FCC/ICES Test Report

Report No.:	FCC_IC_RF_CIXU-TNY-P23050039 CTP2_BLE -15.247_Rev4
FCC ID:	2AKC8 CTP33000000
ISED:	22221-CTP33000000
Test Model/ HVIN:	CTP19TNv3
PMN:	CTP2019DTNA
Received Date:	05/20/2023
Test Date:	05/22/2023
Issued Date:	10/18/2023
Applicant:	Daimler Truck North America LLC
Address:	4555 N. Channel Ave, PORTLAND OR 97217-3849 USA
Manufacturer:	Daimler Truck North America LLC
Address:	4555 N. Channel Ave, PORTLAND OR 97217-3849 USA
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/ IC Test Site Number:	US1109/US0160

ACCREDITED
TESTING CERT # 2742-01

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RELEASE CONTROL RECORD

Issue No.	Description	Date Issued
FCC_IC_RF_CIXU-TNY-P23050039 CTP2_BLE -15.247	Orignal Release	06/28/2023
FCC_IC_RF_CIXU-TNY-P23050039 CTP2_BLE -15.247_Rev2	Updated Measurement uncertainty, EUT Name and model	08/03/2023
FCC_IC_RF_CIXU-TNY-P23050039 CTP2_BLE -15.247_Rev3	Update Power Measurement Procedure	10/10/2023
FCC_IC_RF_CIXU-TNY-P23050039 CTP2_BLE -15.247_Rev4	Remove LTE information	10/18/2023

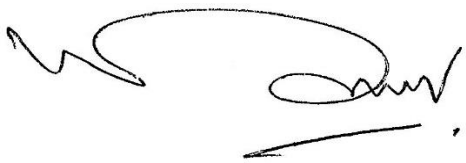
1 CERTIFICATE OF CONFORMITY

Product / PMN:	CTP2019DTNA
Brand:	CTP
Test Model / HVIN:	CTP19TNv3
Sample Status:	Engineering sample
Applicant:	Daimler Truck North America LLC
Test Date:	05/22/2023
Standards:	47 CFR FCC Part 15, Subpart C (Section 15.247) RSS-247 Issue 2**,** February 2017 ANSI C63.10: 2013 RSS-Gen Issue 5, 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:** 10/18/2023

Test Engineer: Abhijit Patibandla & James Ma



Approved by _____ **Date:** 10/18/2023

Suresh Kondapalli / Reviewing Engineer

2 SUMMARY OF TEST RESULTS

47 CFR FCC Part 15, Subpart C (Section 15.247)			
FCC / IC Clause	Test Item	Result	Remarks
15.207 RSS Gen 8.8	AC Power Conducted Emission	NA	EUT is battery powered.
15.247(a)(2) RSS 247 5.2.1	6dB bandwidth & 99% bandwidth	PASS	Meet the requirement of limit.
15.247(b) RSS 247 5.4.4	Maximum Output power	PASS	Meet the requirement of limit.
15.247(e) RSS 247 5.2.2	Power Spectral Density	PASS	Meet the requirement of limit.
15.247(d) RSS 247 5.4.4	Conducted Band Edges and Spurious Emissions	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.
15.203 &15.247(b)	Antenna Requirement	PASS	Unique connector cable is used “Profectional installation required.”

2.1 MEASUREMENT UNCERTAINTY

The following calculation follows the procedures as set forth in the clause 7.2.3 of ETSI TR 100 028-1 V1.4.1 (2001-12). The expression of Uncertainty in Radiated RF Testing is according to ISO/IEC 17025: 2017 and TR 100 028-1 V1.4.1 (2001-12):

Emission Measurement Uncertainty

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

Radio Measurement Uncertainty

Estimated Combined Standard Uncertainty Type	Uncertainty
Frequency Error Measurements	± 3.88 Hz
Carrier Power Measurements	± 0.70 dB.
Adjacent Channel Power Measurements	± 1.47 dB.
Modulation Frequency Response Measurements	± 0.46 dB.
Transmitter Conducted Emission measurements	± 2.06 dB

2.2 MODIFICATION RECORD

There were no modifications required for compliance.

3 GENERAL INFORMATION

3.1 GENERAL DESCRIPTION OF EUT

<table>
<tr><td>Product / PMN</td><td>CTP2019DTNA</td></tr>
<tr><td>Brand</td><td>CTP</td></tr>
<tr><td>Test Model / HVIN</td><td>CTP19TNv3</td></tr>
<tr><td>Identification No. of EUT</td><td>A6633000000
Or A6633000500</td></tr>
<tr><td>Status of EUT</td><td>Engineering sample</td></tr>
<tr><td>Power Supply Rating</td><td>12 V input is expected from vehicles. Supports 8V to 32V</td></tr>
<tr><td>Temperature Operating Range</td><td>-35C to 75C</td></tr>
<tr><td>BT/WLAN Module</td><td>
<table>
<tr><td colspan="2">Model</td><td>UGKZ7A10</td></tr>
<tr><td colspan="2">Manufacturer</td><td>ALPS</td></tr>
<tr><td rowspan="5">WiFi</td><td>Frequency</td><td>2412 to 2462MHz for 802.11b/g/n</td></tr>
<tr><td>Channel Bandwidth</td><td>20 MHz</td></tr>
<tr><td>Modulation</td><td>802.11b – BPSK, QPSK, CCK, DSSS
802.11g – BPSK, QPSK, 16/64QAM, OFDM
802.11n – HT mode MCS0-7</td></tr>
<tr><td>Data rate max</td><td>802.11b – 11Mbps
802.11g – 54Mbps
802.11n – 72.2Mbps</td></tr>
<tr><td>Output Level</td><td>802.11b – +15dBm
802.11g – +13dBm
802.11n – +11dBm</td></tr>
<tr><td rowspan="3"></td><td>Sensitivity</td><td>802.11b – -90dBm
802.11g – -74dBm
802.11n – -72dBm</td></tr>
<tr><td rowspan="2">BT</td><td>Frequency</td><td>2402 ~2480MHz</td></tr>
<tr><td>Channel Spacing</td><td>Normal mode – 1MHz
BLE mode –2MHz</td></tr>
</table>
</td></tr>
<tr><td>Antenna Information</td><td>
<table>
<tr><td>ANTENNA-CABLE, WIFI/BT, INT</td><td>A66-12157-000</td><td>2400-2485 MHz
5150-5925 MHz</td><td>30 dBm</td><td>Antenna Type: WiFi/BT
2400-2485 MHz: 4.0 dBi
5150-5925 MHz: 5.0 dBi</td></tr>
</table>
</td></tr>
<tr><td colspan="2">Note: The above radio information is for the BT/ WLAN radio module inside CTP19TNv3.
This report is only document the BLE radio.</td></tr>
</table>

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

Radiated Emission Test (Above 1GHz):

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinationsbetween 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	0,20,39	GFSK	1

Radiated Emission Test (Below 1GHz):

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinationsbetween 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	0,20,39	GFSK	1

Power Line Conducted Emission Test:

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinationsbetween 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)
-	N/A	-	-
Note: The test did not perform since EUT is only powered by 12V battery.			

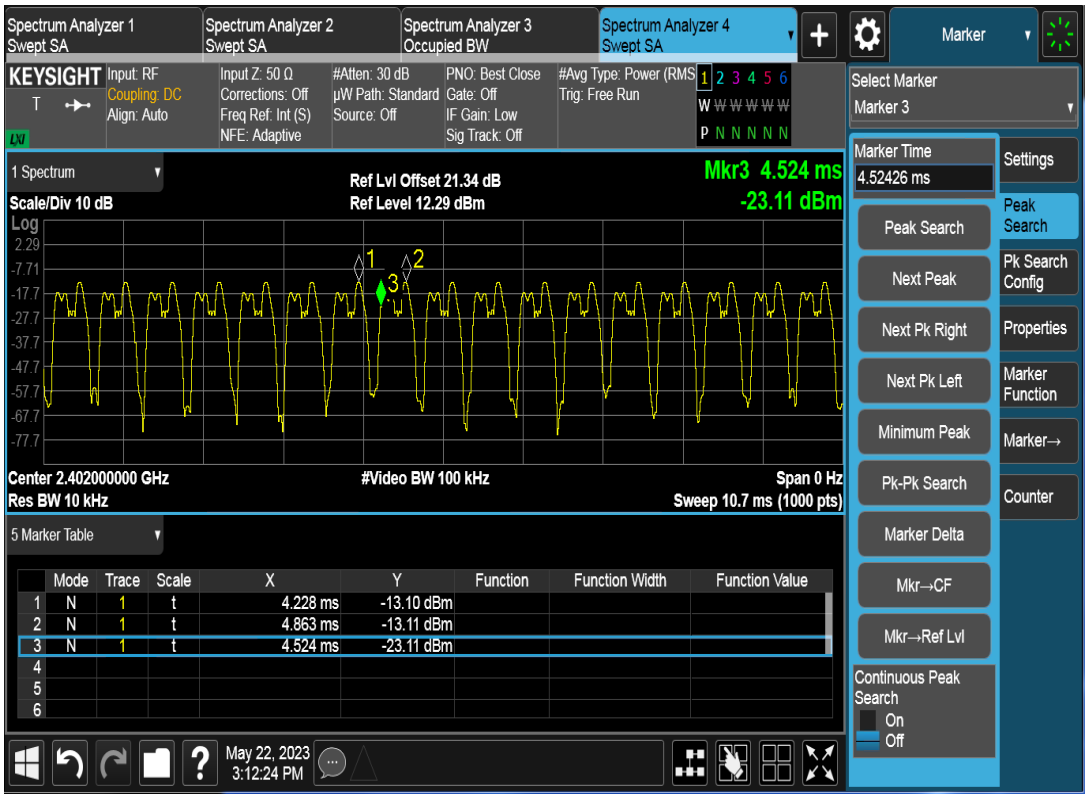
Antenna Port Conducted Measurement:

