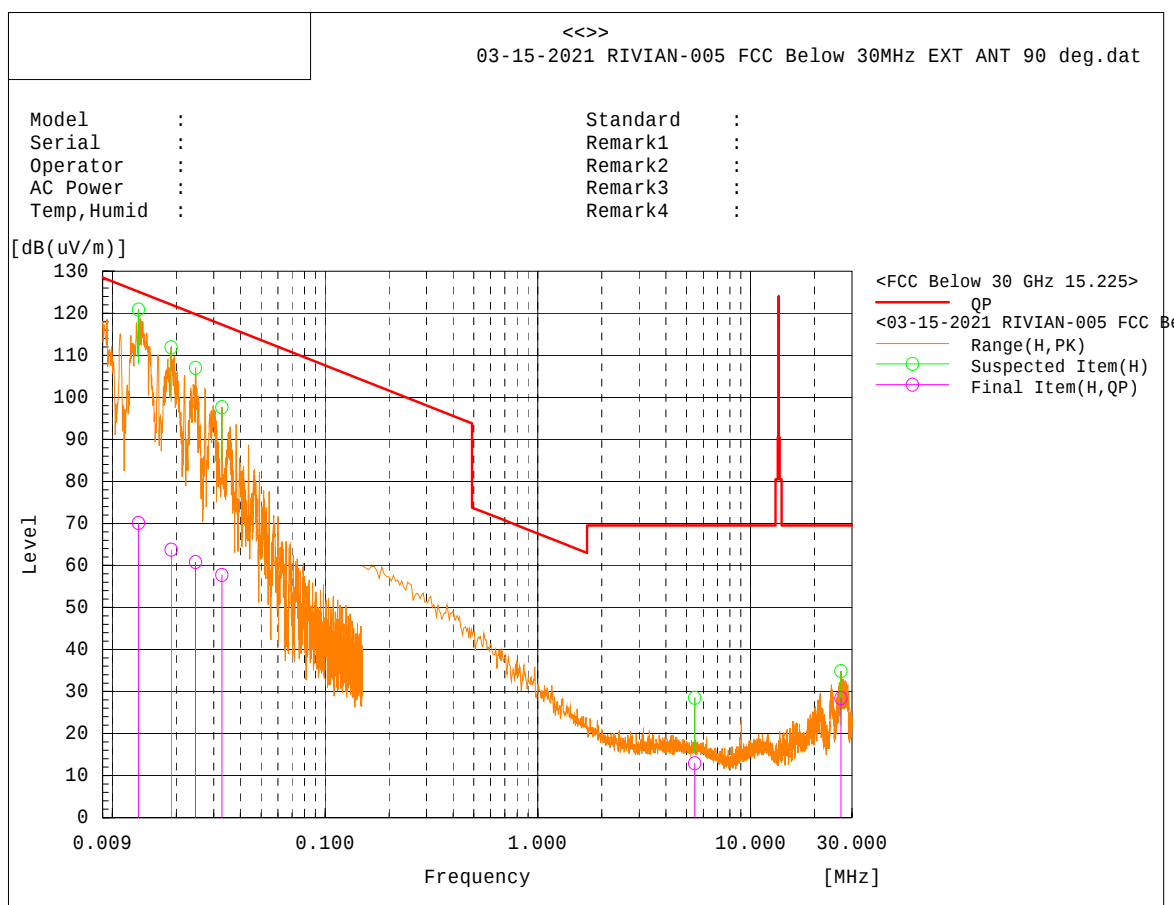
CHANNEL	TX Channel 17	DETECTOR FUNCTION	Quasi Peak
FREQUENCY RANGE	.009-30MHz		

ANTENNA POLARITY & test distance: 0 Degree at 3 m										
No	Freq.	Raw	Factor	Level	Measurement Type	Hgt	Azt	Limit	Margin	Pass /Fail
	[MHz]	(dBuV)	(dB1/m)	(dBuV/m)		(cm)	Deg	(dBuV/m)	(dB)	
1	0.009	54.7	51.5	106.2	Quasi Max	100	0	128.4	-22.2	Pass
2	0.022	15.8	46.3	62.1	Quasi Max	100	1.8	120.8	-58.7	Pass
3	0.038	15.2	40.9	56.1	Quasi Max	100	5.4	116	-59.9	Pass
4	3.448	8.6	4.1	12.7	Quasi Max	100	261.7	69.5	-56.8	Pass
5	9.045	15.9	2.3	18.2	Quasi Max	100	123.5	69.5	-51.3	Pass
6	26.712	18.7	1.8	20.5	Quasi Max	100	271.6	69.5	-49	Pass



CHANNEL	TX Channel 17	DETECTOR FUNCTION	Quasi Peak
FREQUENCY RANGE	.009-30MHz		

ANTENNA POLARITY & test distance: 90 Degree at 3 m										
No	Freq.	Raw	Factor	Level	Measurement Type	Hgt	Azt	Limit	Margin	Pass /Fail
	[MHz]	(dBuV)	(dB1/m)	(dBuV/m)		(cm)	Deg	(dBuV/m)	(dB)	
1	0.013	19.5	50.7	70.2	Quasi Max	100	355.7	125.1	-54.9	Pass
2	5.458	10.9	2	12.9	Quasi Max	100	255.7	69.5	-56.6	Pass
3	26.592	26.6	1.9	28.5	Quasi Max	100	269.3	69.5	-41	Pass
4	0.019	16	47.8	63.8	Quasi Max	100	356.4	122.1	-58.3	Pass
5	0.025	15.6	45.2	60.8	Quasi Max	100	358.5	119.8	-59	Pass
6	0.033	15.3	42.5	57.8	Quasi Max	100	1.1	117.3	-59.5	Pass

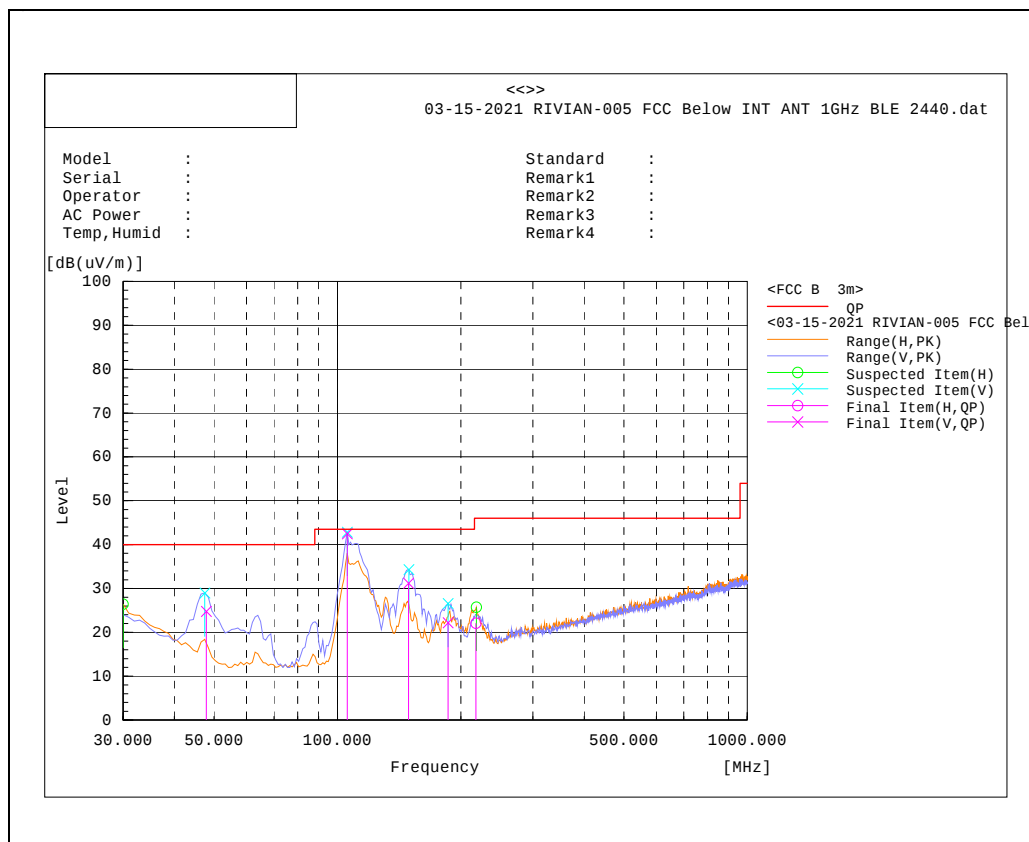


4.1.8 Test Results

BELOW 1GHz WORST-CASE DATA:

BT-LE (Unit with Internal Antenna, Data Rate 1Mbps)

CHANNEL	TX Channel 17	DETECTOR FUNCTION	Quasi Peak
FREQUENCY RANGE	30MHz – 1GHz		



ANTENNA POLARITY & test distance: HORIZONTAL & VERTICAL at 3 m

No	Freq.	Raw	Factor	Level	Measurement Type	Pol	Hgt	Azt	Limit	Margin	Pass /Fail
	[MHz]	(dBuV)	(dB1/m)	(dBuV/m)			(cm)	Deg	(dBuV/m)	(dB)	
1	47.862	10.9	13.9	24.8	Quasi Max	V	100.2	237.6	40	-15.2	Pass
2	105.691	23.6	17.9	41.5	Quasi Max	V	100.2	18.1	43.5	-2	Pass
3	149.041	12.2	19	31.2	Quasi Max	V	102.3	226.3	43.5	-12.3	Pass
4	186.205	4.5	17.7	22.2	Quasi Max	V	105.8	100	43.5	-21.3	Pass
5	217.835	4.6	17.5	22.1	Quasi Max	H	149.1	101	46	-23.9	Pass
6	30	-23.7	26.9	-23	Quasi Max	H	208.2	345.3	40	-36.8	Pass

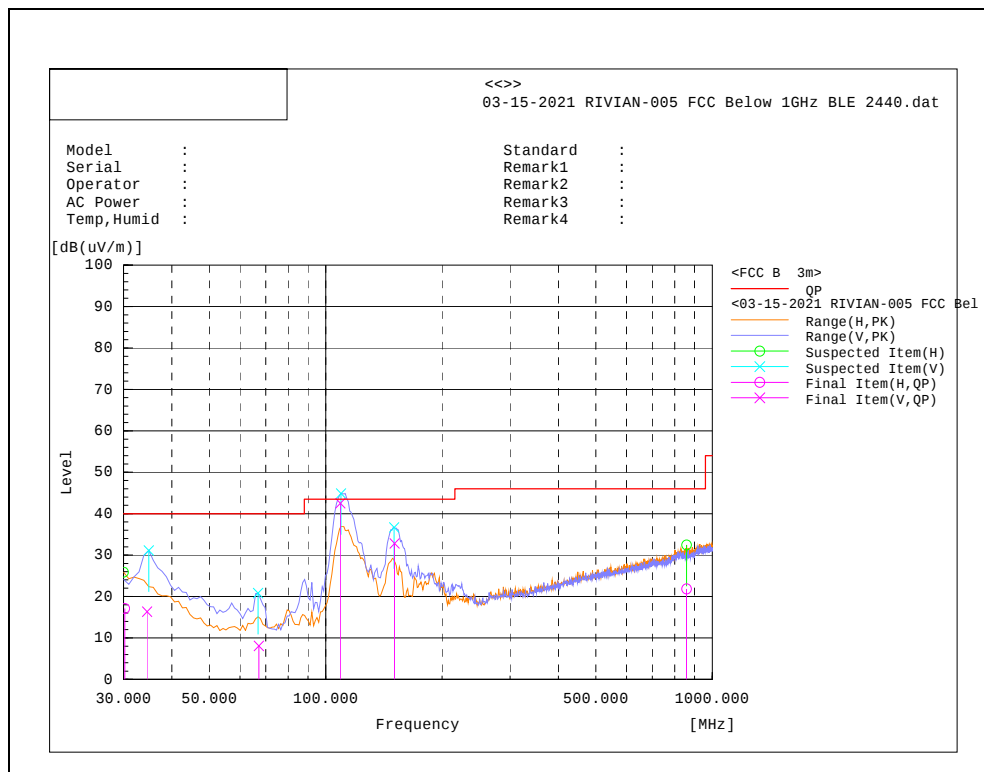
REMARKS:

- Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
- Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB) –Preamplifier Gain (dB)
- Margin = Level (dBuV/m) - Limit value (dBuV/m)

BELOW 1GHz WORST-CASE DATA:

BT-LE (Unit with External Antenna, Data Rate 1Mbps)

CHANNEL	TX Ch 17 (2440MHz)	DETECTOR FUNCTION	Quasi Peak
FREQUENCY RANGE	30MHz – 1GHz		



ANTENNA POLARITY & test distance: HORIZONTAL & VERTICAL at 3 m

No	Freq. [MHz]	Raw (dBuV)	Factor (dB(1/m))	Level (dBuV/m)	Measurement Type	Pol	Hgt (cm)	Azt Deg	Limit (dBuV/m)	Margin (dB)	Pass /Fail
1	34.502	-6.1	22.4	16.3	Quasi Max	V	124	109.8	40	-23.7	Pass
2	150.78	13.9	19	32.9	Quasi Max	V	100	208.6	43.5	-10.6	Pass
3	858.526	-8.3	30.2	21.9	Quasi Max	H	111	54.5	46	-24.1	Pass
4	67.122	-5	13.1	8.1	Quasi Max	V	106	12	40	-31.9	Pass
5	30.236	-9.6	26.7	17.1	Quasi Max	H	143	96.6	40	-22.9	Pass
6	109.153	22.1	18.4	40.5	Quasi Max	V	102.1	147.2	43.5	-3	Pass

REMARKS:

1. Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
2. Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB) –Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value (dBuV/m)

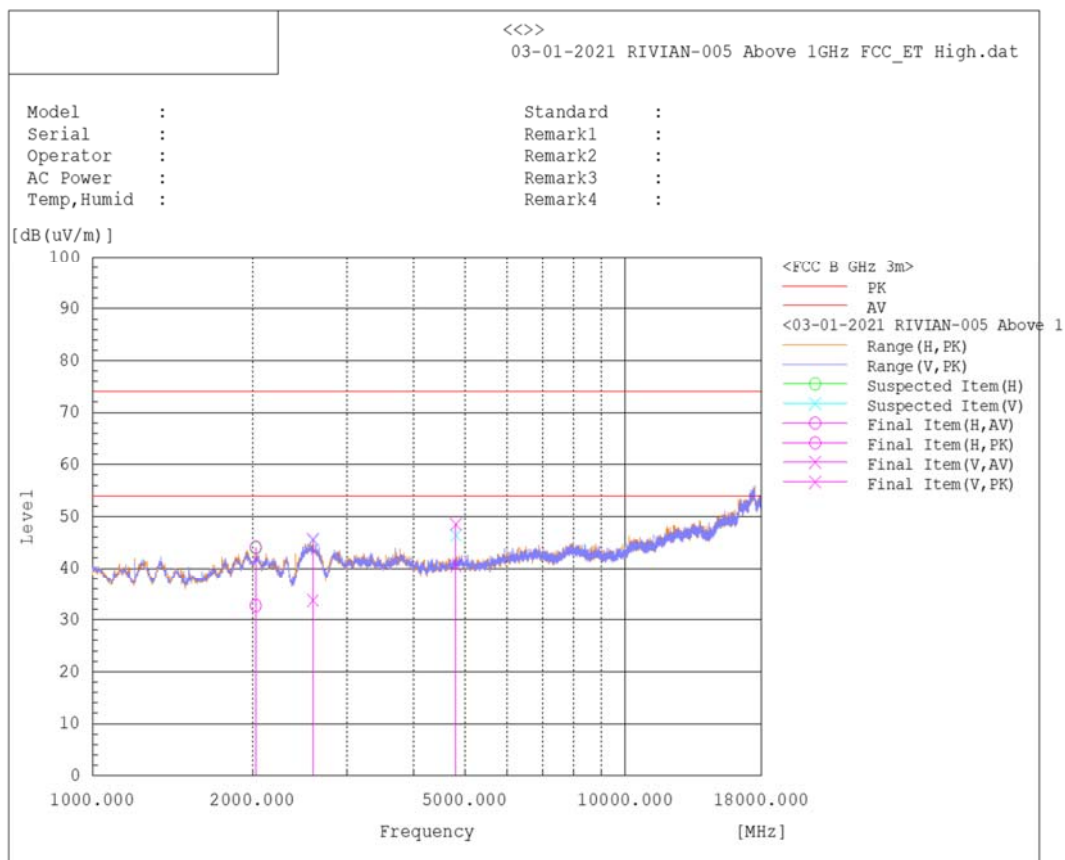
ABOVE 1GHz TEST DATA:

BT-LE (GFSK) (Unit with Internal Antenna, Data Rate 1Mbps)

CHANNEL	TX Ch 37 (2402MHz)	DETECTOR	Peak
FREQUENCY RANGE	1GHz ~ 25GHz	FUNCTION	Average