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinationsbetween 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	0, 20, 39	GFSK	1

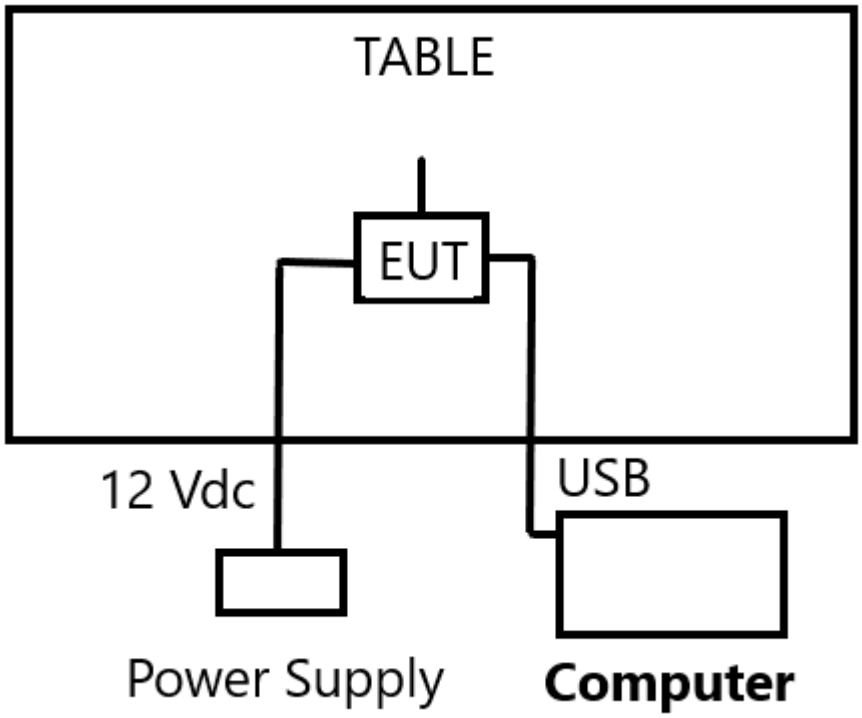
3.3 DUTY CYCLE OF TEST SIGNAL



Duty cycle of test signal is 53.4% (CH 0)
(On time (PW) = 0.339, Total time (PP) = 0.635)

3.4 Configuration and connections with EUT

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.



3.5 GENERAL DESCRIPTION OF APPLIED STANDARDS

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with therequirements 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 Conducted Emission Measurement

4.1.1 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.

4.1.2 Test Procedures

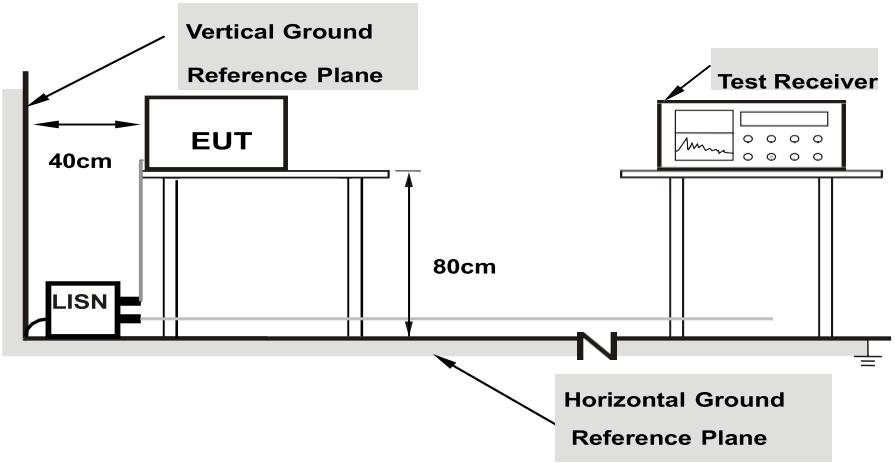
a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.

b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

c. 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.

4.1.3 Deviation from Test Standard



No deviation.

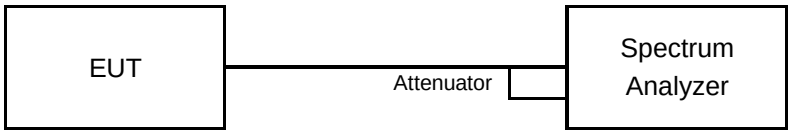
Test Results: N/A (EUT IS NOT CONNECTED AC POWER LINE).

4.2 6DB BANDWIDTH MEASUREMENT & 99% BANDWIDTH MEASUREMENT

4.2.1 LIMITS OF 6DB BANDWIDTH MEASUREMENT

The minimum of 6dB Bandwidth Measurement is 0.5 MHz.

4.2.2 TEST SETUP



The following procedure shall be used for measuring 99% power bandwidth:

a) The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.

b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement.

Note: 99% Bandwidth measurement performed per RSS-Gen Section 6.7.

4.2.3 TEST PROCEDURE

a. Set resolution bandwidth (RBW) = 100kHz
b. Set the video bandwidth (VBW) ≥ 3 x RBW, Detector = Peak.
c. Trace mode = max hold.
d. Sweep = auto couple.
e. 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.

Note: The test method applied according to ANSI C63.10-2013 Section 11.8.

4.2.4 DEVIATION FROM TEST STANDARD

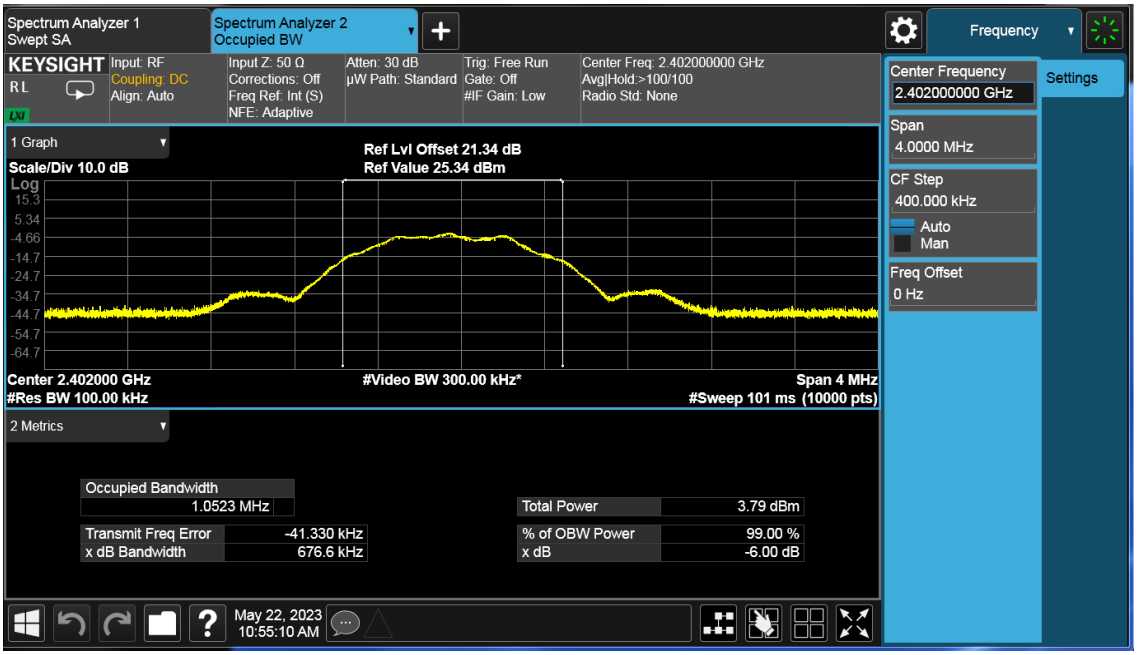
No deviation.