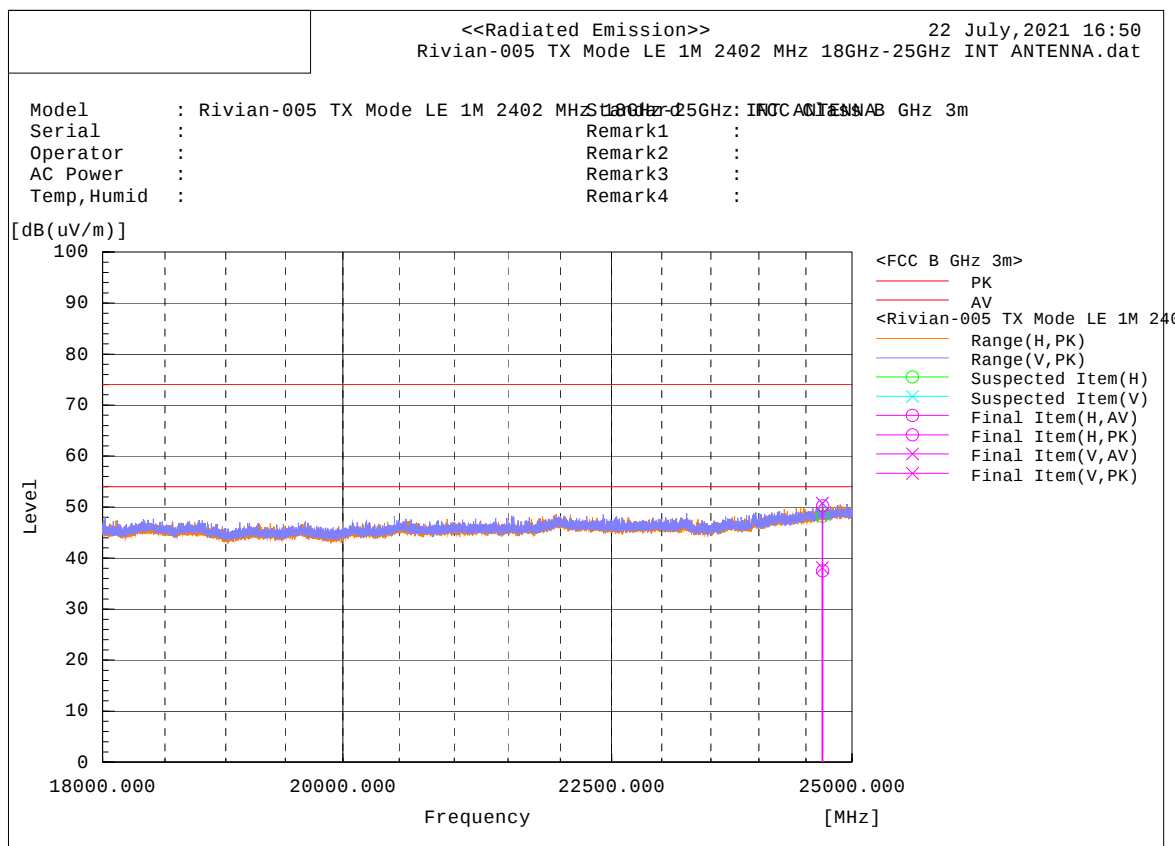
ANTENNA POLARITY & test distance: HORIZONTAL & VERTICAL at 3 m

No	Freq.	Raw	Factor	Level	Measurement Type	Pol	Hgt	Azt	Limit	Margin	Pass /Fail
	[MHz]	(dBuV)	(dB1/m)	(dBuV/m)			(cm)	Deg	(dBuV/m)	(dB)	
1	4804.447	55.8	-7.3	48.5	Peak Max	V	208	356.5	74	-25.5	Pass
2	2592.252	55.1	-9.5	45.6	Peak Max	V	162	56.5	74	-28.4	Pass
3	2023.601	54.8	-10.6	44.2	Peak Max	H	100	197.1	74	-29.8	Pass
4	4804.447	47.8	-7.3	40.5	Average Max	V	208	356.5	54	-13.5	Pass
5	2592.252	43.2	-9.5	33.7	Average Max	V	162	56.5	54	-20.3	Pass
6	2023.601	43.3	-10.6	32.7	Average Max	H	100	197.1	54	-21.3	Pass



Antenna Polarity & Test Distance: Vertical and Horizontal at 3m

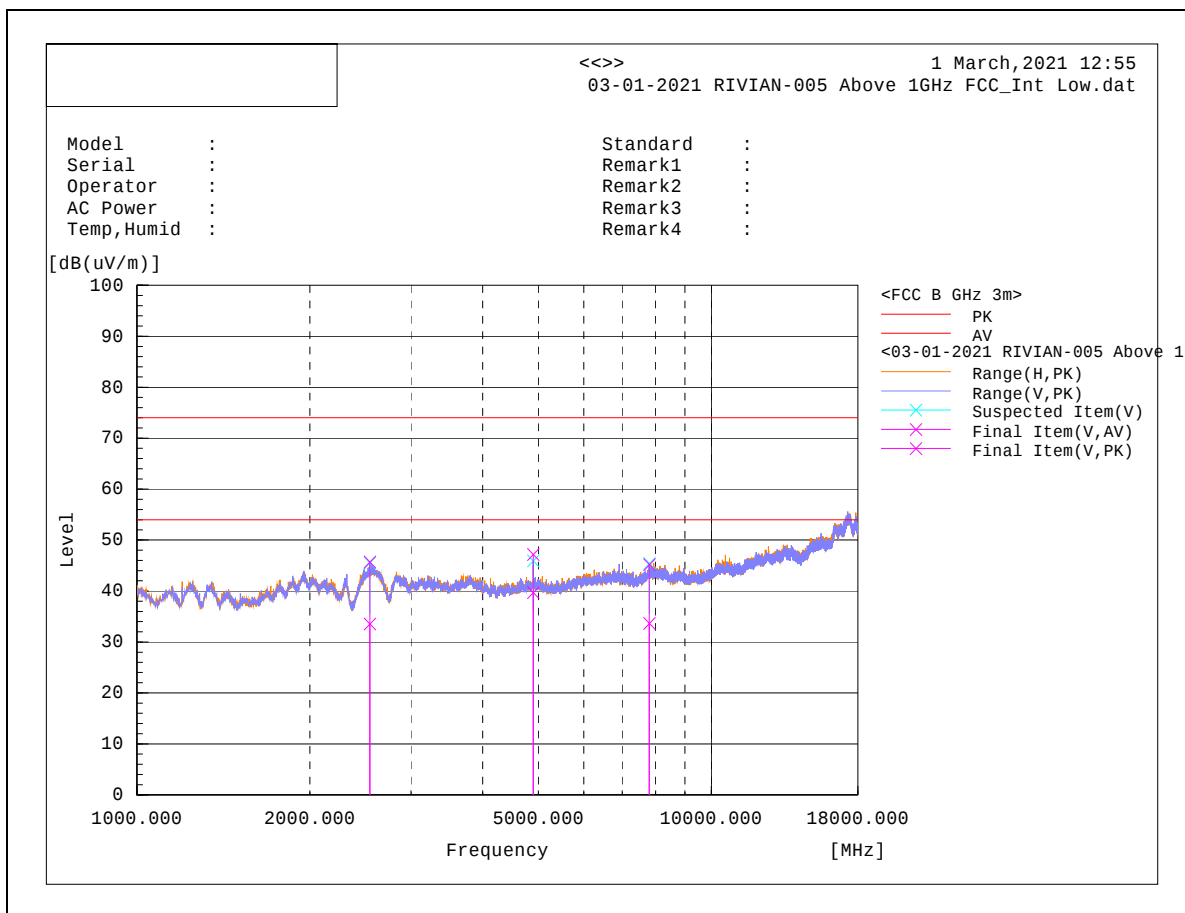
No	Frequency (MHz)	Polarization (H/V)	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]	Height (cm)	Angle (Deg)	Pass / Fail
1	24677.382	V	20.5	33.2	17.6	38.1	50.8	54	74	-15.9	-23.2	192	165.6	Pass
2	24679.766	H	19.9	32.6	17.6	37.5	50.2	54	74	-16.5	-23.8	322	287	Pass



CHANNEL	TX Ch 17 (2440MHz)	DETECTOR	Peak
FREQUENCY RANGE	1GHz ~ 25GHz	FUNCTION	Average

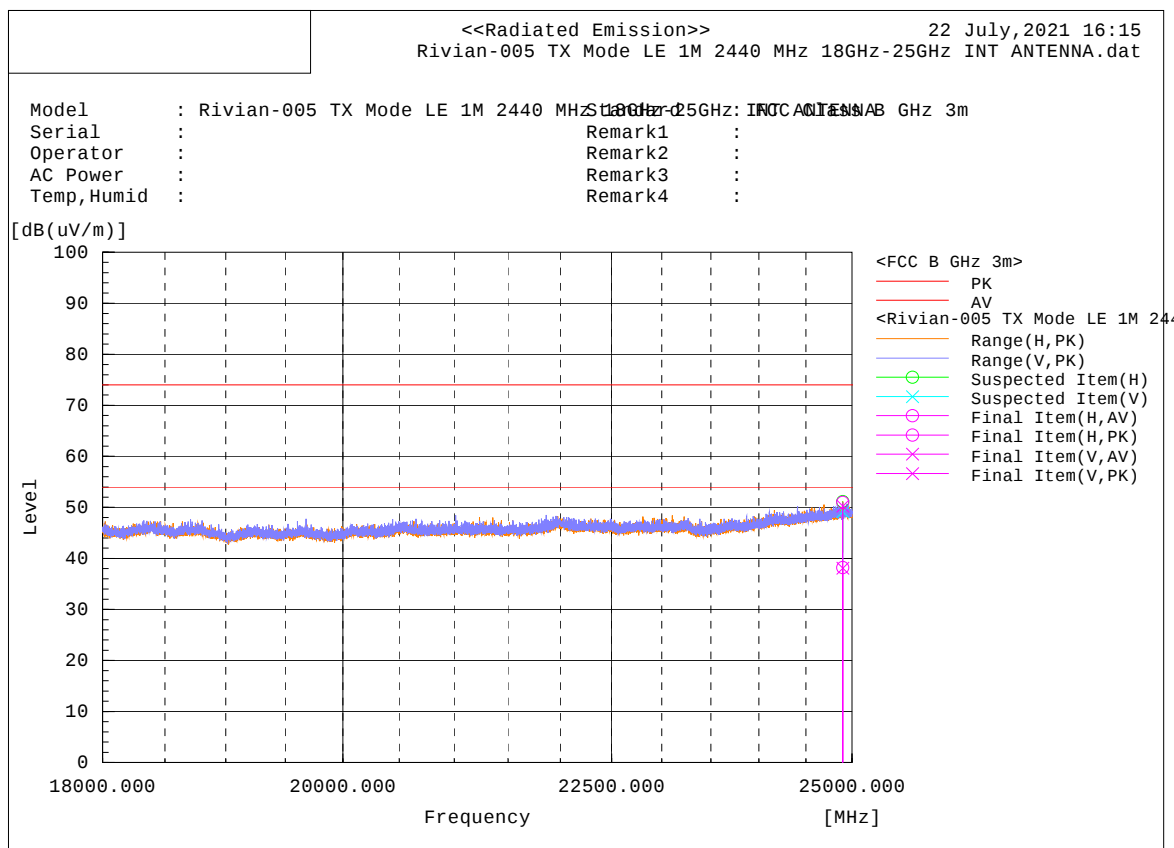
ANTENNA POLARITY & test distance: HORIZONTAL & VERTICAL at 3 m

No	Freq.	Raw	Factor	Level	Measurement Type	Pol	Hgt	Azt	Limit	Margin	Pass /Fail
	[MHz]	(dBuV)	(dB1/m)	(dBuV/m)			(cm)	Deg	(dBuV/m)	(dB)	
1	4899.8	53.1	-7.1	46	Peak Max	V	200	347.2	74	-28	Pass
2	2543.6	55.1	-9.6	45.5	Peak Max	V	300	355.1	74	-28.5	Pass
3	7801.701	45.8	-0.4	45.4	Peak Max	V	350	334.4	74	-28.6	Pass
4	4899.8	46.8	-7.1	39.7	Average Max	V	200	347.2	54	-14.3	Pass
5	2543.6	43.1	-9.6	33.5	Average Max	V	300	355.1	54	-20.5	Pass
6	7801.701	34.1	-0.4	33.7	Average Max	V	350	334.4	54	-20.3	Pass



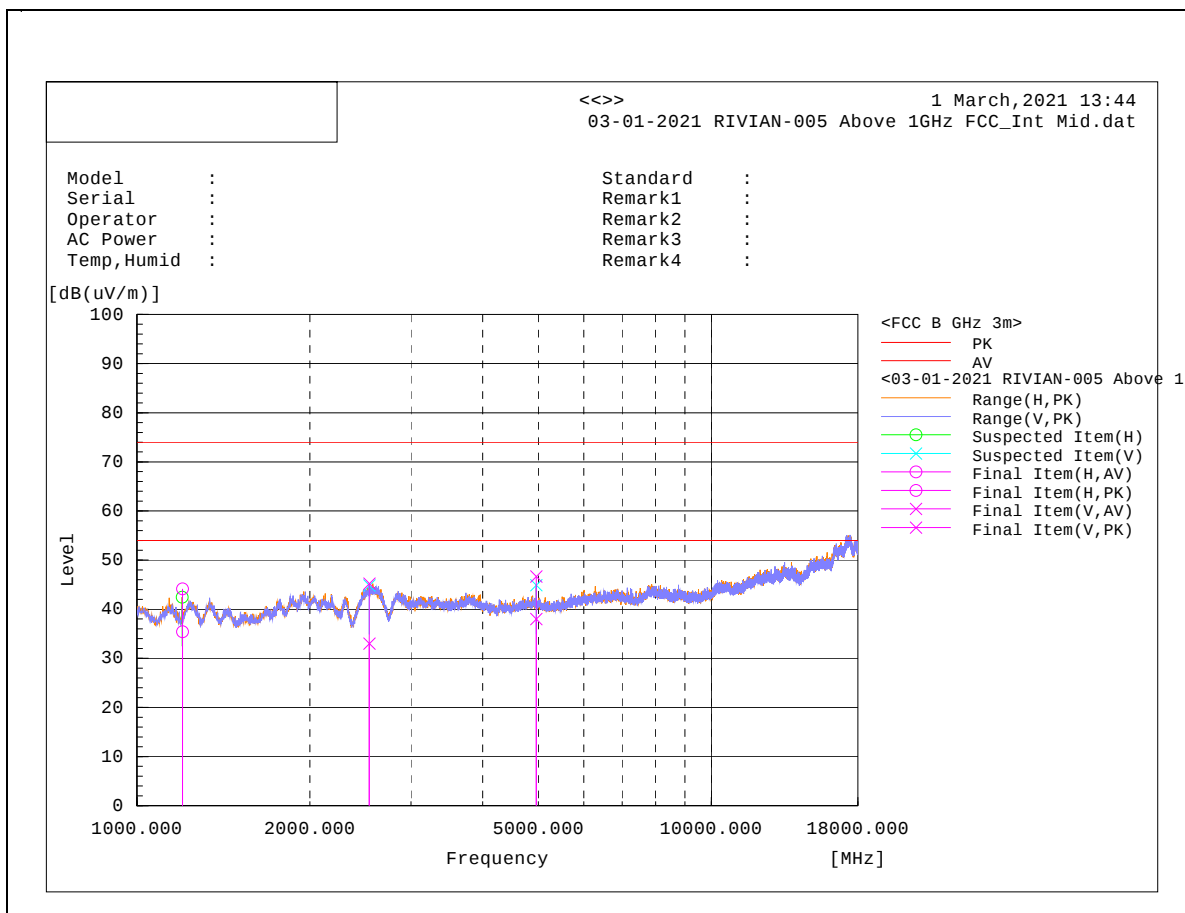
Antenna Polarity & Test Distance: Vertical and Horizontal at 3m

No	Frequency (MHz)	Polarization (H/V)	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]	Height (cm)	Angle (Deg)	Pass / Fail
1	24897.524	H	20.5	33.3	17.7	38.2	51	54	74	-15.8	-23	313	225.8	Pass
2	24897.878	V	20.4	32.6	17.7	38.1	50.3	54	74	-15.9	-23.7	208	244	Pass



CHANNEL	TX Ch 39 (2480MHz)	DETECTOR	Peak
FREQUENCY RANGE	1GHz ~ 25GHz	FUNCTION	Average

ANTENNA POLARITY & test distance: HORIZONTAL & VERTICAL at 3 m											
No	Freq.	Raw	Factor	Level	Measurement Type	Pol	Hgt	Azt	Limit	Margin	Pass /Fail
	[MHz]	(dBuV)	(dB1/m)	(dBuV/m)			(cm)	Deg	(dBuV/m)	(dB)	
1	4959.782	53.7	-7	46.7	Peak Max	V	177	21.4	74	-27.3	Pass
2	2537.813	54.9	-9.7	45.2	Peak Max	V	283	134.9	74	-28.8	Pass
3	1200.016	58.5	-14.4	44.1	Peak Max	H	162	326.9	74	-29.9	Pass
4	4959.782	45	-7	38	Average Max	V	177	21.4	54	-16	Pass
5	2537.813	42.7	-9.7	33	Average Max	V	283	134.9	54	-21	Pass
6	1200.016	49.8	-14.4	35.4	Average Max	H	162	326.9	54	-18.6	Pass

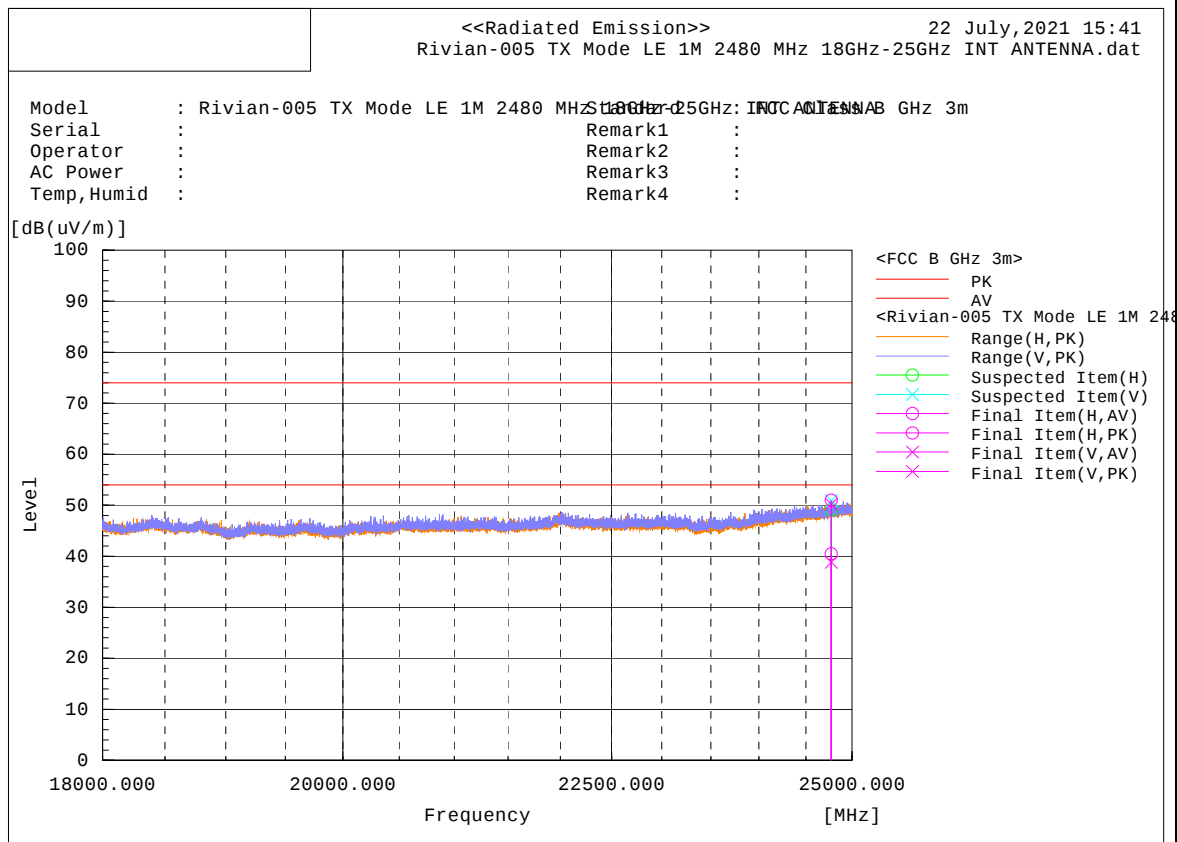


REMARKS:

1. Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
2. Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB) –Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value (dBuV/m)

Antenna Polarity & Test Distance: Vertical and Horizontal at 3m

No	Frequency (MHz)	Polarization (H/V)	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]	Height (cm)	Angle (Deg)	Pass / Fail
1	24772.64	V	21.1	32.6	17.7	38.8	50.3	54	74	-15.2	-23.7	208	145.6	Pass
2	24773.926	H	22.8	33.3	17.7	40.5	51	54	74	-13.5	-23	103	282.9	Pass



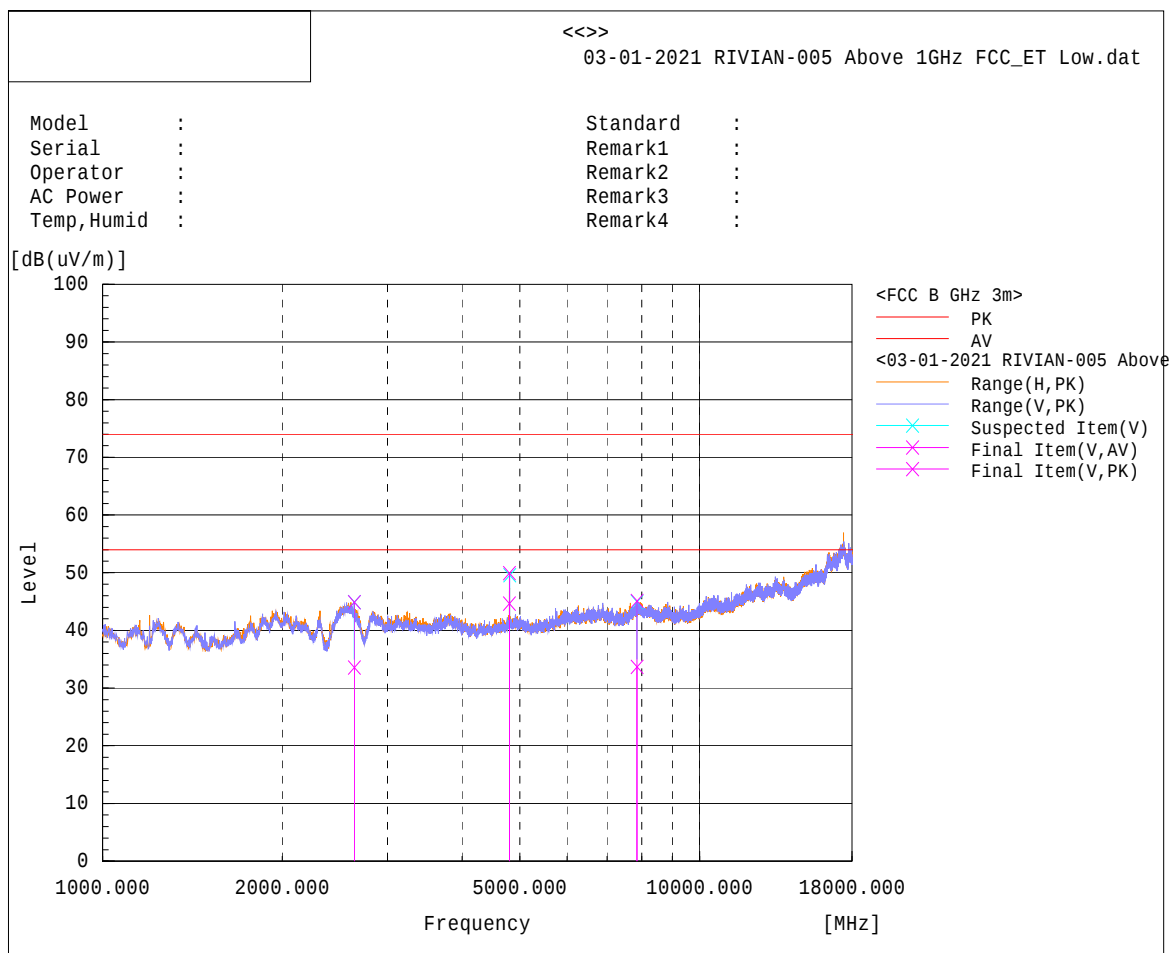
ABOVE 1GHz TEST DATA:

BT-LE (GFSK) (Unit with External Antenna, Data Rate 1Mbps)

CHANNEL	TX Ch 37 (2402MHz)	DETECTOR	Peak
FREQUENCY RANGE	1GHz ~ 25GHz	FUNCTION	Average

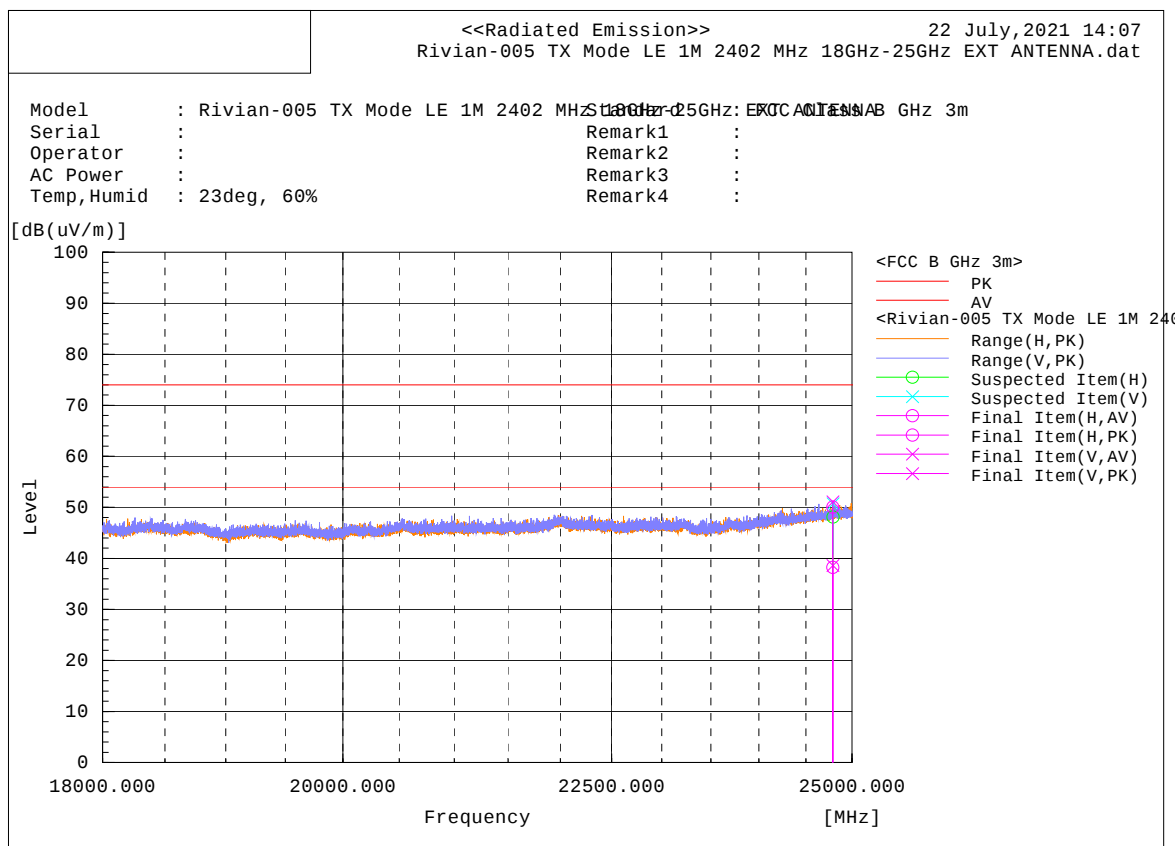
ANTENNA POLARITY & test distance: HORIZONTAL & VERTICAL at 3 m

No	Freq.	Raw	Factor	Level	Measurement Type	Pol	Hgt	Azt	Limit	Margin	Pass /Fail
	[MHz]	(dBuV)	(dB1/m)	(dBuV/m)			(cm)	Deg	(dBuV/m)	(dB)	
1	4803.628	57.3	-7.3	50	Peak Max	V	103	278.8	74	-24	Pass
2	2639.742	54.3	-9.4	44.9	Peak Max	V	274	283.3	74	-29.1	Pass
3	7856.931	45.3	-0.2	45.1	Peak Max	V	317	358.8	74	-28.9	Pass
4	4803.628	52	-7.3	44.7	Average Max	V	103	278.8	54	-9.3	Pass
5	2639.742	43	-9.4	33.6	Average Max	V	274	283.3	54	-20.4	Pass
6	7856.931	33.9	-0.2	33.7	Average Max	V	317	358.8	54	-20.3	Pass



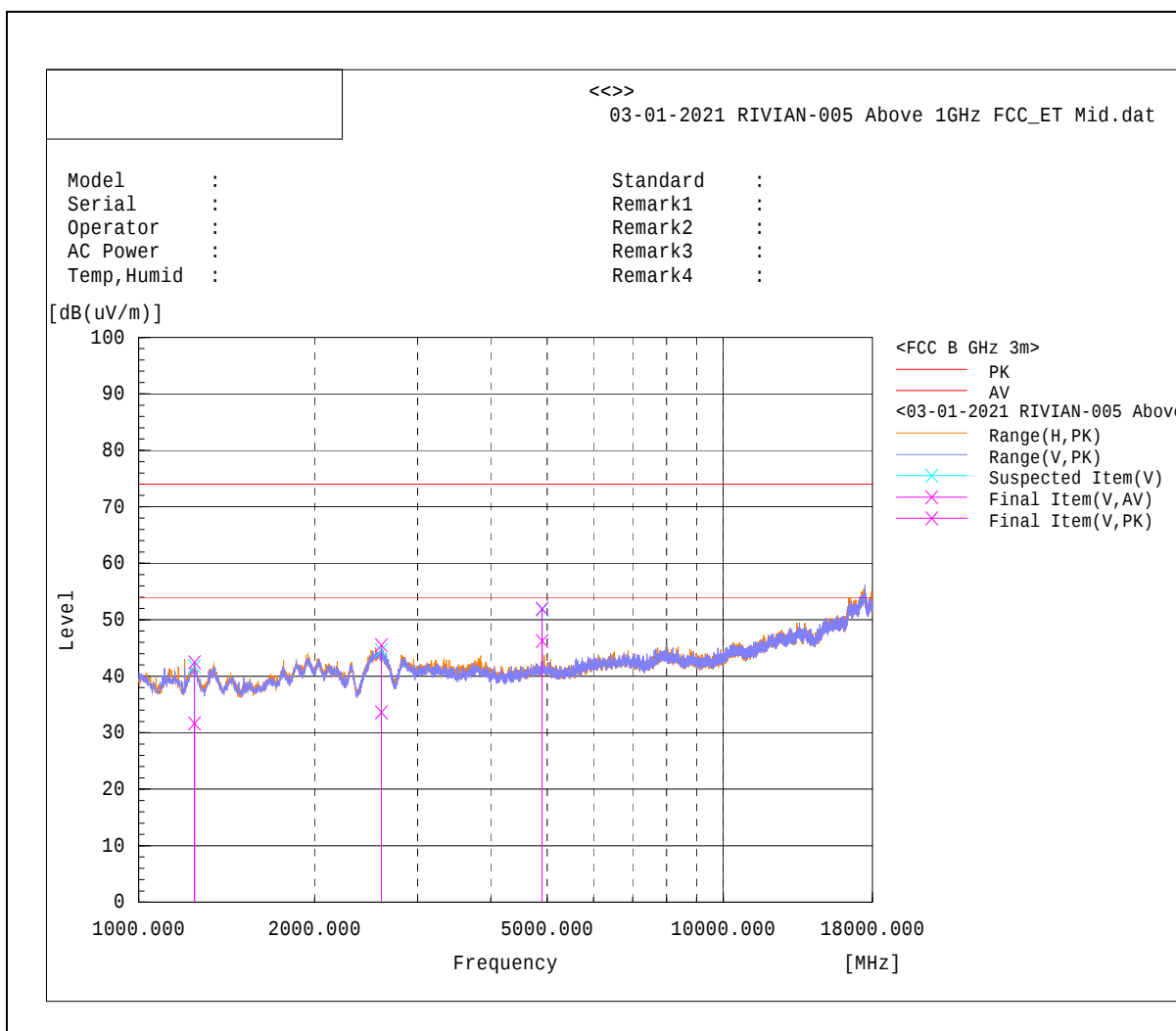
Antenna Polarity & Test Distance: Vertical and Horizontal at 3m

No	Frequency (MHz)	Polarization (H/V)	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]	Height (cm)	Angle (Deg)	Pass / Fail
1	24791.132	H	20.6	32.3	17.7	38.3	50	54	74	-15.7	-24	162	57.9	Pass
2	24789.526	V	20.9	33.4	17.7	38.6	51.1	54	74	-15.4	-22.9	400	123.1	Pass



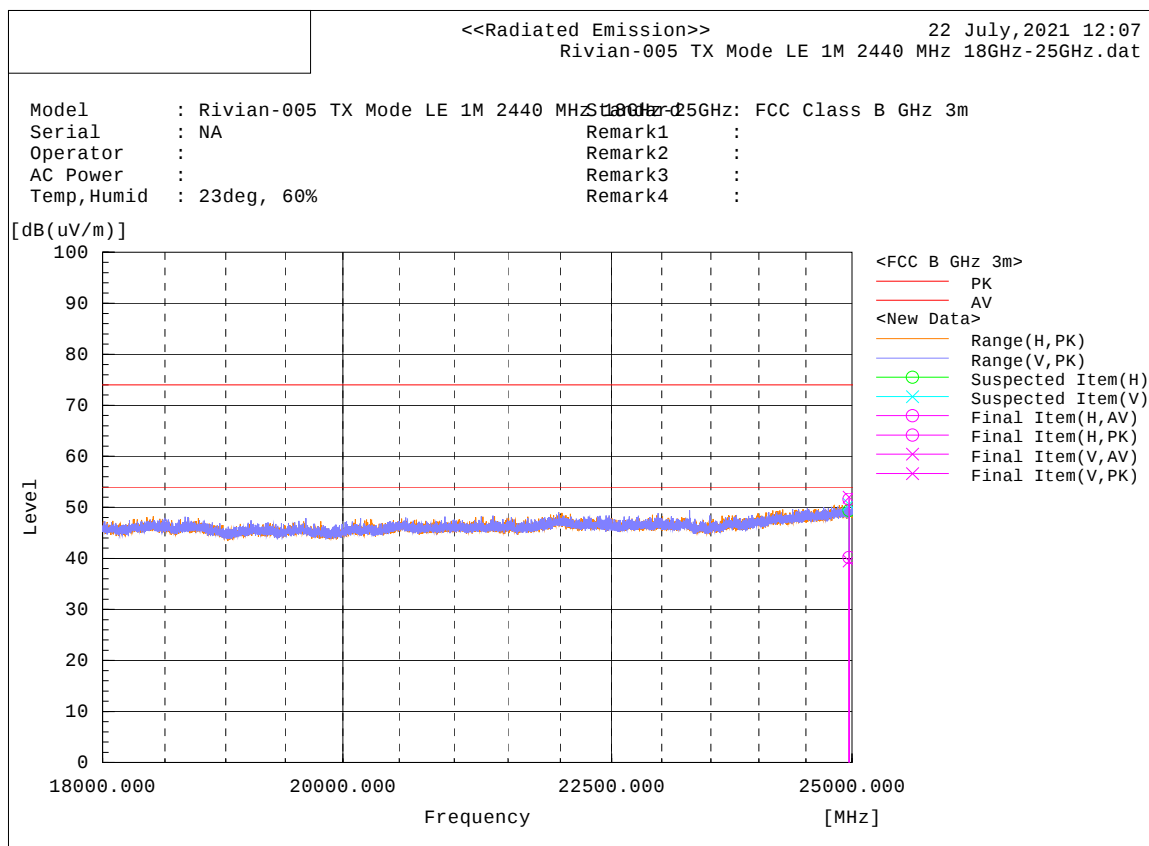
CHANNEL	TX Ch 17 (2440MHz)	DETECTOR	Peak
FREQUENCY RANGE	1GHz ~ 25GHz	FUNCTION	Average

ANTENNA POLARITY & test distance: HORIZONTAL & VERTICAL at 3 m											
No	Freq.	Raw	Factor	Level	Measurement Type	Pol	Hgt	Azt	Limit	Margin	Pass /Fail
	[MHz]	(dBuV)	(dB1/m)	(dBuV/m)			(cm)	Deg	(dBuV/m)	(dB)	
1	4899.952	59.1	-7.1	52	Peak Max	V	177	186.9	74	-22	Pass
2	2601.404	55	-9.5	45.5	Peak Max	V	105	339.2	74	-28.5	Pass
3	1245.926	56.6	-14.1	42.5	Peak Max	V	287	92.3	74	-31.5	Pass
4	4899.952	53.4	-7.1	46.3	Average Max	V	177	186.9	54	-7.7	Pass
5	2601.404	43.1	-9.5	33.6	Average Max	V	105	339.2	54	-20.4	Pass
6	1245.926	45.8	-14.1	31.7	Average Max	V	287	92.3	54	-22.3	Pass