4.2.5 EUT OPERATING CONDITIONS

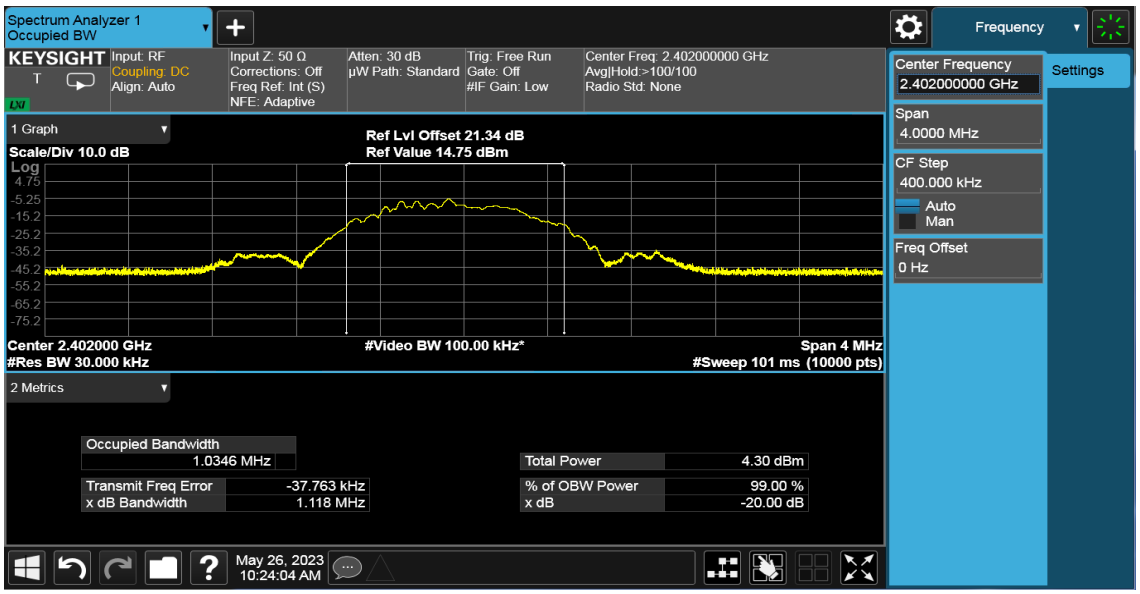
The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

TEST RESULT

Channel	Frequency (MHz)	6dB Bandwidth (MHz)	99% Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
0	2402	0.676	1.034	0.5	PASS
20	2442	0.692	1.033	0.5	PASS
39	2480	0.687	1.033	0.5	PASS



DTS BW at 2402 MHz



99% BW at 2402 MHz

DTS BW at 2442 MHz

99% BW at 2442 MHz

DTS BW at 2480 MHz

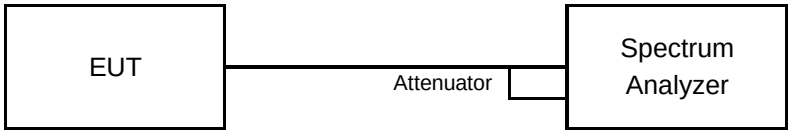
99% BW at 2480 MHz

4.3 Conducted Output Power Measurement

4.3.1 Limits Of Conducted Output Power Measurement

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

4.3.2 Test Setup



4.3.3 Test Instruments

Refer to section 4.6.2 to get information about the above instrument.

4.3.4 Test Procedures

a. Set the RBW ≥ DTS bandwidth.
b. Set VBW ≥ 3 × RBW.
c. Set span ≥ 3 x 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.
Note: The measurement procedure performed according to ANSI C63.10-2023 Section 11.9.1.1

4.3.5 Deviation From Test Standard

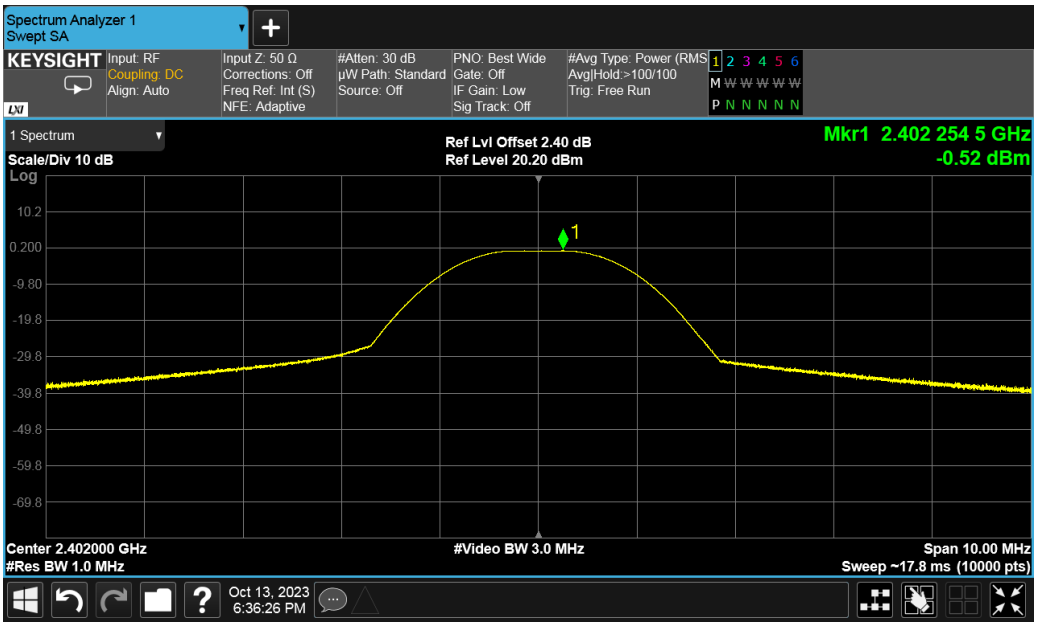
No deviation.

Eut Operating Conditions

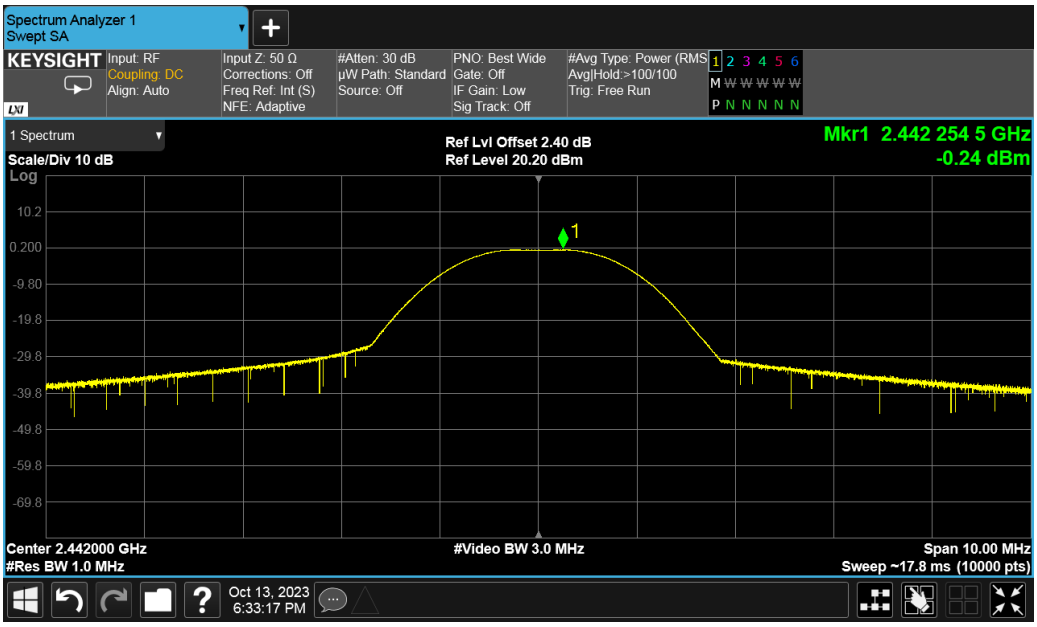
The software provided by client to enable the EUT under transmission condition continuously at lowest, mile and highest channel frequencies individually.

4.3.6 Test Results

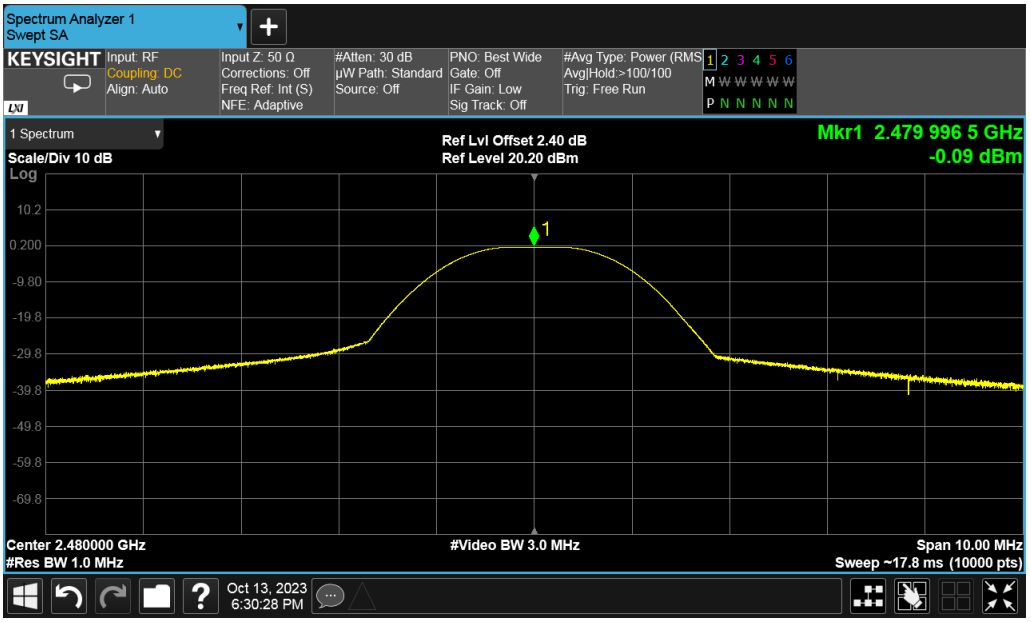
Channel	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Pass/Fail
0	2402	-0.52	30.00	Pass
20	2442	-0.24	30.00	Pass
39	2480	-0.09	30.00	Pass



Peak Output Power at 2402 MHz.



Peak Output Power at 2442 MHz



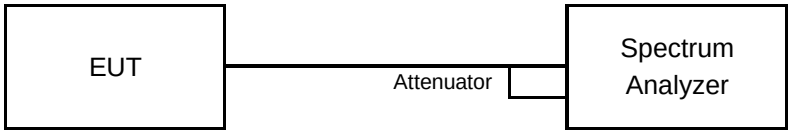
Peak Output Power at 2480 MHz

4.4 POWER SPECTRAL DENSITY MEASUREMENT

4.4.1 Limits Of Power Spectral Density Measurement

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

4.4.2 Test Setup



4.4.3 Test Instruments

Refer to section 4.6.2 to get information of above instrument.