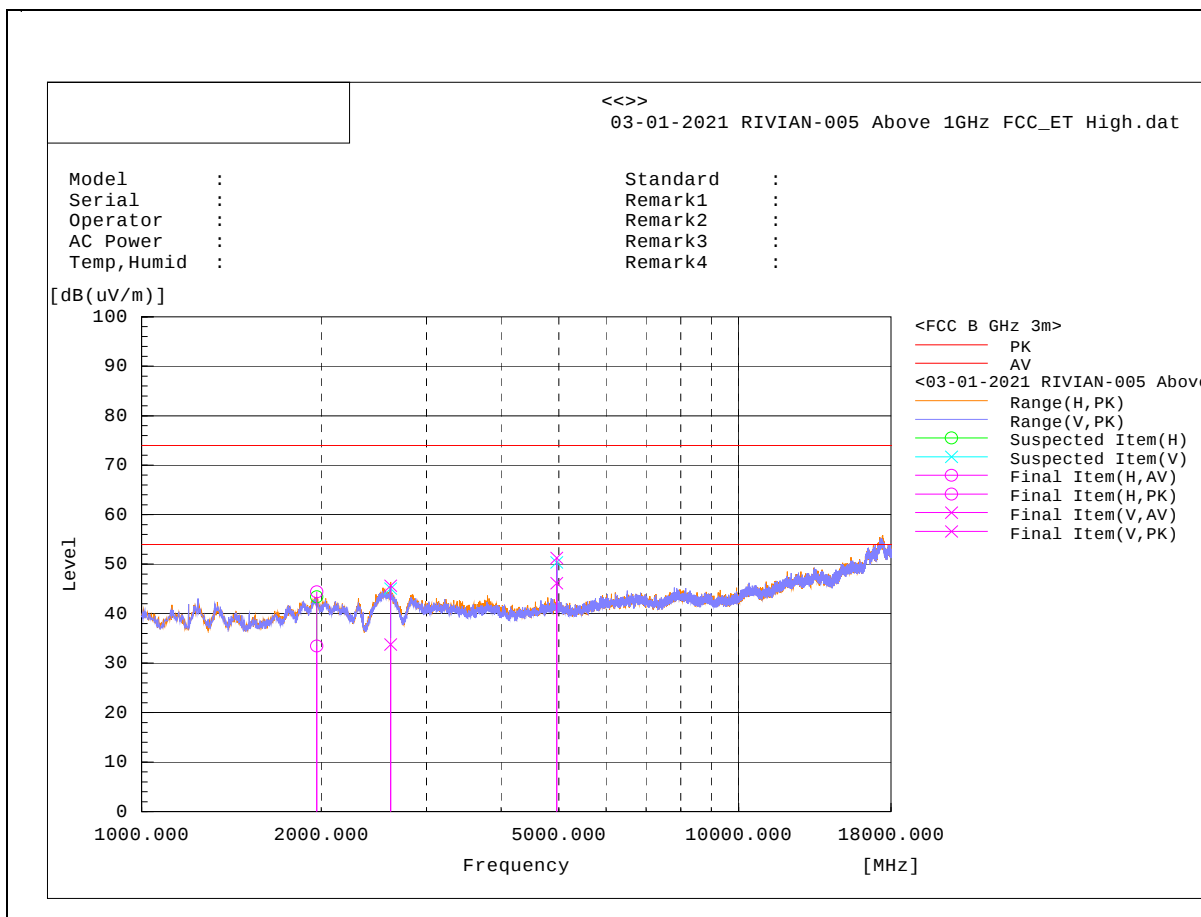
Antenna Polarity & Test Distance: Vertical and Horizontal at 3m

No	Frequency (MHz)	Polarization (H/V)	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]	Height (cm)	Angle (Deg)	Pass / Fail
1	24967.796	H	22.3	33.7	17.9	40.2	51.6	54	74	-13.8	-22.4	389	33.4	Pass
2	24968.116	V	21.6	34.1	17.9	39.5	52	54	74	-14.5	-22	117	358.2	Pass



CHANNEL	TX Ch 39 (2480MHz)	DETECTOR	Peak
FREQUENCY RANGE	1GHz ~ 25GHz	FUNCTION	Average

ANTENNA POLARITY & test distance: HORIZONTAL & VERTICAL at 3 m											
No	Freq.	Raw	Factor	Level	Measurement Type	Pol	Hgt	Azt	Limit	Margin	Pass /Fail
	[MHz]	(dBuV)	(dB1/m)	(dBuV/m)			(cm)	Deg	(dBuV/m)	(dB)	
1	4959.526	58.3	-7	51.3	Peak Max	V	117	355	74	-22.7	Pass
2	2613.882	55.1	-9.4	45.7	Peak Max	V	122	1.6	74	-28.3	Pass
3	1965.716	55	-10.6	44.4	Peak Max	H	135	235.5	74	-29.6	Pass
4	4959.526	53.2	-7	46.2	Average Max	V	117	355	54	-7.8	Pass
5	2613.882	43.2	-9.4	33.8	Average Max	V	122	1.6	54	-20.2	Pass
6	1965.716	44.1	-10.6	33.5	Average Max	H	135	235.5	54	-20.5	Pass

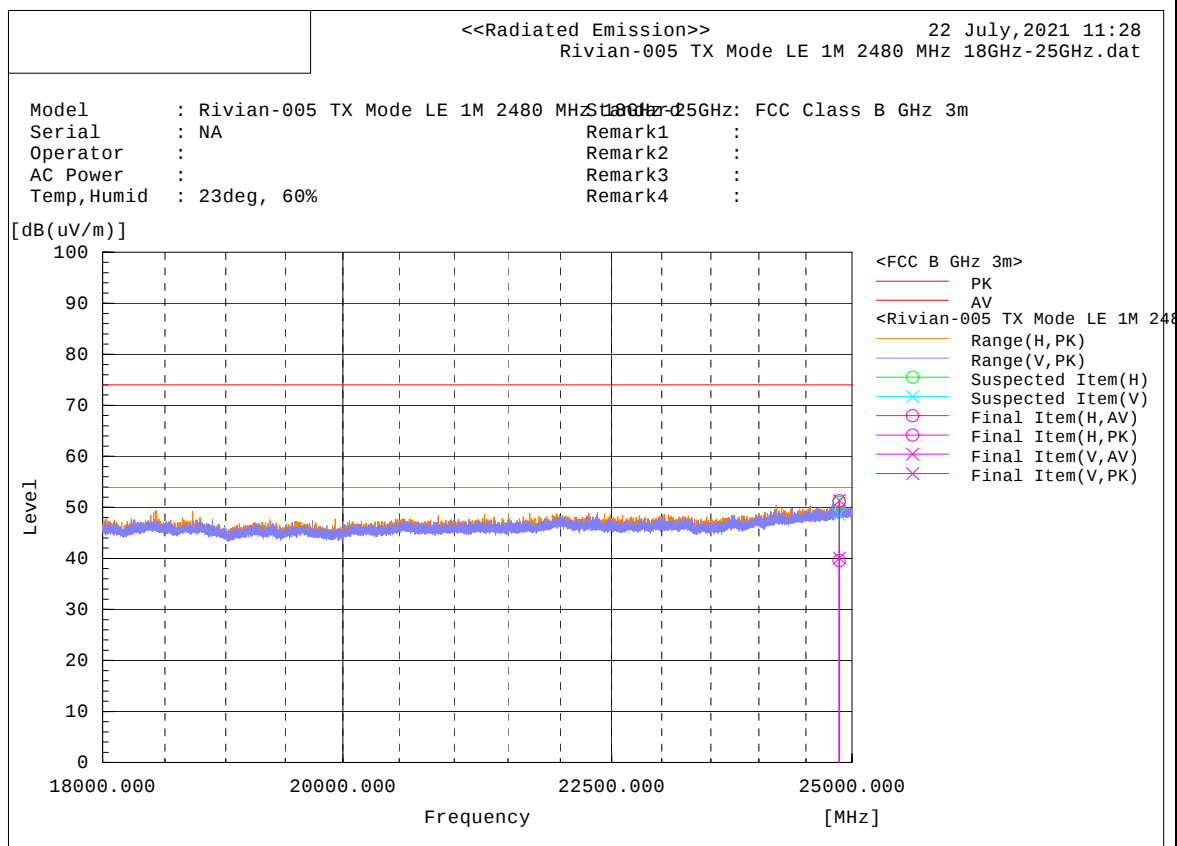


REMARKS:

1. Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
2. Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB) –Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value (dBuV/m)

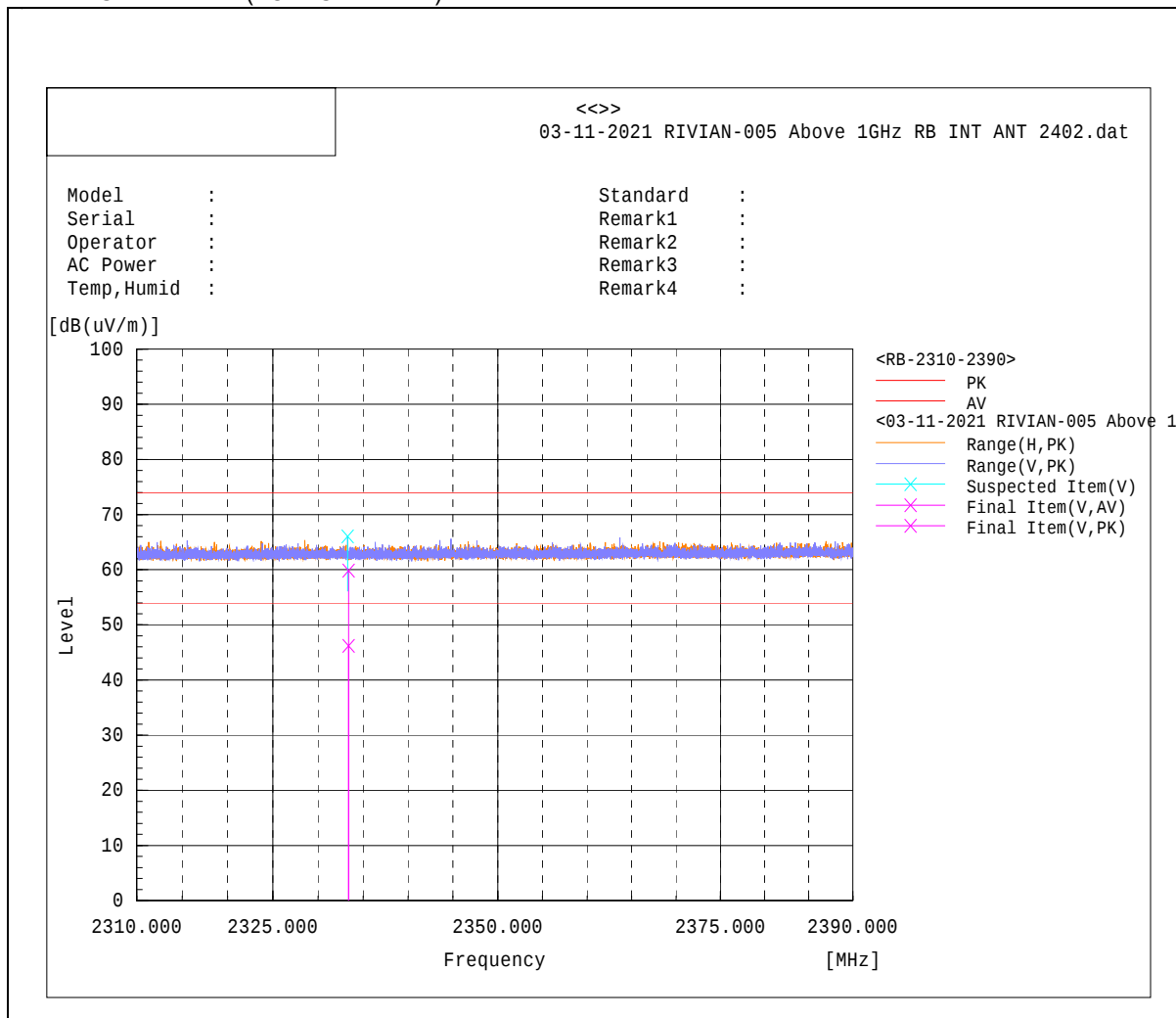
Antenna Polarity & Test Distance: Vertical and Horizontal at 3m

No	Frequency (MHz)	Polarization (H/V)	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]	Height (cm)	Angle (Deg)	Pass / Fail
1	24859.348	H	21.9	33.6	17.7	39.6	51.3	54	74	-14.4	-22.7	314	301.9	Pass
2	24861.004	V	22.4	33.7	17.7	40.1	51.4	54	74	-13.9	-22.6	314	353.4	Pass



BT-LE (GFSK) (Unit with Internal Antenna, Data Rate 1Mbps)

RESTRICTED BAND (LOW CHANNEL)



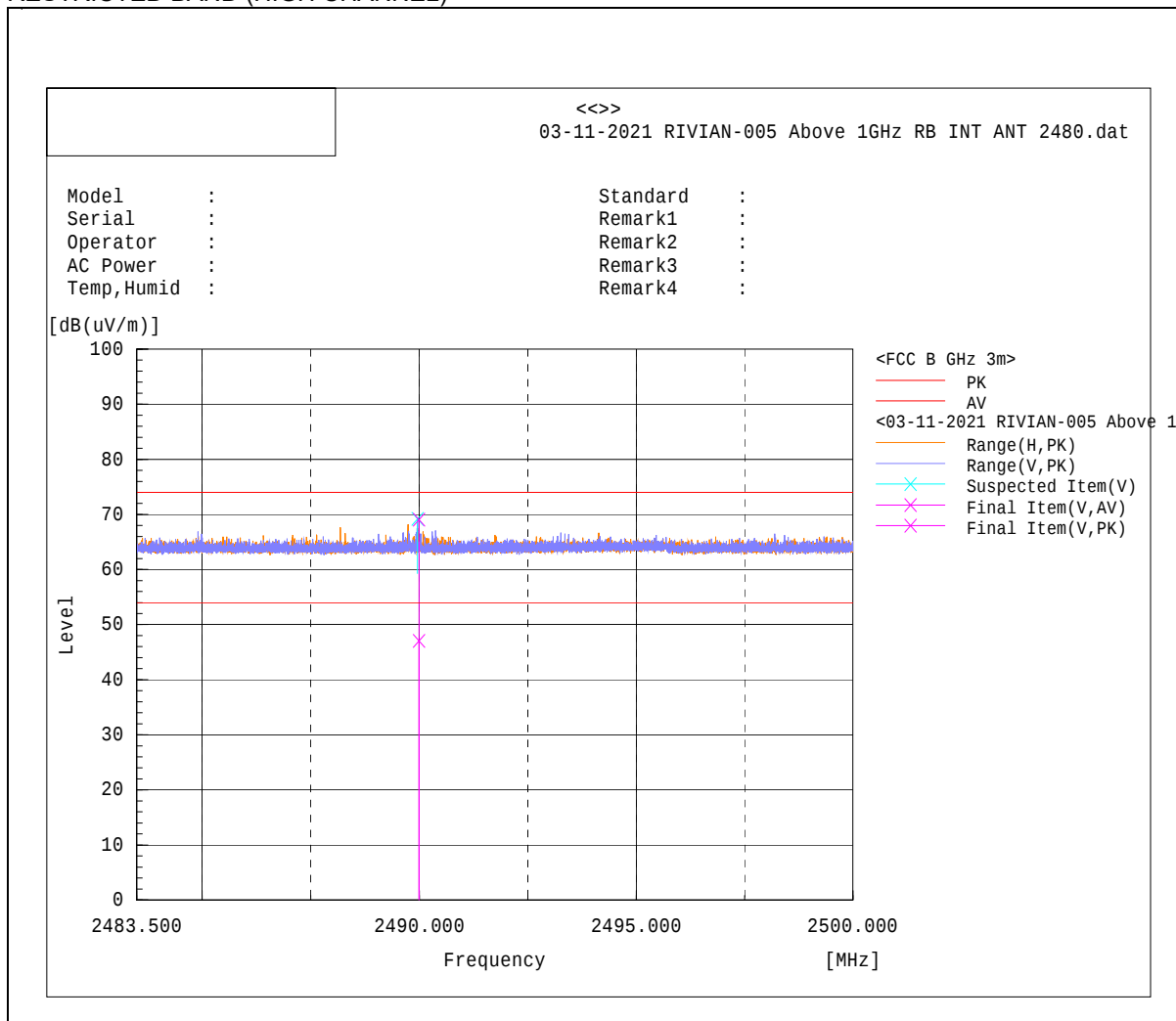
ANTENNA POLARITY & test distance: HORIZONTAL & VERTICAL at 3 m

No	Freq.	Raw	Factor	Level	Measurement Type	Pol	Hgt	Azt	Limit	Margin	Pass /Fail
	[MHz]	(dBuV)	(dB1/m)	(dBuV/m)			(cm)	Deg	(dBuV/m)	(dB)	
1	2333.3	21.1	38.8	59.9	Peak Max	V	264.4	177.1	74	-14.1	Pass
4	2333.3	7.4	38.8	46.2	Average Max	V	264.4	177.1	54	-7.8	Pass

REMARKS:

- Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
- Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB) –Preamplifier Gain (dB)
- Margin = Level (dBuV/m) - Limit value (dBuV/m)

RESTRICTED BAND (HIGH CHANNEL)



ANTENNA POLARITY & test distance: HORIZONTAL & VERTICAL at 3 m

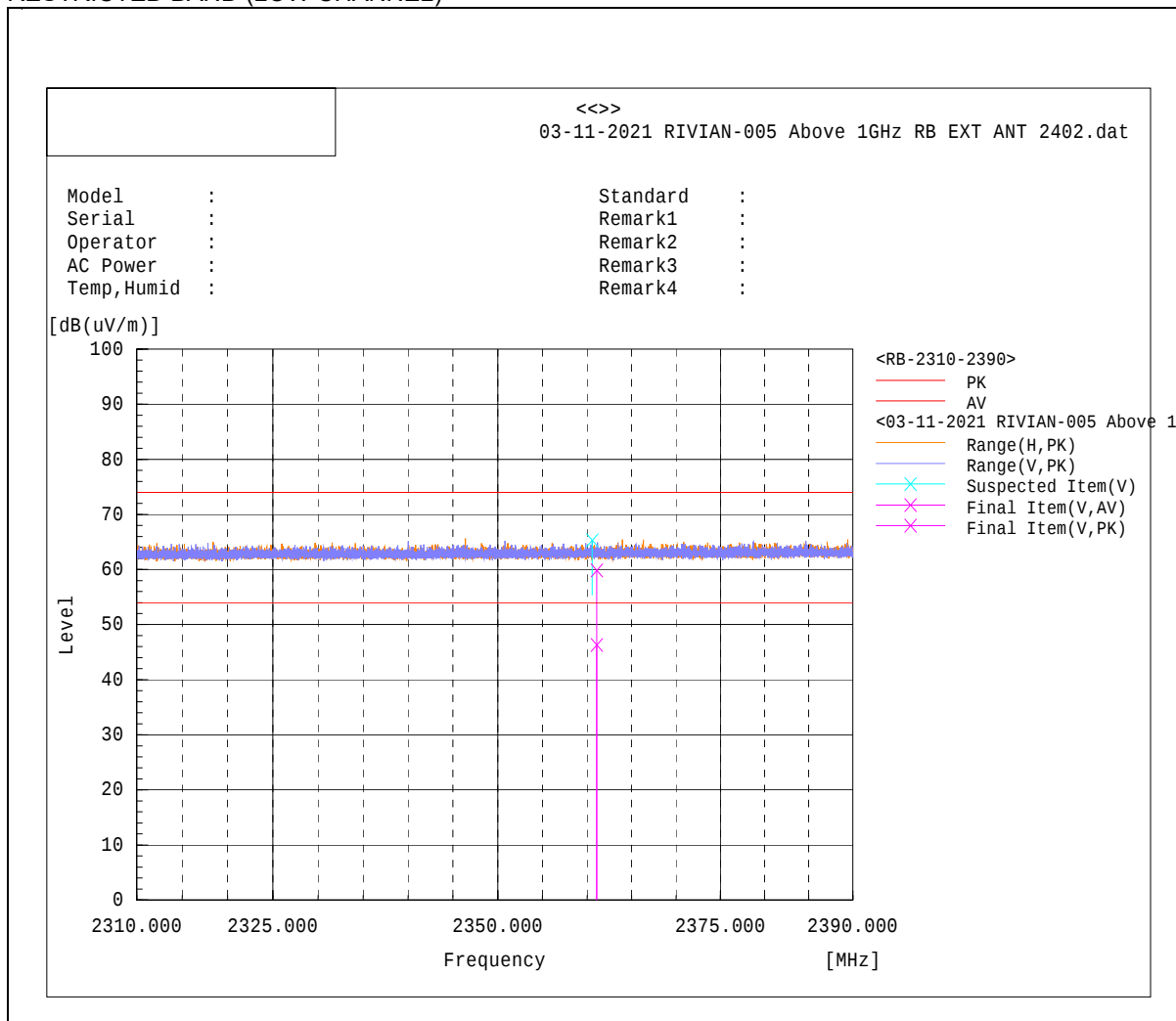
No	Freq.	Raw	Factor	Level	Measurement Type	Pol	Hgt	Azt	Limit	Margin	Pass /Fail
	[MHz]	(dBuV)	(dB1/m)	(dBuV/m)			(cm)	Deg	(dBuV/m)	(dB)	
1	2489.991	29.5	39.6	69.1	Peak Max	V	195.2	0	74	-4.9	Pass
4	2489.991	7.5	39.6	47.1	Average Max	V	195.2	0	54	-6.9	Pass

REMARKS:

- Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
- Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB) –Preamplifier Gain (dB)
- Margin = Level (dBuV/m) - Limit value (dBuV/m)

BT-LE (Unit with External Antenna, Data Rate 1Mbps)

RESTRICTED BAND (LOW CHANNEL)



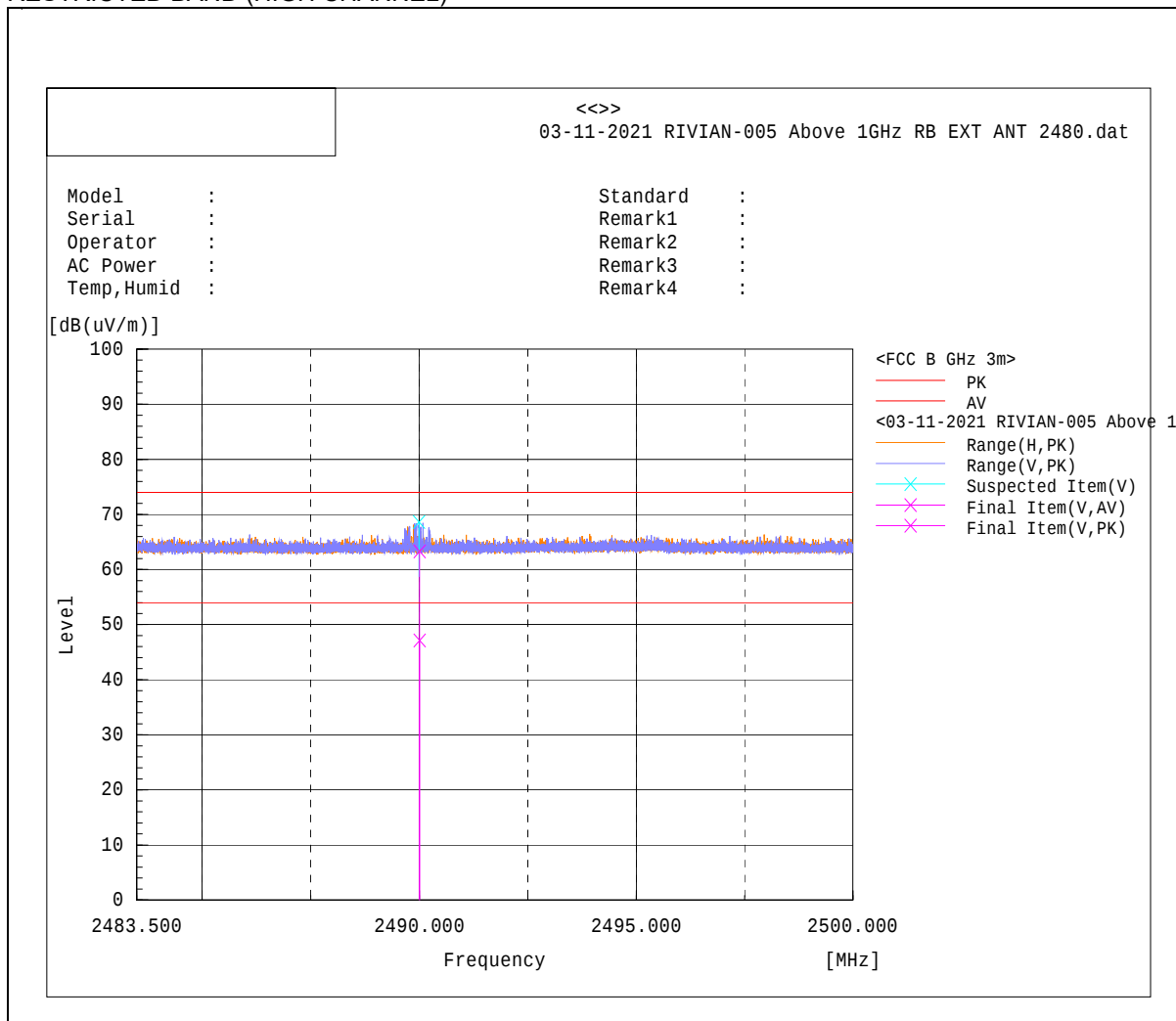
ANTENNA POLARITY & test distance: HORIZONTAL & VERTICAL at 3 m

No	Freq.	Raw	Factor	Level	Measurement Type	Pol	Hgt	Azt	Limit	Margin	Pass /Fail
	[MHz]	(dBuV)	(dB1/m)	(dBuV/m)			(cm)	Deg	(dBuV/m)	(dB)	
1	2361.08	20.9	38.9	59.8	Peak Max	V	0	68.1	74	-14.2	Pass
4	2361.08	7.4	38.9	46.3	Average Max		0	68.1	54	-7.7	Pass

REMARKS:

- Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
- Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB) –Preamplifier Gain (dB)
- Margin = Level (dBuV/m) - Limit value (dBuV/m)

RESTRICTED BAND (HIGH CHANNEL)



ANTENNA POLARITY & test distance: HORIZONTAL & VERTICAL at 3 m

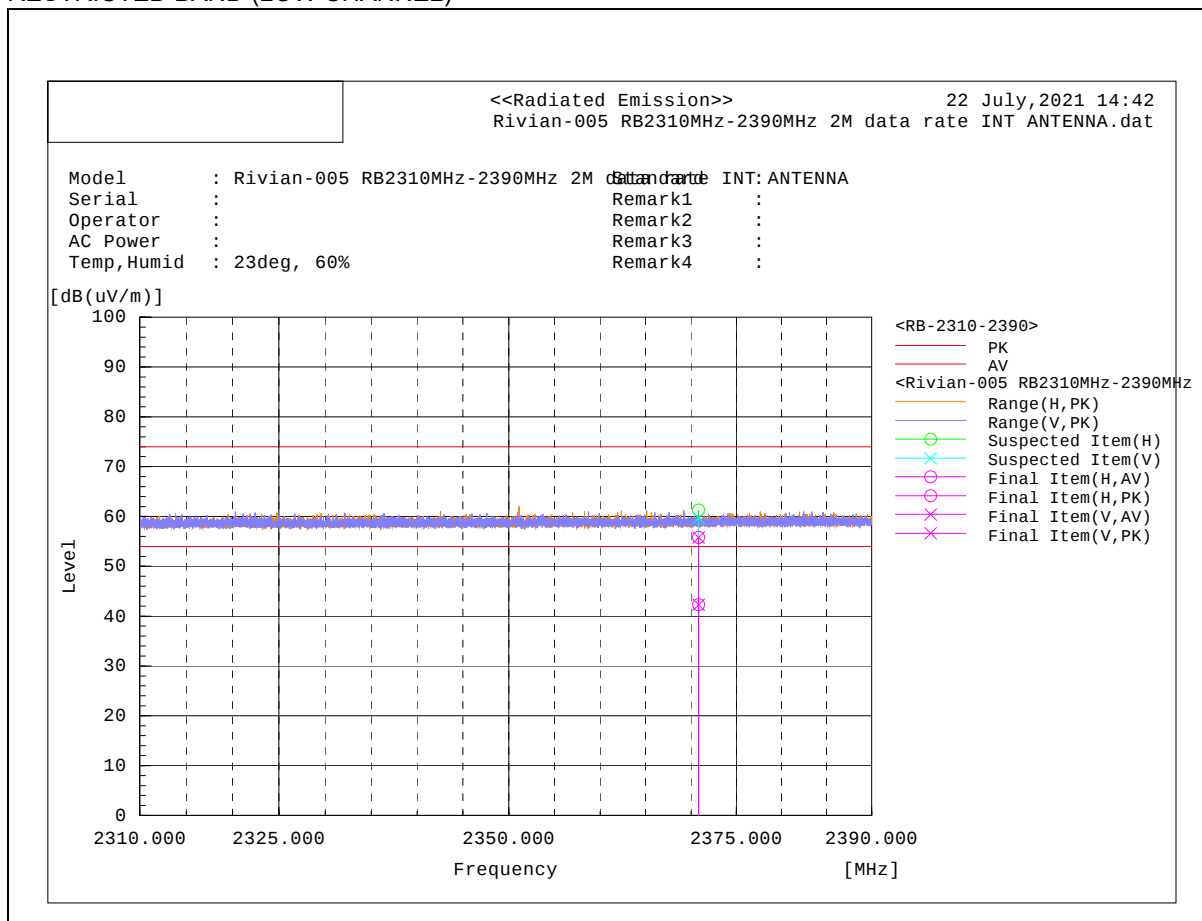
No	Freq.	Raw	Factor	Level	Measurement Type	Pol	Hgt	Azt	Limit	Margin	Pass /Fail
	[MHz]	(dBuV)	(dB1/m)	(dBuV/m)			(cm)	Deg	(dBuV/m)	(dB)	
1	2490.007	23.7	39.6	63.3	Peak Max	V	100.1	277.6	74	-10.7	Pass
4	2490.007	7.5	39.6	41.7	Average Max	V	100.1	277.6	54	-6.9	Pass

REMARKS:

- Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
- Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB) –Preamplifier Gain (dB)
- Margin = Level (dBuV/m) - Limit value (dBuV/m)

BT-LE (GFSK) (Unit with Internal Antenna, Data Rate 2Mbps)

RESTRICTED BAND (LOW CHANNEL)

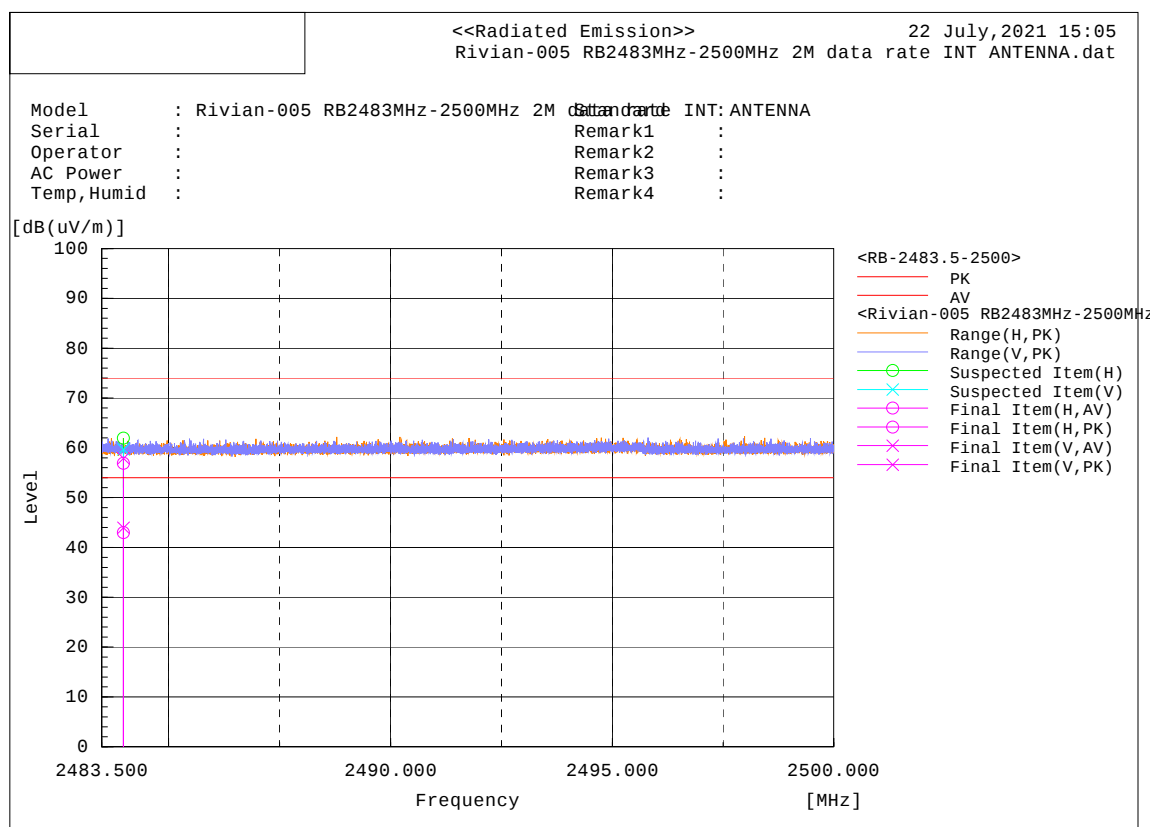


Antenna Polarity & Test Distance: Vertical and Horizontal at 3m														
No	Frequency (MHz)	Polarization (H/V)	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]	Height (cm)	Angle (Deg)	Pass/Fail
1	2370.84	H	7.4	20.9	34.9	42.3	55.8	54	74	-11.7	-18.2	152	182.6	Pass
2	2370.84	V	7.4	20.9	34.9	42.3	55.8	54	74	-11.7	-18.2	145	287.2	Pass

REMARKS:

- Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
- Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB) –Preamplifier Gain (dB)
- Margin = Level (dBuV/m) - Limit value (dBuV/m)

RESTRICTED BAND (HIGH CHANNEL)