4.4.4 Test Procedure

a. Set analyzer center frequency to DTS channel center frequency.
b. Set the span to 1.5 times the DTS bandwidth.
c. Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
d. Set the VBW ≥ 3 × RBW.
e. Detector = Peak.
f. Sweep time = auto couple.
g. Trace mode = Max Hold.
h. Use Peak marker function to determine the maximum amplitude level.

Note: The measurement procedure performed according to ANSI C63.10-2023 Section 11.10.2

4.4.5 Deviation From Test Standard

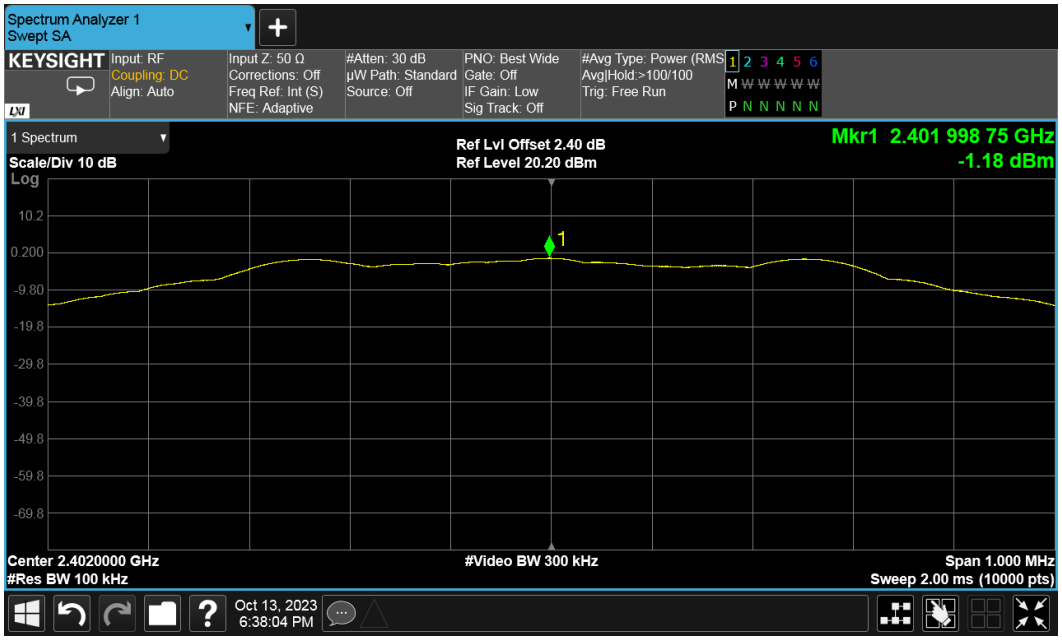
No deviation.

4.4.6 EUT Operating Condition

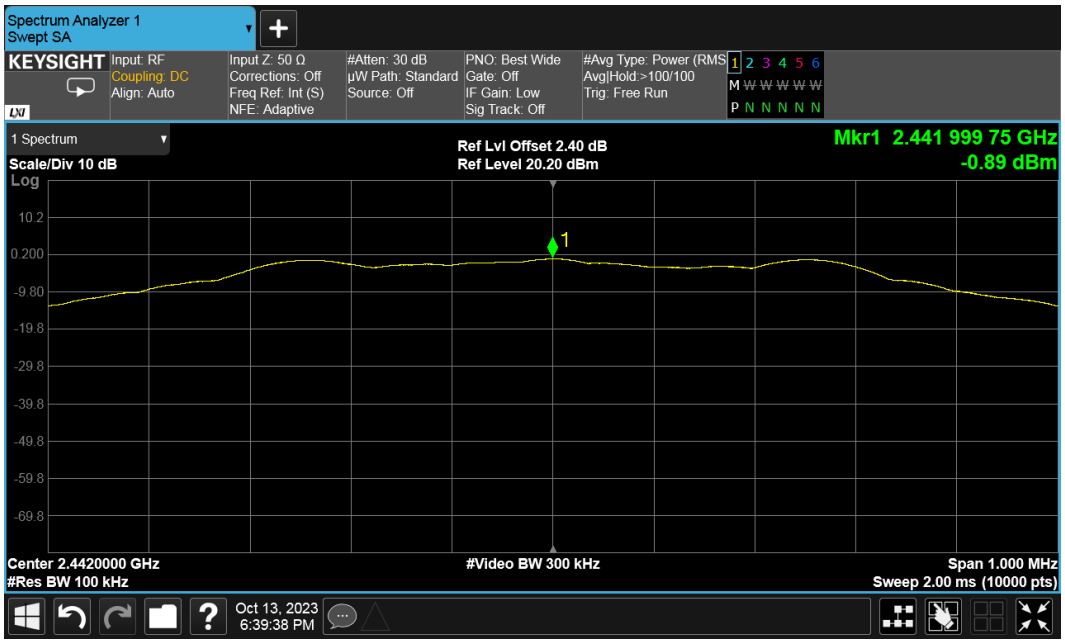
Same As Item 4.2.5

4.4.7 Test Results

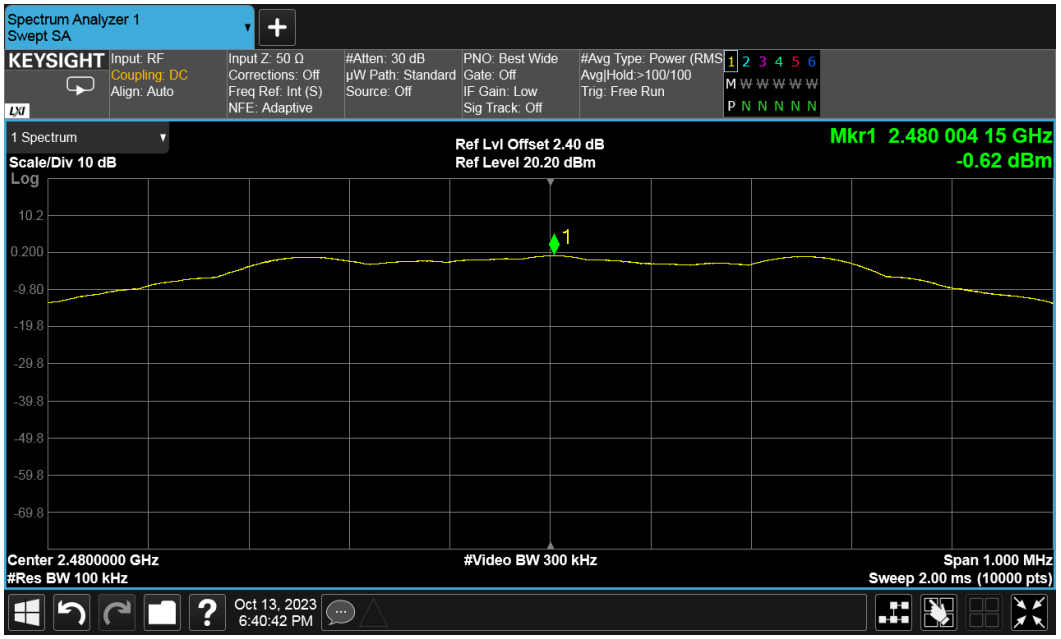
Channel	Frequency (MHz)	PSD (dBm/100KHz)	Limit (dBm/3KHz)	Pass/Fail
0	2402	-1.18	8.00	Pass
20	2442	-0.89	8.00	Pass
39	2480	-0.62	8.00	Pass



Peak Power Spectral Density at 2402 MHz



Peak Power Spectral Density at 2442 MHz



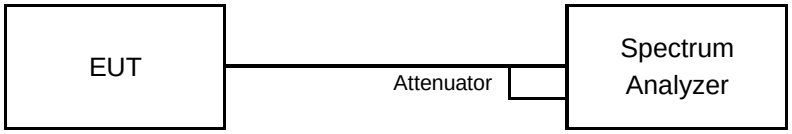
Peak Power Spectral Density at 2480 MHz

4.5 CONDUCTED OUT OF BAND EMISSION MEASUREMENT

4.5.1 Limits Of Conducted Out Of Band Emission Measurement

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

4.5.2 Test Setup



4.5.3 Test Instruments

Refer to section 4.6.2 to get information of above instrument.

4.5.4 Test Procedure

MEASUREMENT PROCEDURE REF

1. Set the RBW = 100 kHz.
2. Set the VBW ≥ 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 OOBE

1. Set RBW = 100 kHz.
2. Set VBW ≥ 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.

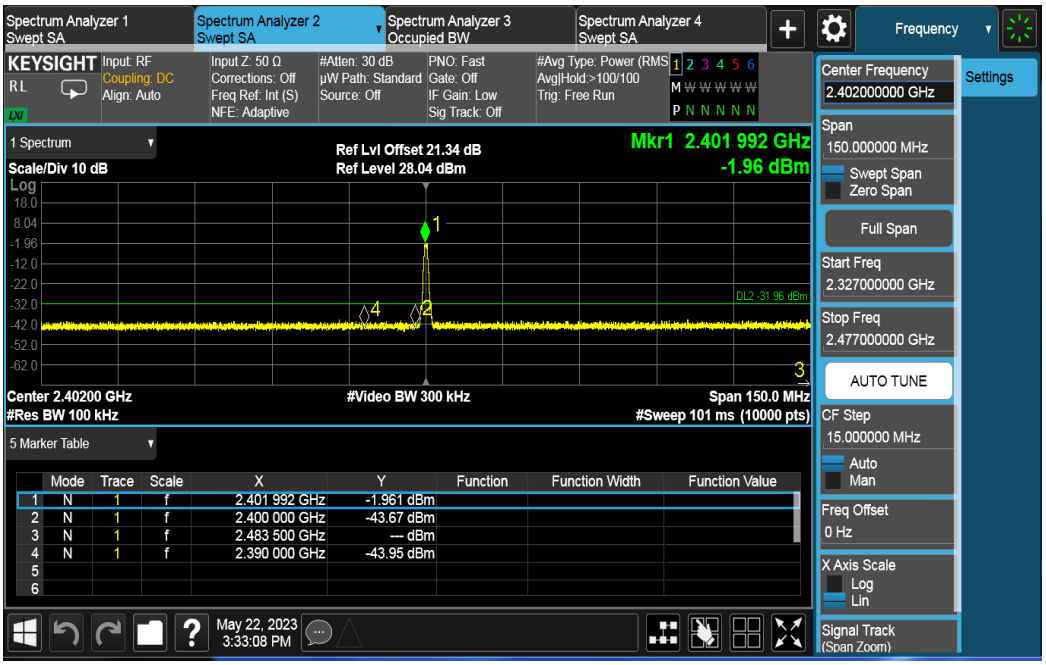
4.5.5 Deviation From Test Standard

No Deviation.