Antenna Polarity & Test Distance: Vertical and Horizontal at 3m

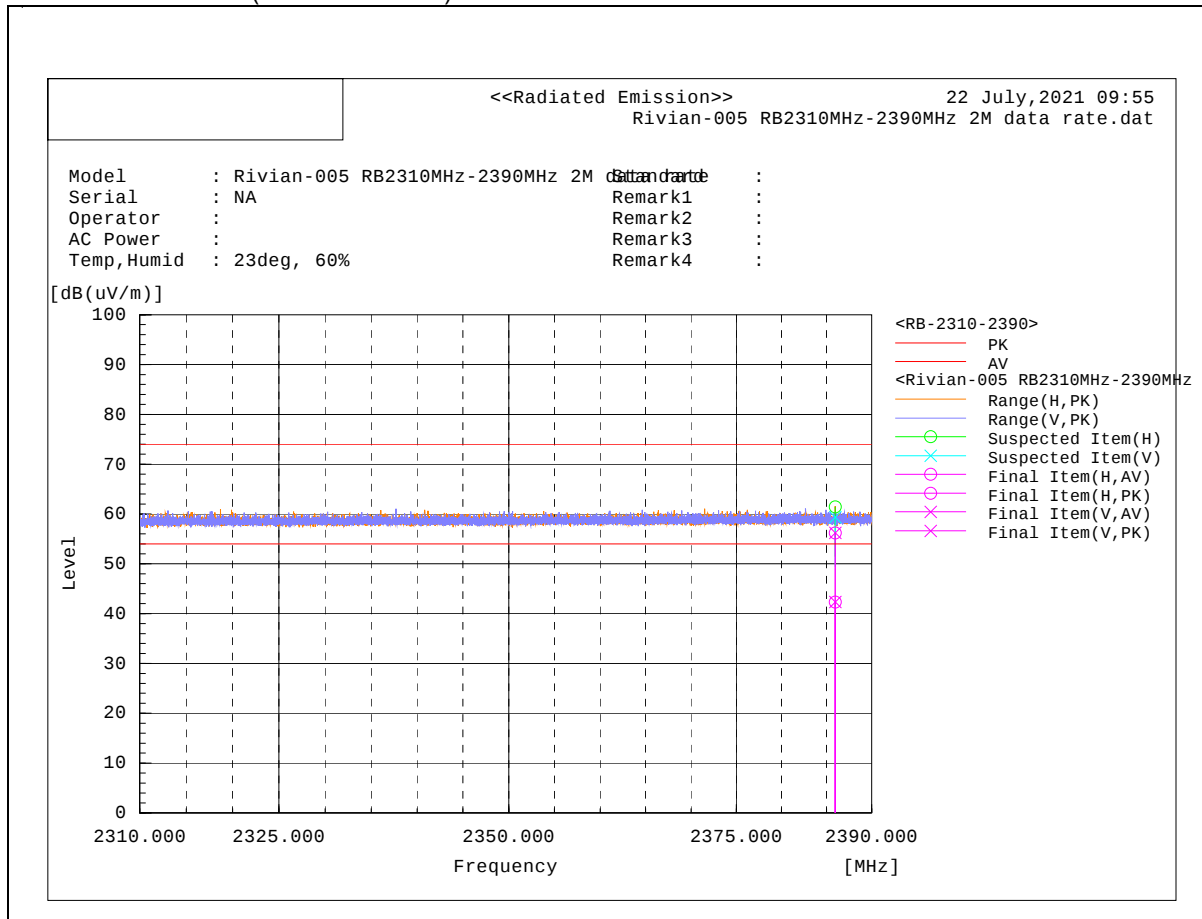
No	Frequency (MHz)	Polarization (H/V)	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]	Height (cm)	Angle (Deg)	Pass/Fail
1	2483.989	H	7.6	21.5	35.4	43	56.9	54	74	-11	-17.1	370	288	Pass
2	2483.989	V	8.6	22.5	35.4	44	57.9	54	74	-10	-16.1	271	65	Pass

REMARKS:

- Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
- Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB) –Preamplifier Gain (dB)
- Margin = Level (dBuV/m) - Limit value (dBuV/m)

BT-LE (Unit with External Antenna, Data Rate 2Mbps)

RESTRICTED BAND (LOW CHANNEL)

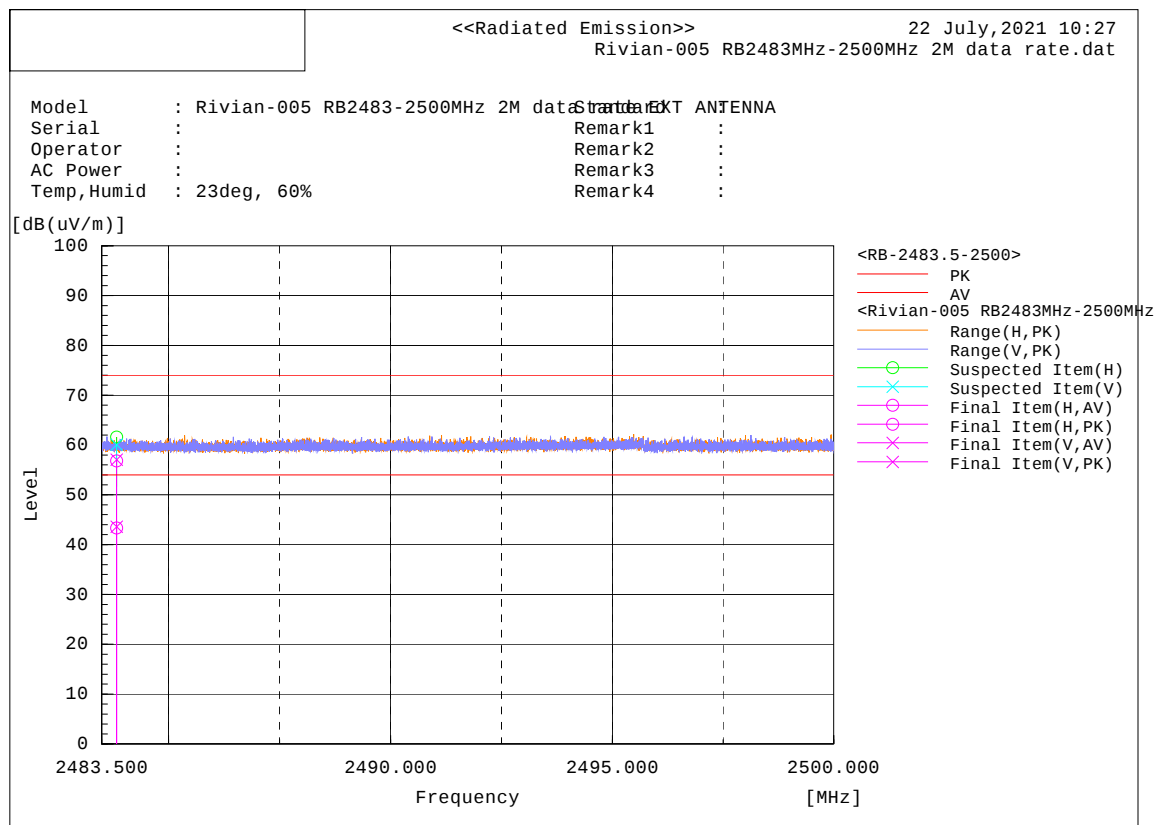


Antenna Polarity & Test Distance: Vertical and Horizontal at 3m														
No	Frequency (MHz)	Polarization (H/V)	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]	Height (cm)	Angle (Deg)	Pass/Fail
1	2385.968	H	7.3	21.2	35	42.3	56.2	54	74	-11.7	-17.8	323	233.4	Pass
2	2385.968	V	7.3	21.3	35	42.3	56.3	54	74	-11.7	-17.7	365	356.8	Pass

REMARKS:

- Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
- Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB) –Preamplifier Gain (dB)
- Margin = Level (dBuV/m) - Limit value (dBuV/m)

RESTRICTED BAND (HIGH CHANNEL)



Antenna Polarity & Test Distance: Vertical and Horizontal at 3m														
No	Frequency (MHz)	Polarization (H/V)	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]	Height (cm)	Angle (Deg)	Pass/Fail
1	2483.835	H	7.9	21.4	35.4	43.3	56.8	54	74	-10.7	-17.2	331	80.9	Pass
2	2483.835	V	8.2	21.6	35.4	43.6	57	54	74	-10.4	-17	384	359.8	Pass

REMARKS:

- Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
- Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB) –Preamplifier Gain (dB)
- Margin = Level (dBuV/m) - Limit value (dBuV/m)

4.2 Conducted Emission Measurement

4.2.1 Limits of Conducted Emission Measurement

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15 - 0.5	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30.0	60	50

Note: 1. The lower limit shall apply at the transition frequencies.

2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

4.2.2 Test Procedures

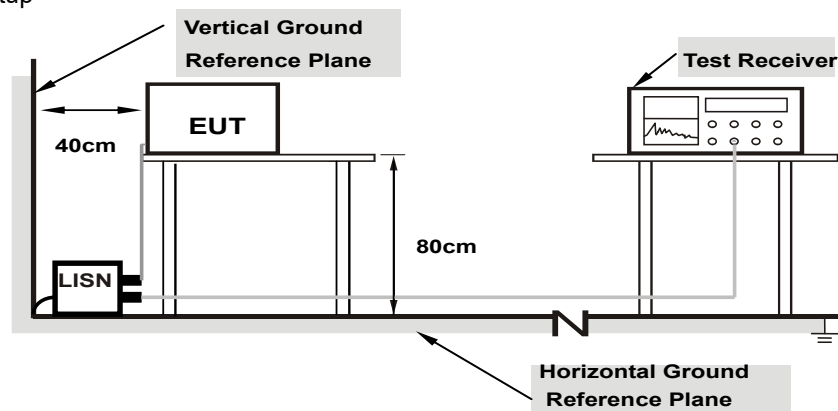
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.
- Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

NOTE: The resolution bandwidth and video bandwidth of test receiver is 9kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15MHz-30MHz.

4.2.3 Deviation from Test Standard

No deviation.

4.2.4 Test Setup



Note: 1.Support units were connected to second LISN.

For the actual test configuration, please refer to the attached file (Test Setup Photo).

4.2.5 EUT Operating Conditions

Same as 4.1.6.

4.2.6 Test Results

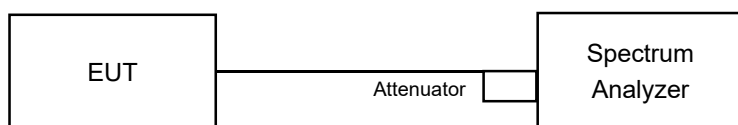
N/A (Unit powered by battery).

4.3 6dB Bandwidth Measurement & 99% Bandwidth Measurement

4.3.1 Limits of 6dB Bandwidth Measurement

The minimum of 6dB Bandwidth Measurement is 0.5 MHz.

4.3.2 Test Setup



4.3.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.3.4 Test Procedure

99% Bandwidth Measurement

Refer to ANSI C63.10 section 6.9.3

-6dB Bandwidth Measurement

- Set resolution bandwidth (RBW) = 100kHz
- Set the video bandwidth (VBW) $\geq 3 \times$ RBW, Detector = Peak.
- Trace mode = max hold.
- Sweep = auto couple.
- Measure the maximum width of the emission that is constrained by the frequencies associated with the two amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission

4.3.5 Deviation from Test Standard

No deviation.

4.3.6 EUT Operating Conditions

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

4.3.7 Test Result

Data Rate 1Mbps

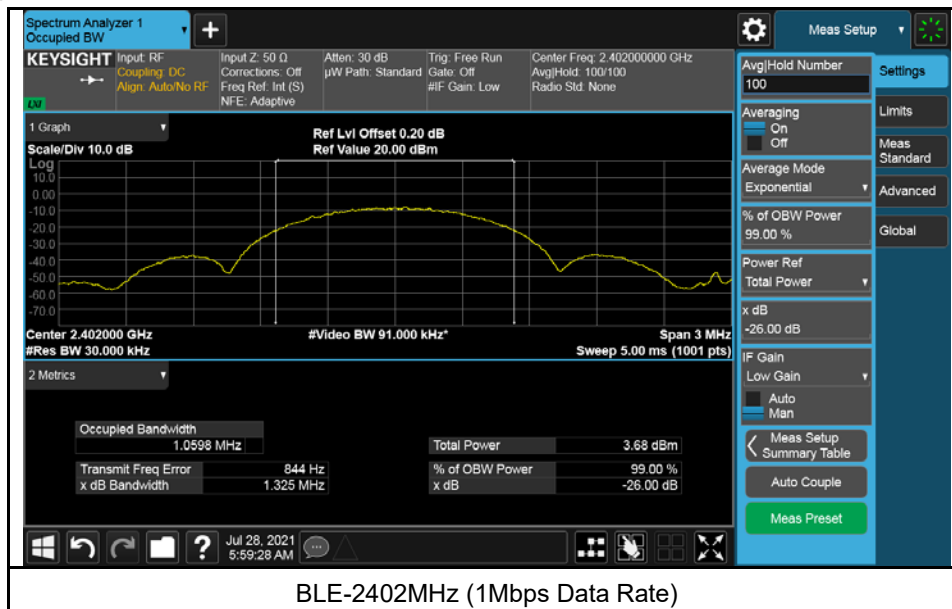
Channel	Frequency (MHz)	6dB Bandwidth (MHz)	99% Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
37	2402	0.7297	1.0598	0.5	PASS
17	2440	0.7371	1.0601	0.5	PASS
39	2480	0.7125	1.0532	0.5	PASS

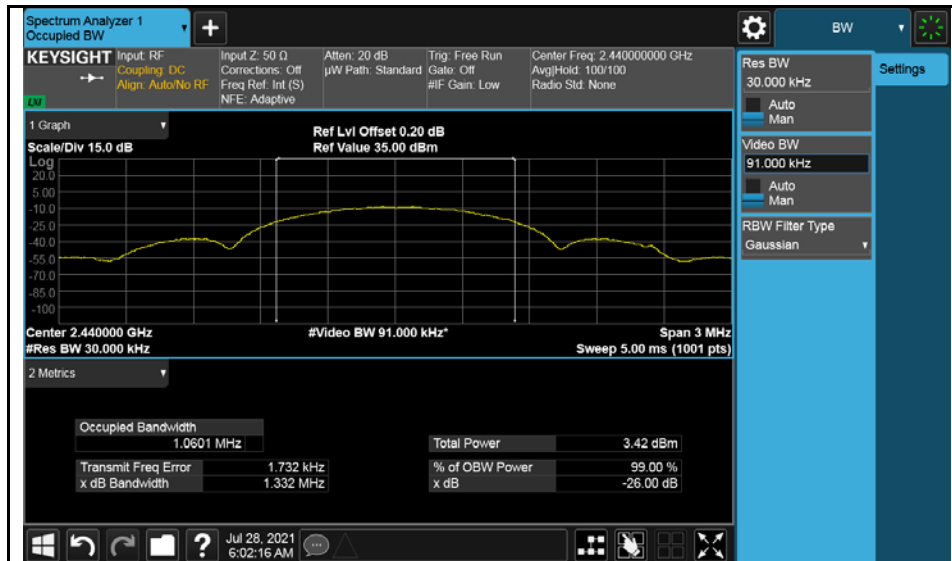
Data Rate 2bps

Channel	Frequency (MHz)	6dB Bandwidth (MHz)	99% Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
37	2402	1.321	2.0826	0.5	PASS
17	2440	1.454	2.0960	0.5	PASS
39	2480	1.409	2.0937	0.5	PASS

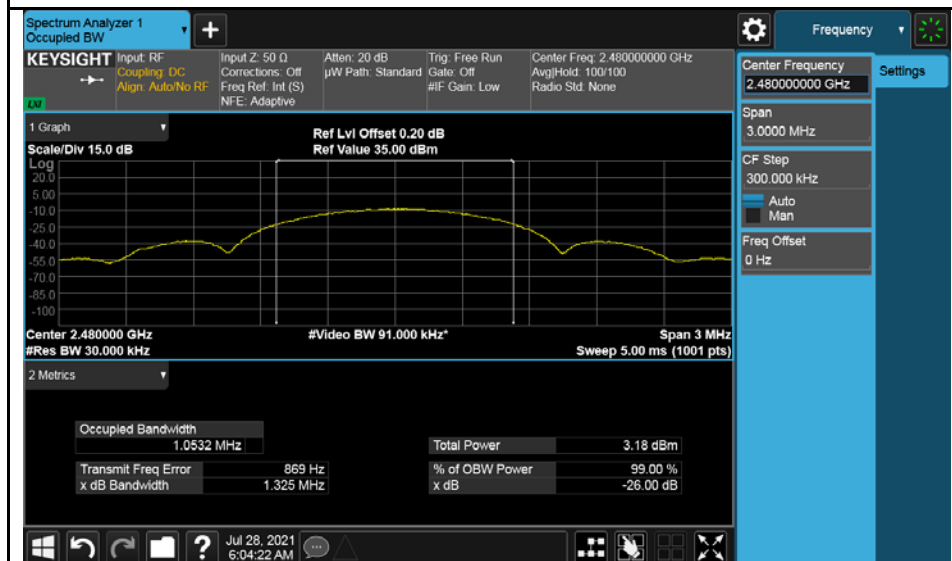
Test Plots:

99% Occupied Bandwidth:

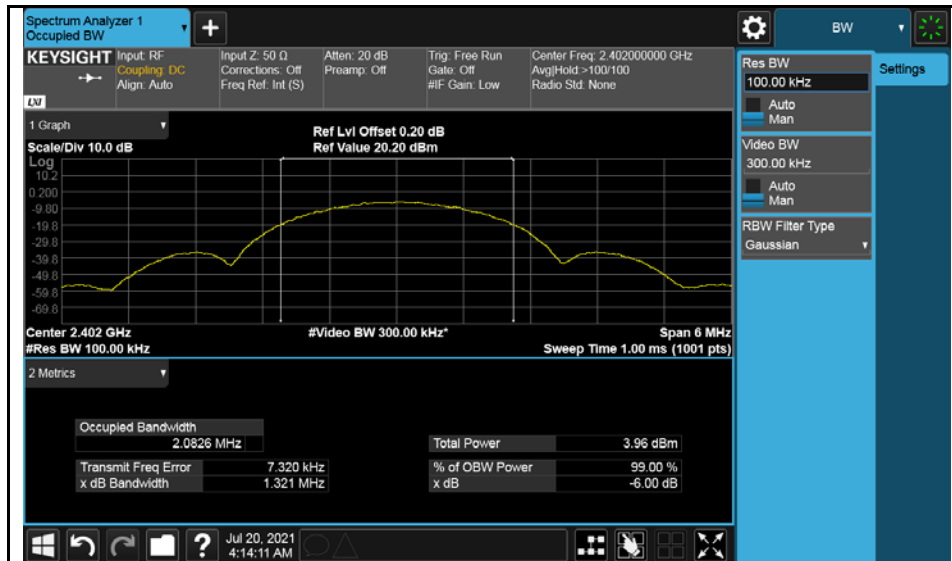




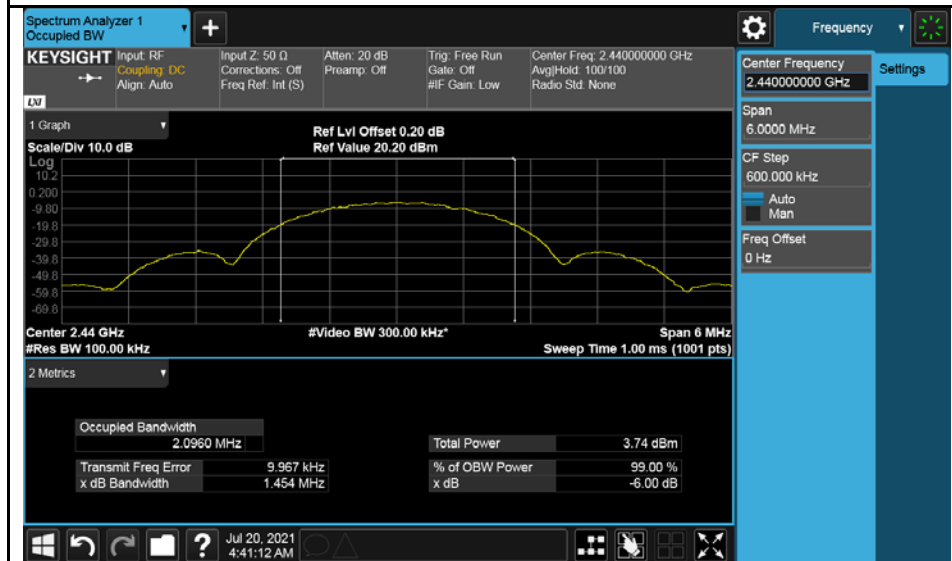
BLE-2440MHz (1Mbps Data Rate)