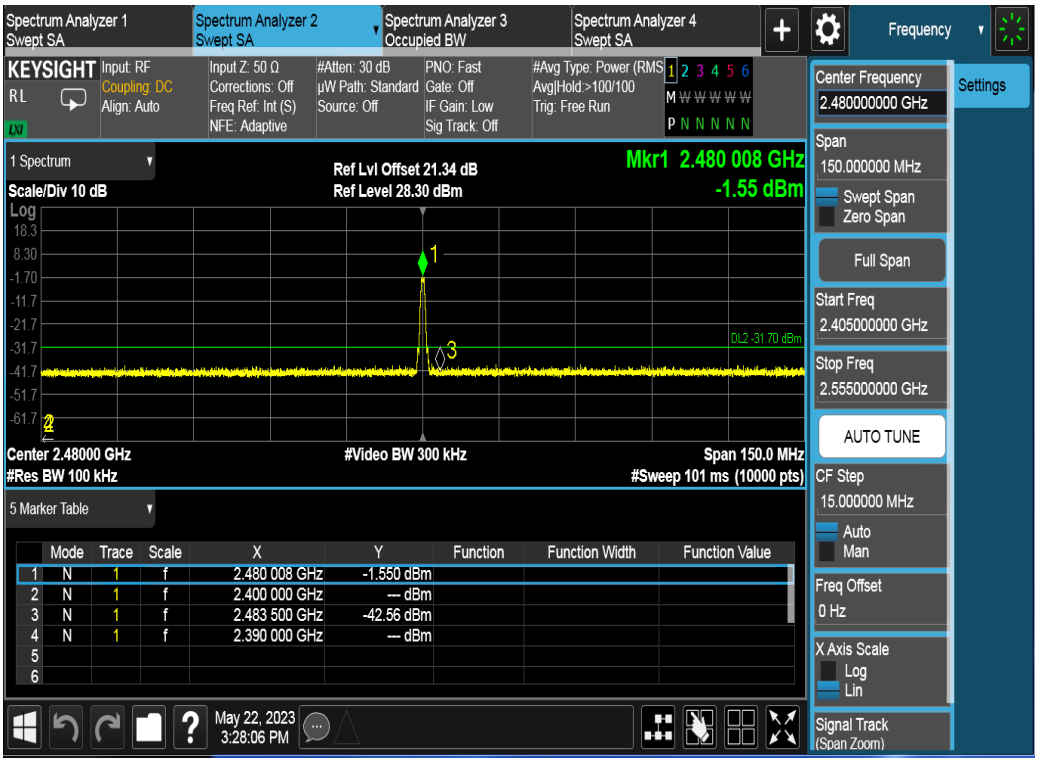
4.5.6 EUT Operating Condition

Same As Item 4.2.5

4.5.7 Test Results of Conducted Band Edges Plots

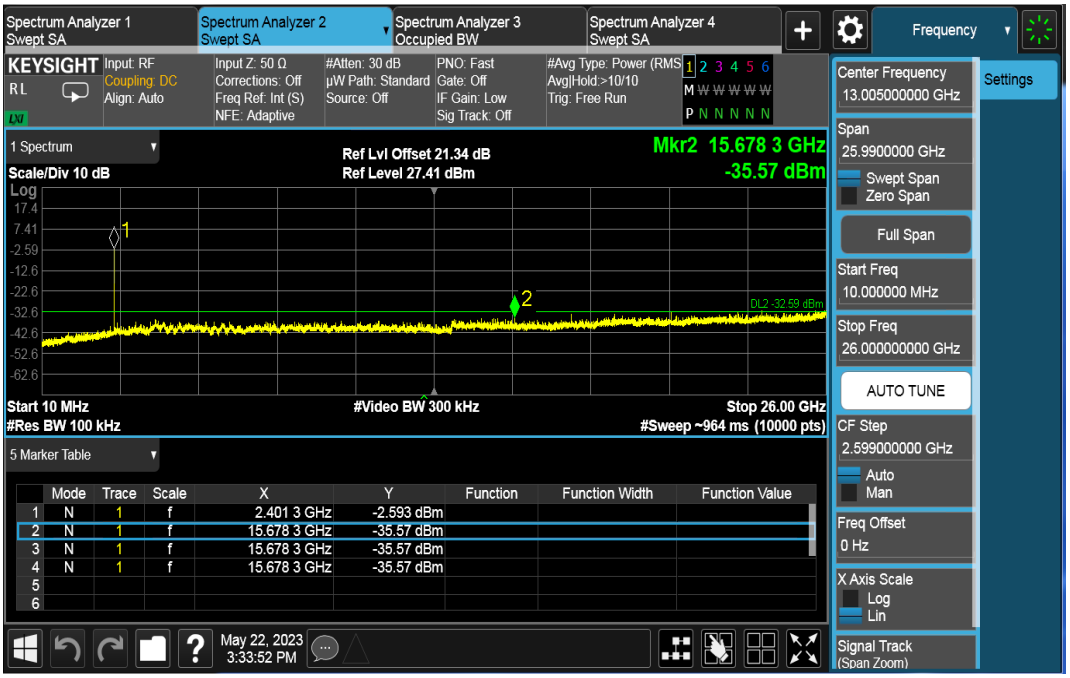


CH 0

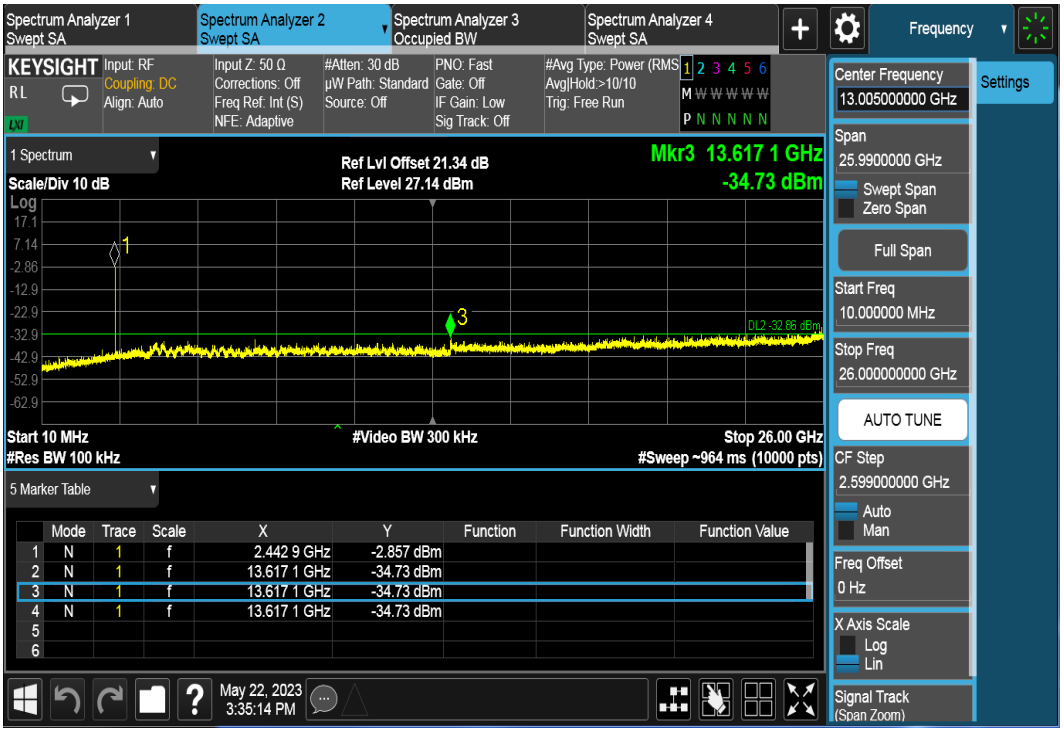


CH 39

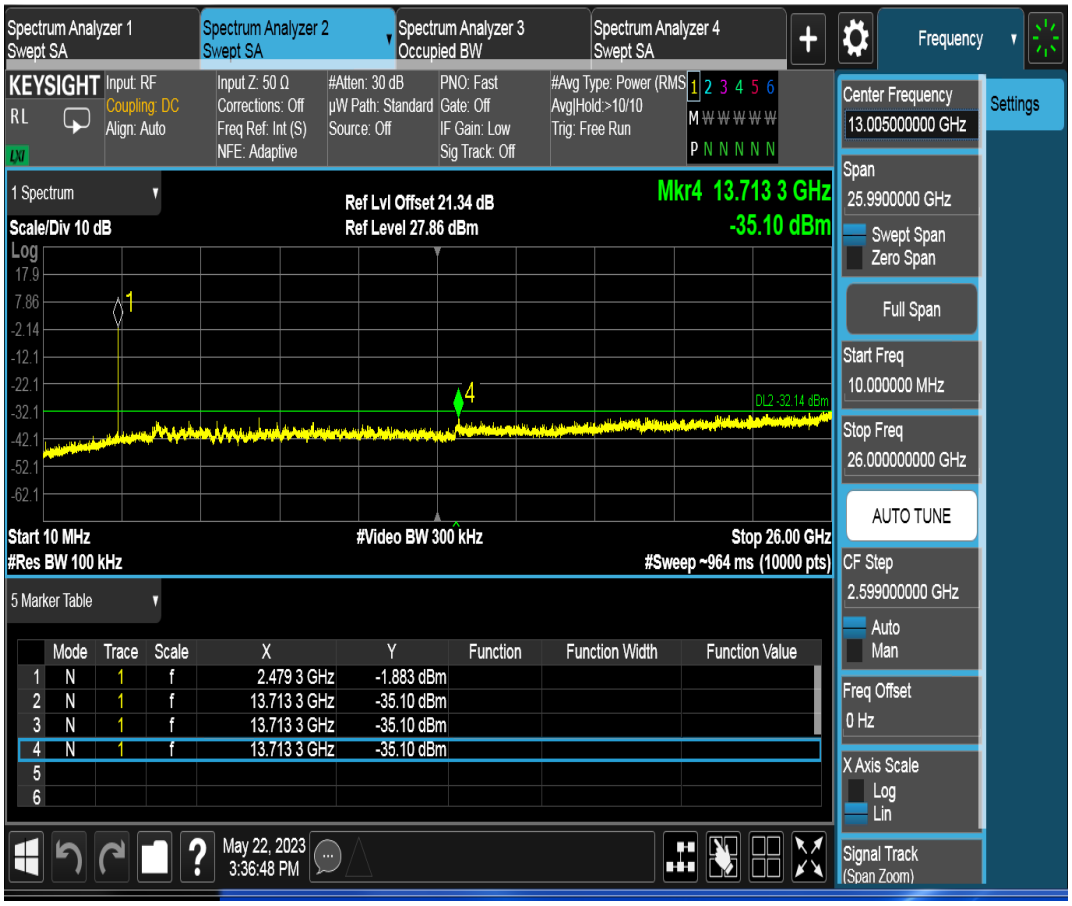
4.5.8 Test Results of Conducted Spurious Emission Plots



CH 0



CH 20


Spectrum Analyzer 1
Swept SA
Spectrum Analyzer 2
Swept SA
Spectrum Analyzer 3
Occupied BW
Spectrum Analyzer 4
Swept SA
Frequency
KEYSIGHT
Input: RF
Coupling: DC
Align: Auto
Input Z: 50 Ω
Corrections: Off
Freq Ref: Int (S)
NFE: Adaptive
#Atten: 30 dB
µW Path: Standard
Source: Off
PNO: Fast
Gate: Off
IF Gain: Low
Sig Track: Off
#Avg Type: Power (RMS)
Avg|Hold:>10/10
Trig: Free Run
1 Spectrum
Ref Lvl Offset 21.34 dB
Ref Level 27.86 dBm
Mkr4 13.713 3 GHz
-35.10 dBm
Scale/Div 10 dB
Log
17.9
7.86
-2.14
-12.1
-22.1
-32.1
-42.1
-52.1
-62.1
DL2 -32.14 dBm
Start 10 MHz
#Res BW 100 kHz
#Video BW 300 kHz
Stop 26.00 GHz
#Sweep ~964 ms (10000 pts)
5 Marker Table
Mode Trace Scale X Y Function Function Width Function Value
1 N 1 f 2.479 3 GHz -1.883 dBm
2 N 1 f 13.713 3 GHz -35.10 dBm
3 N 1 f 13.713 3 GHz -35.10 dBm
4 N 1 f 13.713 3 GHz -35.10 dBm
5
6
May 22, 2023
3:36:48 PM
Center Frequency
13.005000000 GHz
Settings
Span
25.9900000 GHz
Swept Span
Zero Span
Full Span
Start Freq
10.000000 MHz
Stop Freq
26.000000000 GHz
AUTO TUNE
CF Step
2.599000000 GHz
Auto
Man
Freq Offset
0 Hz
X Axis Scale
Log
Lin
Signal Track
(Span Zoom)

CH 39

4.6 RADIATED EMISSION AND BAND EDGE MEASUREMENT

4.6.1 Limits Of Radiated Emission and Band Edge 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.

4.6.2 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	09/20/2022	09/20/2024
PXA Signal Analyzer KEYSIGHT	N9030B	MY57140374	07/20/2022	07/20/2024
Biconilog Antenna Sunol	JB6	A111717	09/22/2022	09/22/2024
Horn Antenna ETS-Lindgren	3117	218554	08/11/2022	08/11/2024
The EMC Shop	PA18G-HA	001337	12/20/2022	12/20/2024
DRG Horn Antenna	SAS574	579	09/22/2022	09/22/2024
The EMC Shop	PA40G	17610-01	07/08/2022	07/08/2024

Test software used: Toyo Corporation: Radiated Emission EP7/RE Ver 8.0.1 30

4.6.3 Test Procedures

For Radiated emission below 30MHz

f. 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.

g. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

h. Parallel, perpendicular, and ground-parallel orientations of the antenna are set to make the measurement.

i. 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.

j. The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

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:

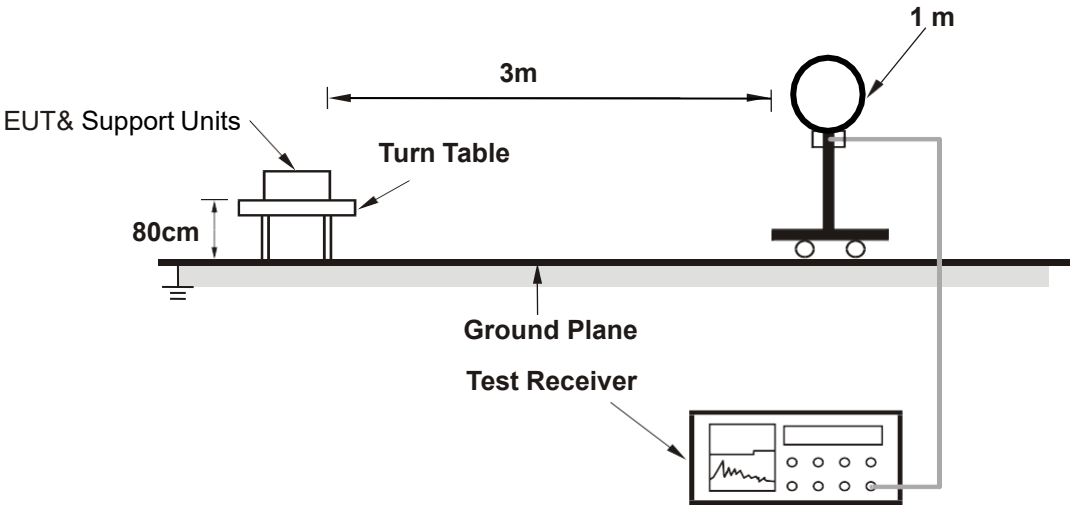
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.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

4.6.4 Deviation From Test Standard

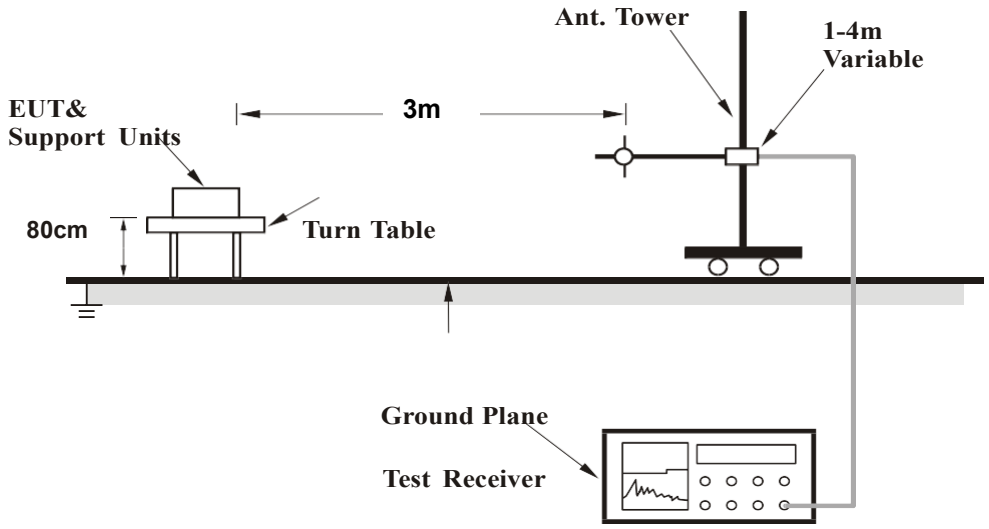
No deviation.