BLE-2480MHz (1Mbps Data Rate)



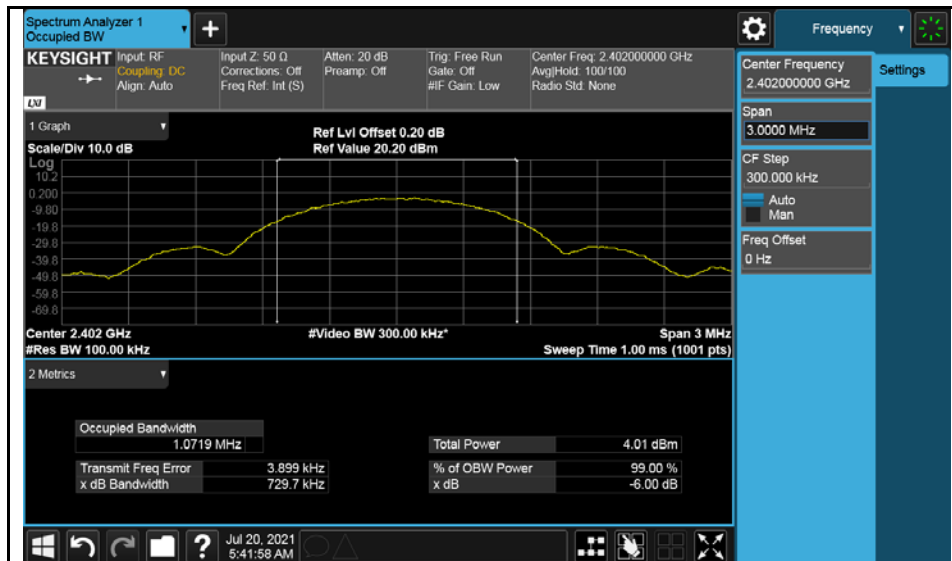
BLE-2402MHz (2Mbps Data Rate)



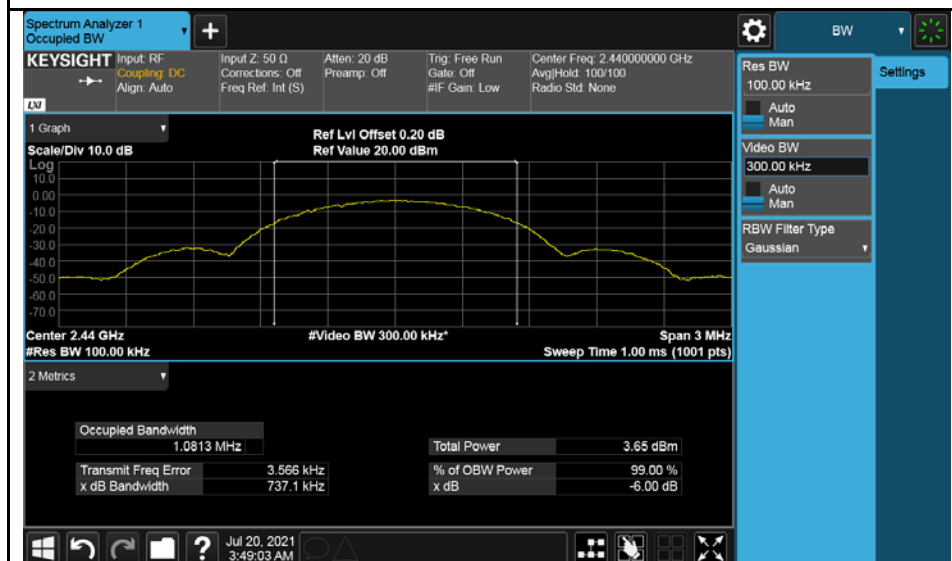
BLE-2440MHz (2Mbps Data Rate)



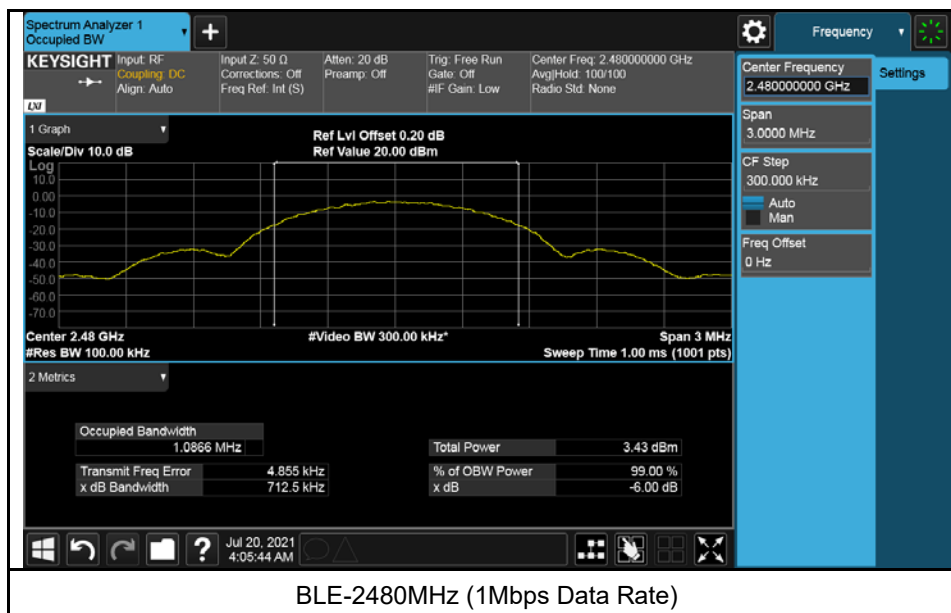
-6 dB Occupied Bandwidth:

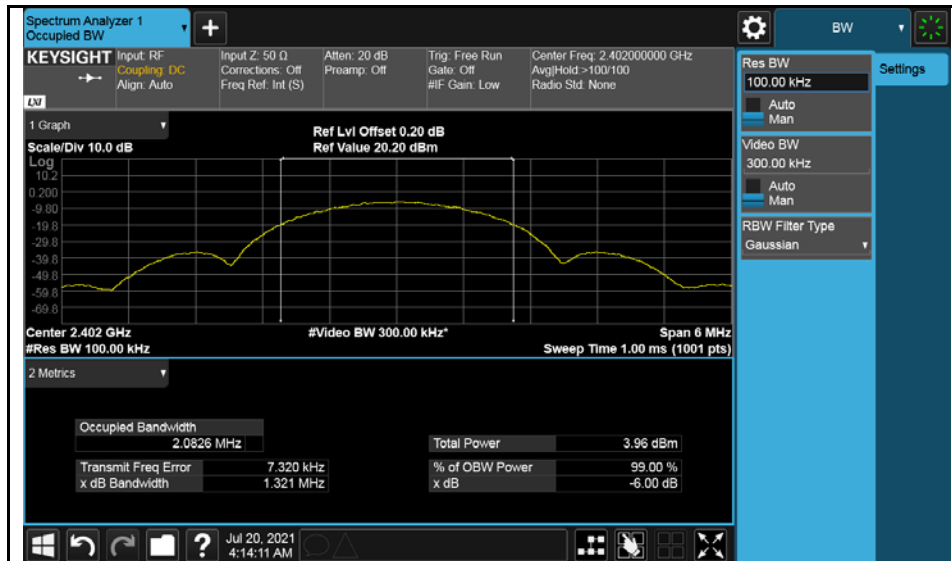


BLE-2402MHz (1Mbps Data Rate)

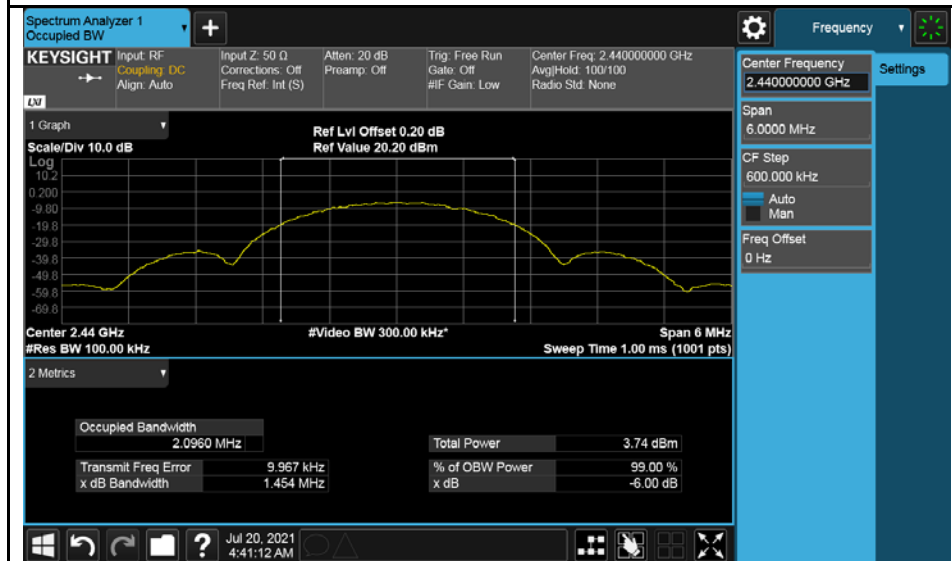


BLE-2440MHz (1Mbps Data Rate)





BLE-2402MHz (2Mbps Data Rate)



BLE-2440MHz (2Mbps Data Rate)

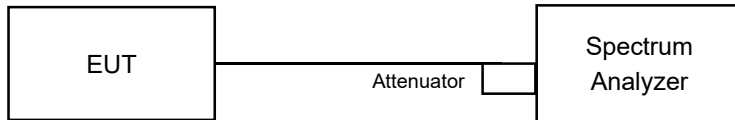


4.4 Conducted Output Power Measurement

4.4.1 Limits of Conducted Output Power Measurement

For systems using digital modulation in the 2400–2483.5 MHz bands: 1 Watt (30dBm)

4.4.2 Test Setup



4.4.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.4.4 Test Procedures

- a. Set the RBW $\geq$ DTS bandwidth.
- b. Set VBW $\geq 3 \times$ RBW.
- c. Set span $\geq 3 \times$ RBW
- d. Sweep time = auto couple.
- e. Detector = peak.
- f. Trace mode = max hold.
- g. Allow trace to fully stabilize.
- h. Use peak marker function to determine the peak amplitude level.

4.4.5 Deviation from Test Standard

No deviation.

4.4.6 EUT Operating Conditions

Same as Item 4.3.6.

4.4.7 Test Results

Data Rate: 1Mbps

Channel	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Pass/Fail
37	2402	5.04	30	Pass
17	2440	4.50	30	Pass
39	2480	4.43	30	Pass

Data Rate: 2Mbps

Channel	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Pass/Fail
37	2402	3.71	30	Pass
17	2440	3.32	30	Pass
39	2480	3.13	30	Pass

Test Plots:

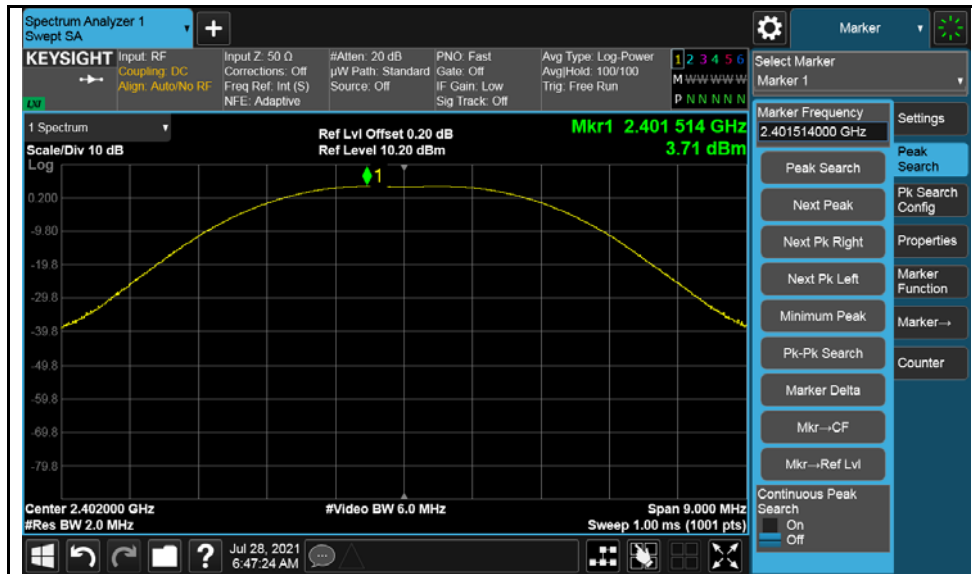




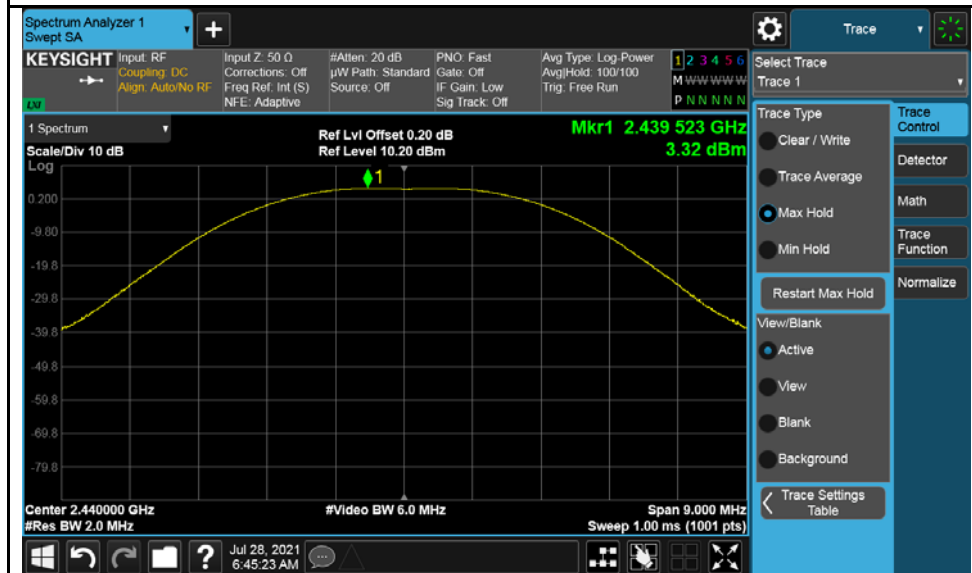
BLE-2440MHz (1Mbps Data Rate)



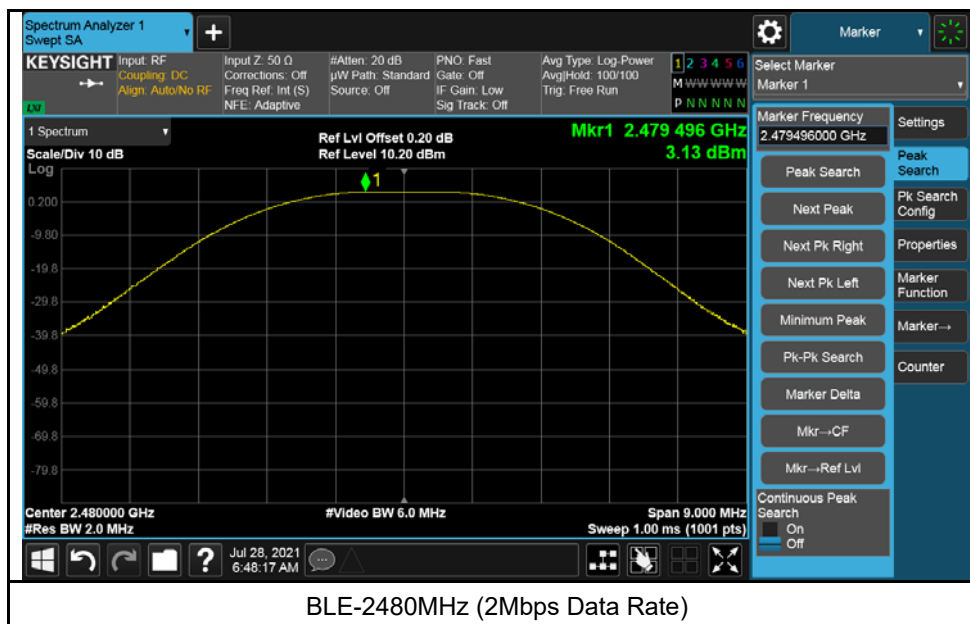
BLE-2480MHz (1Mbps Data Rate)



BLE-2402MHz (2Mbps Data Rate)



BLE-2440MHz (2Mbps Data Rate)

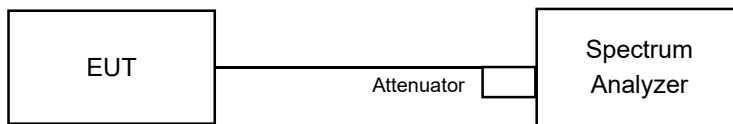


4.5 Power Spectral Density Measurement

4.5.1 Limits of Power Spectral Density Measurement

The Maximum of Power Spectral Density Measurement is 8dBm in any 3 kHz.