4.6.5 Test Setup

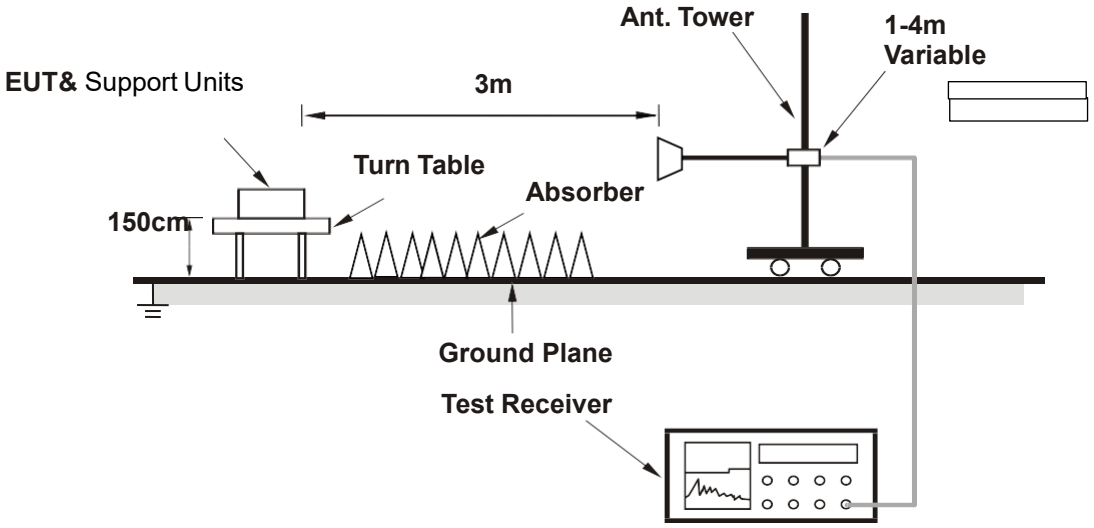
For Radiated emission below 30MHz



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).

4.6.6 EUT Operating Conditions

a. Connected the EUT with the Notebook Computer.
b. Controlling software has been activated to set the EUT on specific status.

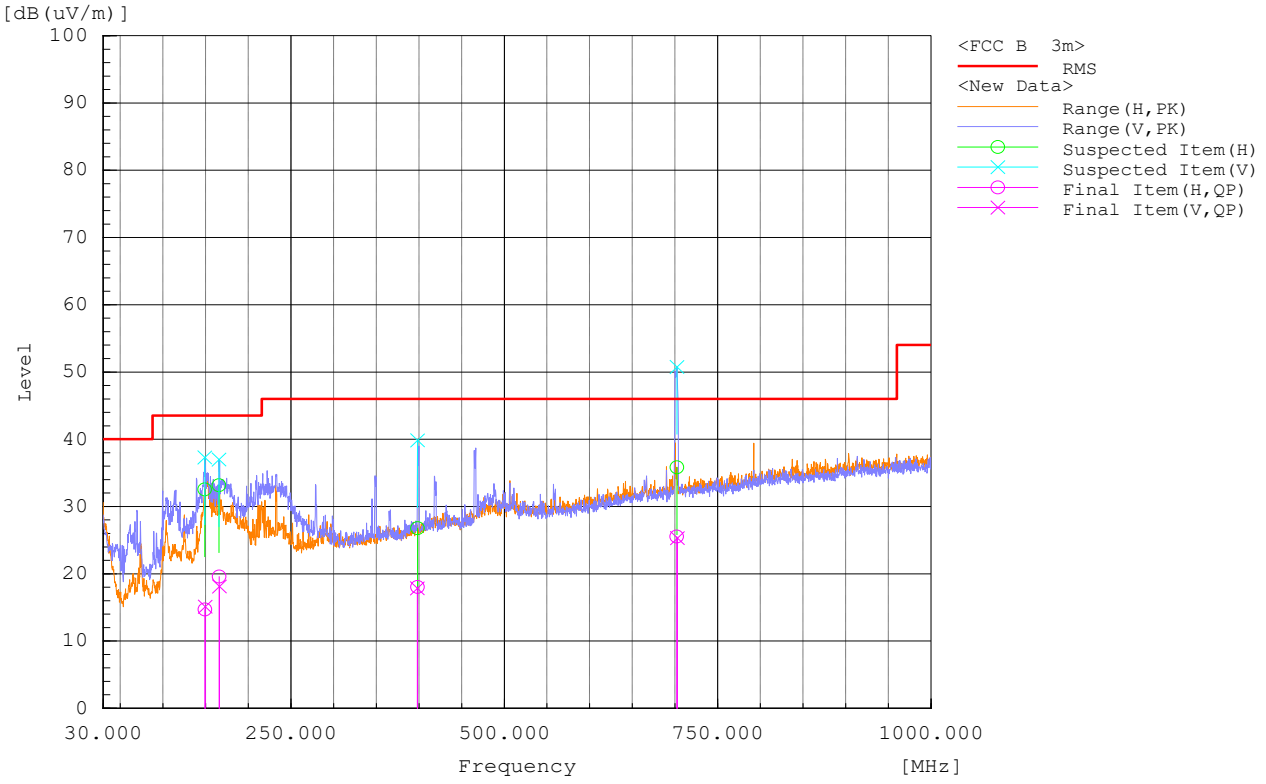
4.6.7 Test Results

BELOW 1GHz WORST-CASE DATA:

BT-LE (GFSK)

CHANNEL	TX Mid Channel 20	**DETECTOR FUNCTION**	Quasi Peak
FREQUENCY RANGE	30MHz – 1GHz		

Frequency [MHz]	Pol V/H	Reading QP [dB(uV)]	Factor [dB(1/m)]	Level QP [dB(uV/m)]	Limit\QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]
149.48	V	-7.9	23.0	15.1	43.5	-28.4	127.5	113.0
149.15	H	-8.1	22.8	14.7	43.5	-28.8	221.0	101.9
166.04	H	-2.9	22.5	19.6	43.5	-23.9	208.6	258.2
166.08	V	-4.6	22.7	18.1	43.5	-25.4	100.4	225.9
398.12	V	-9.3	27.2	17.9	46.0	-28.1	166.4	339.6
398.38	H	-9.5	27.5	18.0	46.0	-28.0	114.1	163.0
701.87	H	-8.2	33.7	25.5	46.0	-20.5	291.5	296.4
702.78	V	-7.9	33.2	25.3	46.0	-20.7	246.2	119.5



REMARKS:

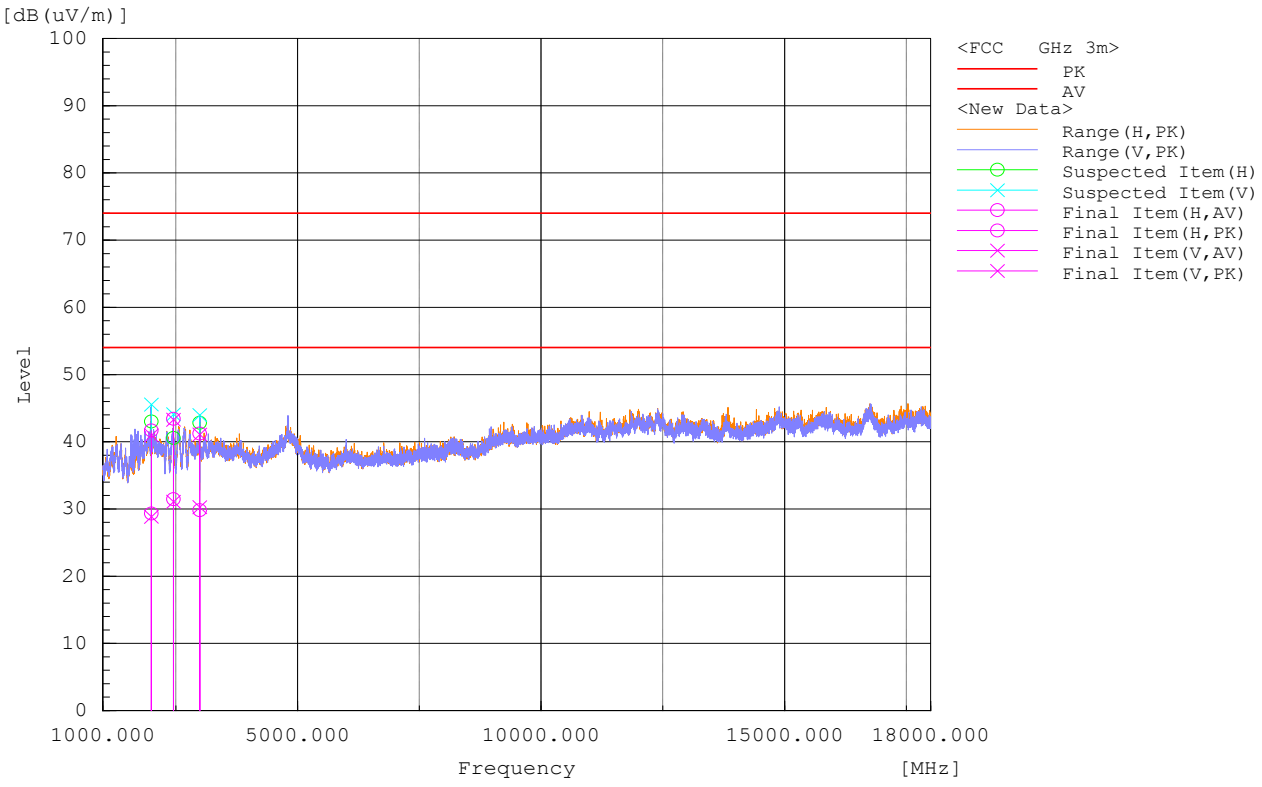
1. Level (dBuV/m) = Reading (dBuV) + Factor (dB(1/m)).
2. Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB) –Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value (dBuV/m)