4.5.2 Test Setup



4.5.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.5.4 Test Procedure

- Set analyzer center frequency to DTS channel center frequency.
- Set the span to 1.5 times the DTS bandwidth.
- Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- Set the VBW $\geq 3 \times \text{RBW}$.
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level within the RBW.

4.5.5 Deviation from Test Standard

No deviation.

4.5.6 EUT Operating Condition

Same as Item 4.3.6

4.5.7 Test Results

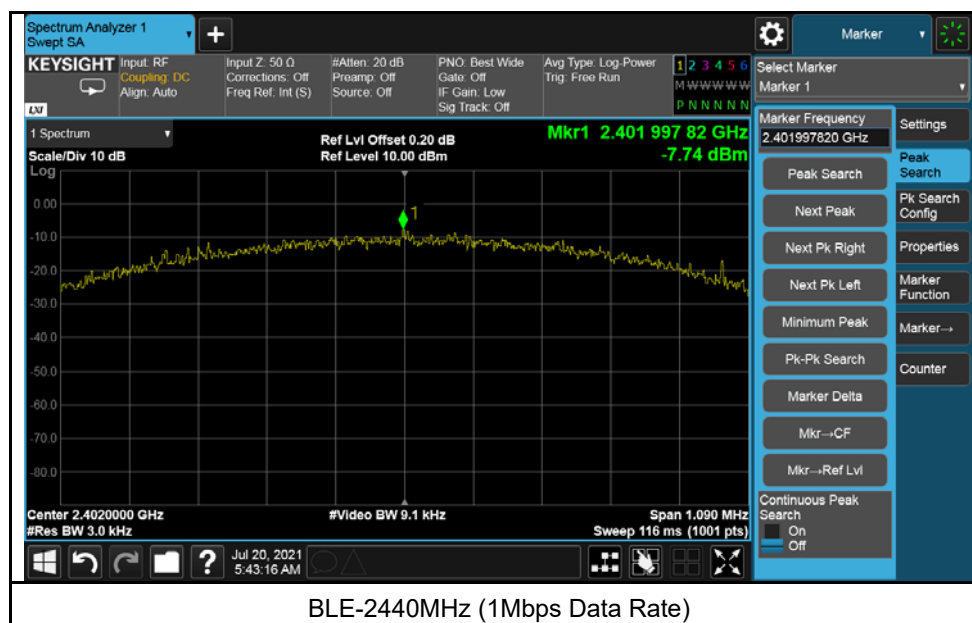
Data Rate: 1Mbps

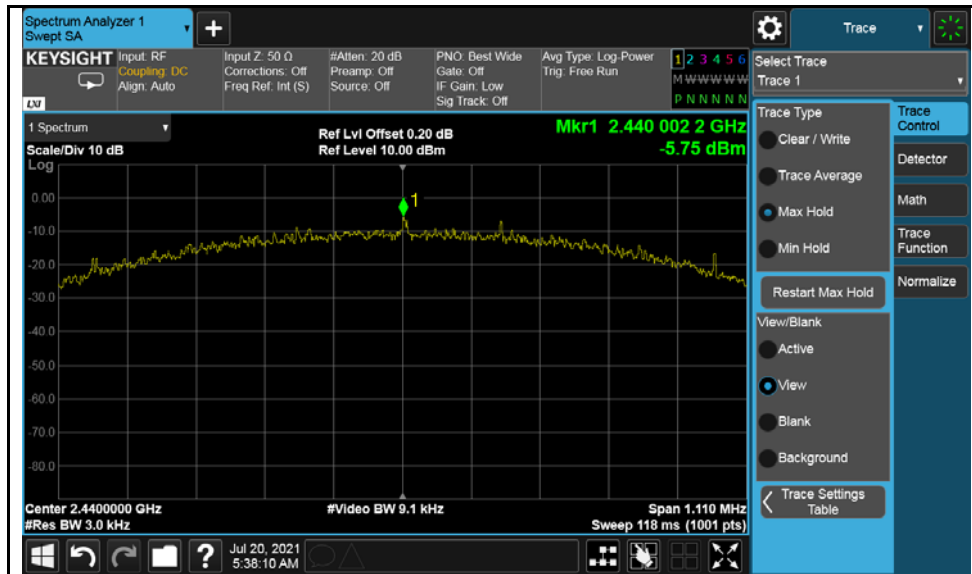
Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Pass/Fail
37	2402	-7.74	8	Pass
17	2440	-5.75	8	Pass
39	2480	-8.04	8	Pass

Data Rate: 2Mbps

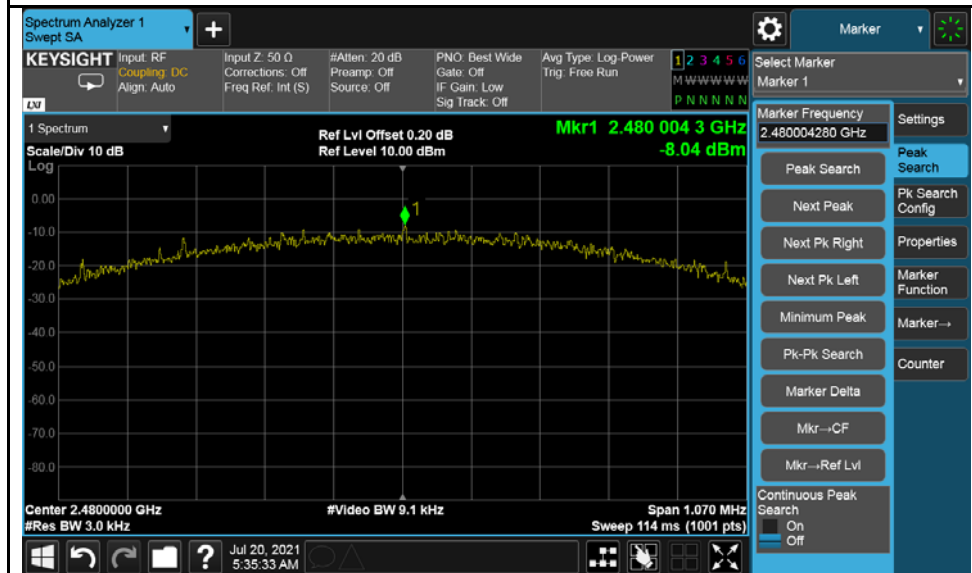
Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Pass/Fail
37	2402	-8.41	8	Pass
17	2440	-10.34	8	Pass
39	2480	-11.8	8	Pass

Test Plots:

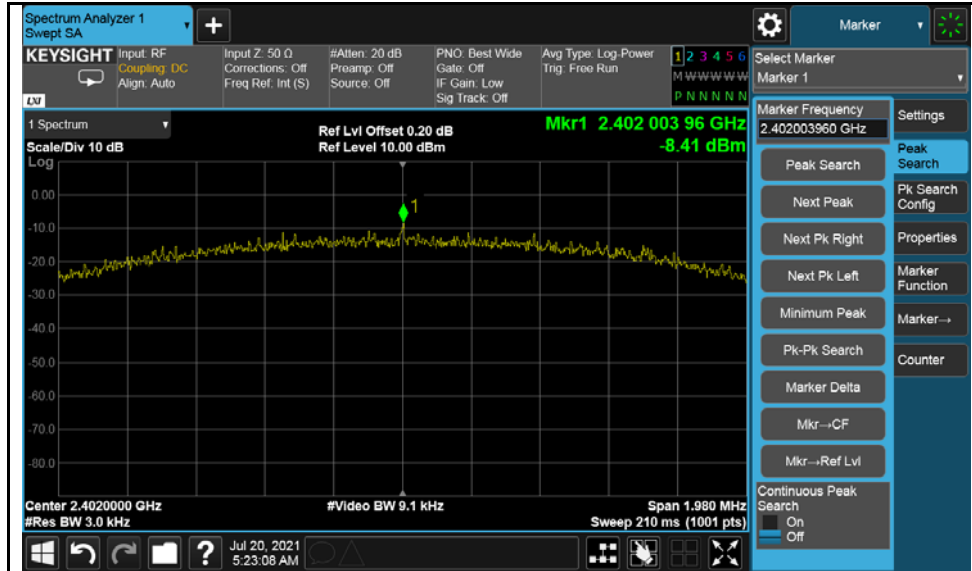




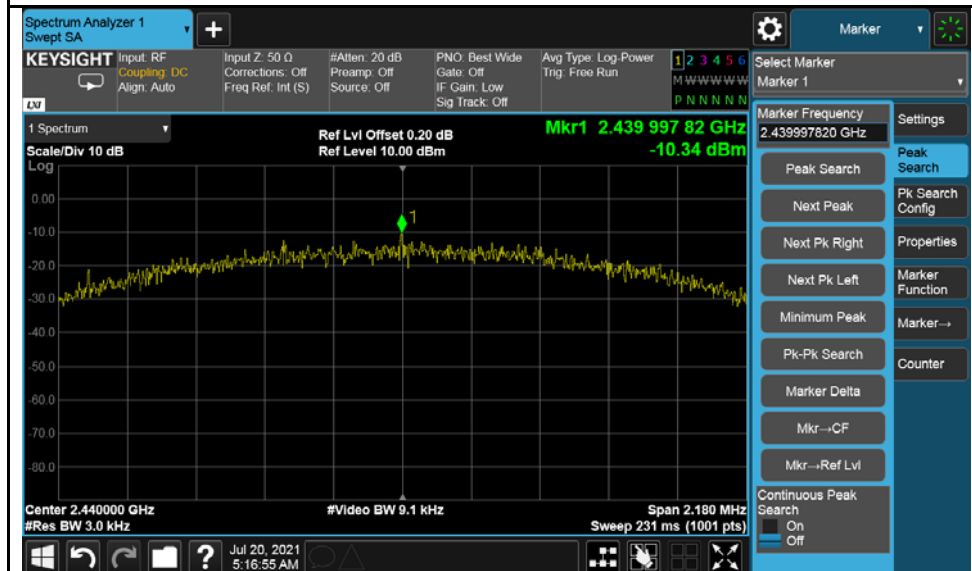
BLE-2440MHz (1Mbps Data Rate)



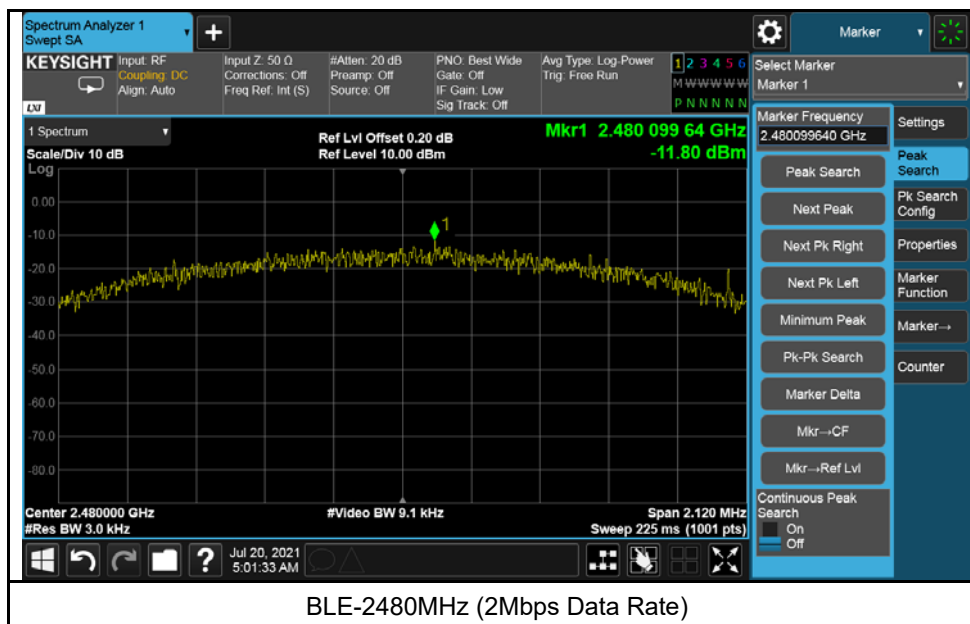
BLE-2480MHz (1Mbps Data Rate)



BLE-2440MHz (2Mbps Data Rate)



BLE-2440MHz (2Mbps Data Rate)

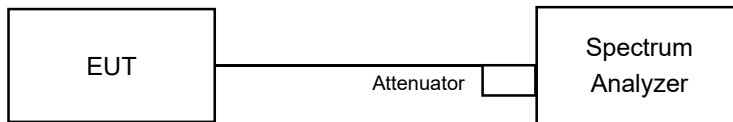


4.6 Conducted Out of Band Emission Measurement

4.6.1 Limits of Conducted Out of Band Emission Measurement

Below 20dB of the highest emission level of operating band (in 100kHz Resolution Bandwidth).

4.6.2 Test Setup



4.6.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.6.4 Test Procedure

MEASUREMENT PROCEDURE REF

1. Set the RBW = 100 kHz.
2. Set the VBW $\geq$ 300 kHz.
3. Detector = peak.
4. Sweep time = auto couple.
5. Trace mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

MEASUREMENT PROCEDURE OOB

1. Set RBW = 100 kHz.
2. Set VBW $\geq$ 300 kHz.
3. Detector = peak.
4. Sweep = auto couple.
5. Trace Mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum amplitude level.

4.6.5 Deviation from Test Standard

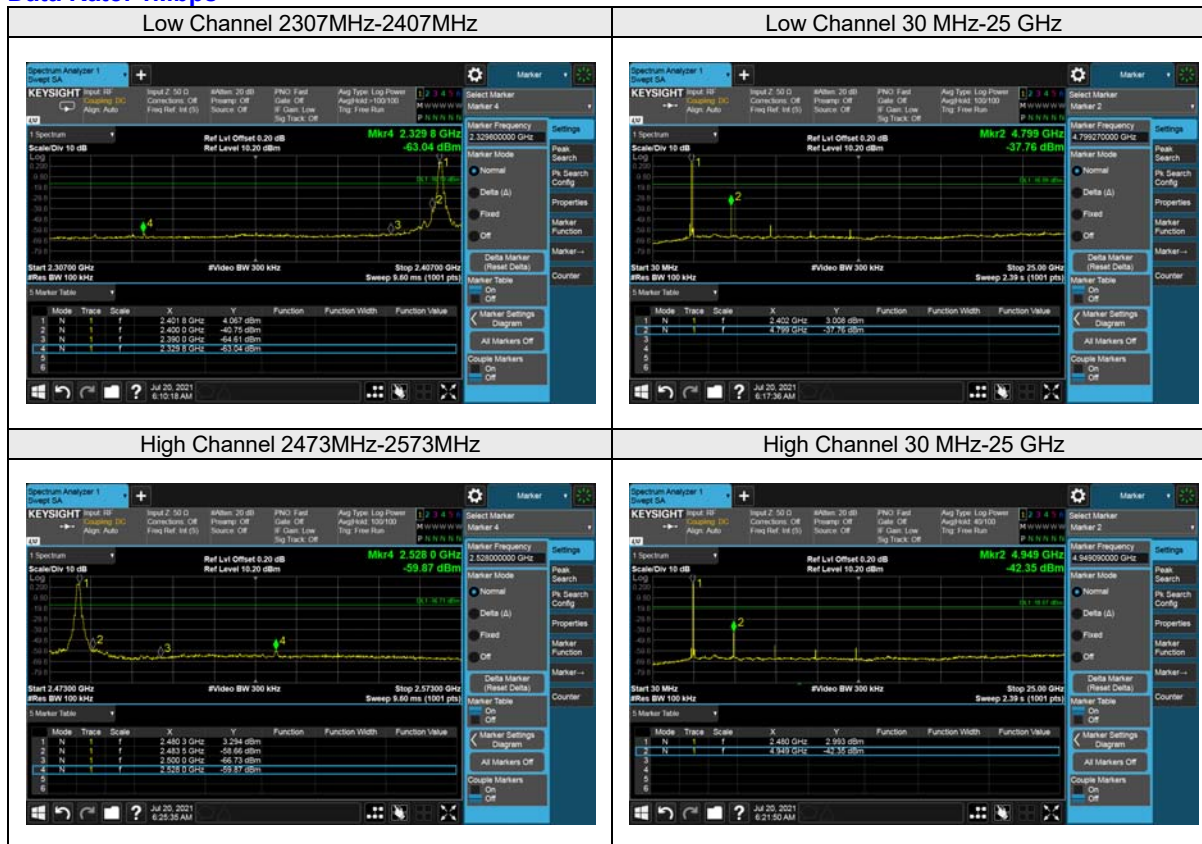
No deviation.

4.6.6 EUT Operating Condition

Same as Item 4.3.6

4.6.7 Test Results

Data Rate: 1Mbps



Data Rate: 2Mbps

Low Channel 2307MHz-2407MHz



Low Channel 30 MHz-25 GHz



High Channel 2473MHz-2573MHz



High Channel 30 MHz-25 GHz



5 Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo).

Appendix – Information on the Testing Laboratories

Bureau Veritas is a global leader in testing, inspection and certification (TIC) services. We help businesses improve safety, sustainability and productivity; and our clients include the majority of leading brands in retail, manufacturing and other industries. With a presence in every major country around the world, our quality assurance and compliance solutions are vital in helping our customers enhance product quality and concept-to-consumer journeys. We also assist with increasing speed to market, profitability and brand equity throughout the supply chain. Bureau Veritas is a leading wireless/IoT testing, inspection, audit and certification provider, with a global network of test laboratories to support the IoT industry in areas of connectivity, security, interoperability as well as quality, health & safety, and environmental/chemical requirements.

If you have any comments, please feel free to contact us at the following:

Milpitas EMC/RF/Safety/Telecom Lab

775 Montague Expressway, Milpitas, CA 95035
Tel: +1 408 526 1188

Sunnyvale OTA/Bluetooth Lab

1293 Anvilwood Avenue, Sunnyvale, CA 94089
Tel: +1 669 600 5293

Littleton EMC/RF/Safety/Environmental Lab

1 Distribution Center Cir #1, Littleton, MA 01460
Tel: +1 978 486 8880

Email: sales.eaw@us.bureauveritas.com

Web Site: www.cpsusa-bureauveritas.com

The address and road map of all our labs can be found in our web site also.

--- END ---