ABOVE 1GHz TEST DATA:

BT-LE (GFSK)

CHANNEL	TX Channel 0	**DETECTOR FUNCTION**	Peak Average
FREQUENCY RANGE	1GHz ~ 18GHz		

Frequency [MHz]	Pol V/H	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]
2000.00	V	40.5	52.7	-11.7	28.8	41.0	54	74	-25.2	-33.0
1998.91	H	41.0	53.4	-11.7	29.3	41.7	54	74	-24.7	-32.3
2450.02	H	43.0	54.9	-11.5	31.5	43.4	54	74	-22.5	-30.6
2450.09	V	42.6	54.8	-11.5	31.1	43.3	54	74	-22.9	-30.7
2990.17	V	41.3	52.1	-11.0	30.3	41.1	54	74	-23.7	-32.9
2990.00	H	40.8	52.2	-11.0	29.8	41.2	54	74	-24.2	-32.8

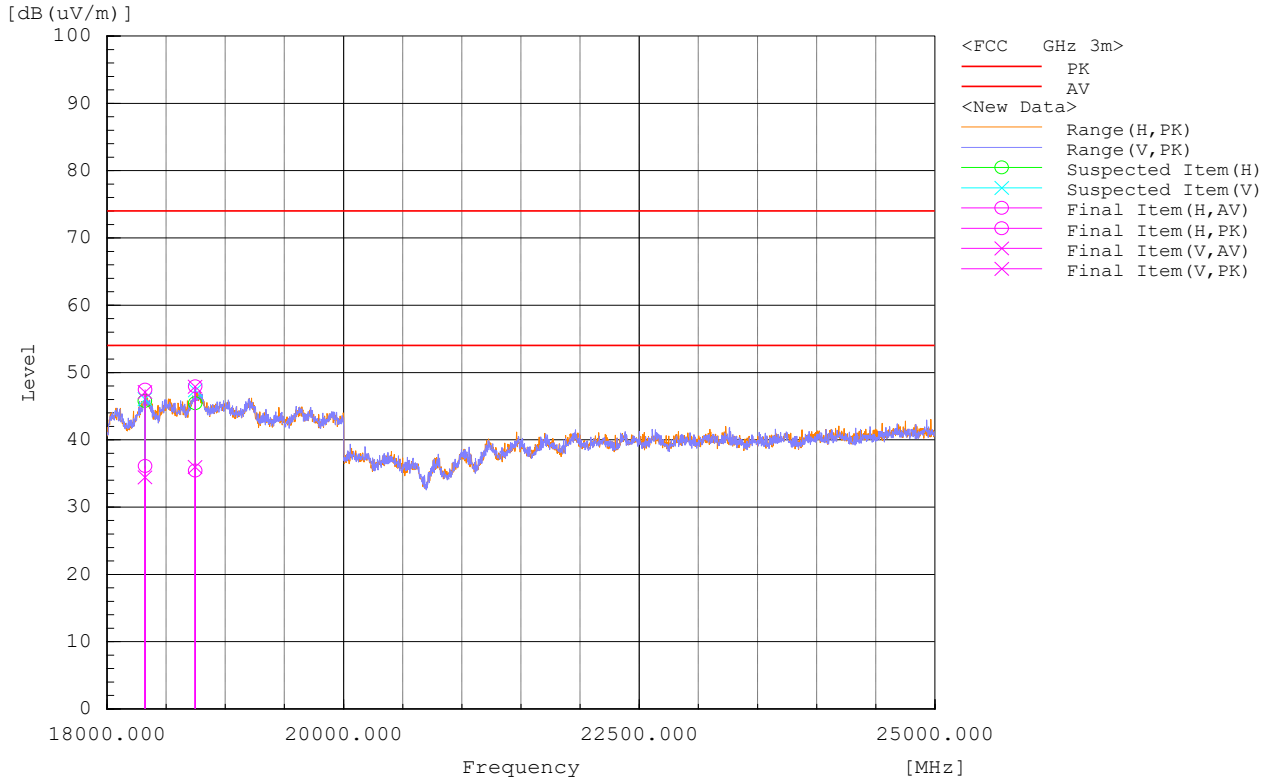


REMARKS:

1. Level (dBuV/m) = 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)

CHANNEL	TX Channel 0	DETECTOR FUNCTION	Peak Average
FREQUENCY RANGE	18 ~ 25GHz		

Frequency [MHz]	Pol V/H	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]
18320.84	V	19.0	31.7	15.4	34.4	47.1	54	74	-19.6	-26.9
18321.18	H	20.7	32.0	15.4	36.1	47.4	54	74	-17.9	-26.6
18746.61	H	20.8	33.3	14.6	35.4	47.9	54	74	-18.6	-26.1
18744.47	V	21.4	33.3	14.6	36.0	47.9	54	74	-18.0	-26.1

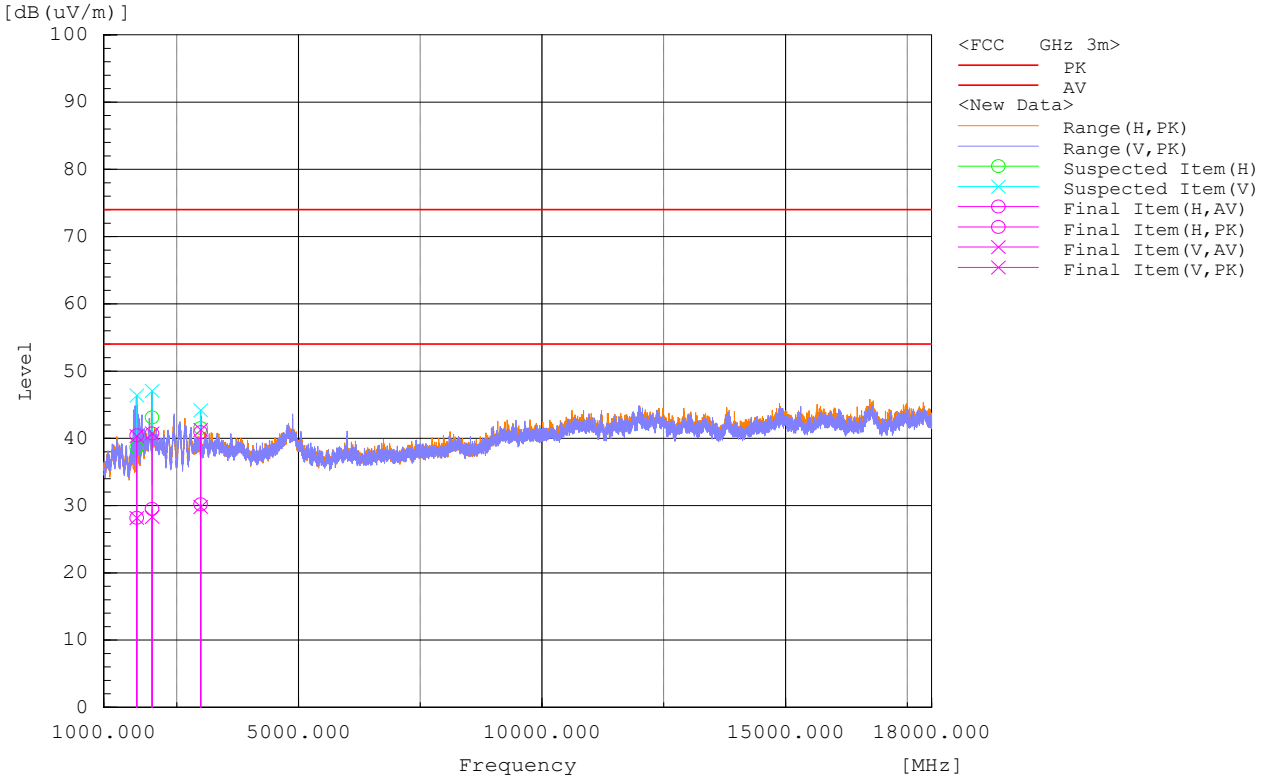


REMARKS:

1. Level (dBuV/m) = 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)

CHANNEL	TX Channel 20	**DETECTOR FUNCTION**	Peak Average
FREQUENCY RANGE	1GHz ~ 18GHz		

Frequency [MHz]	Pol V/H	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]
1677.18	H	42.1	54.3	-13.9	28.2	40.4	54	74	-25.8	-33.6
1678.97	V	42.0	54.1	-13.8	28.2	40.3	54	74	-25.8	-33.7
1993.33	H	41.2	52.4	-11.7	29.5	40.7	54	74	-24.5	-33.3
1992.65	V	40.0	52.4	-11.7	28.3	40.7	54	74	-25.7	-33.3
2990.86	V	40.8	52.3	-11.0	29.8	41.3	54	74	-24.2	-32.7
2990.92	H	41.2	51.9	-11.0	30.2	40.9	54	74	-23.8	-33.1

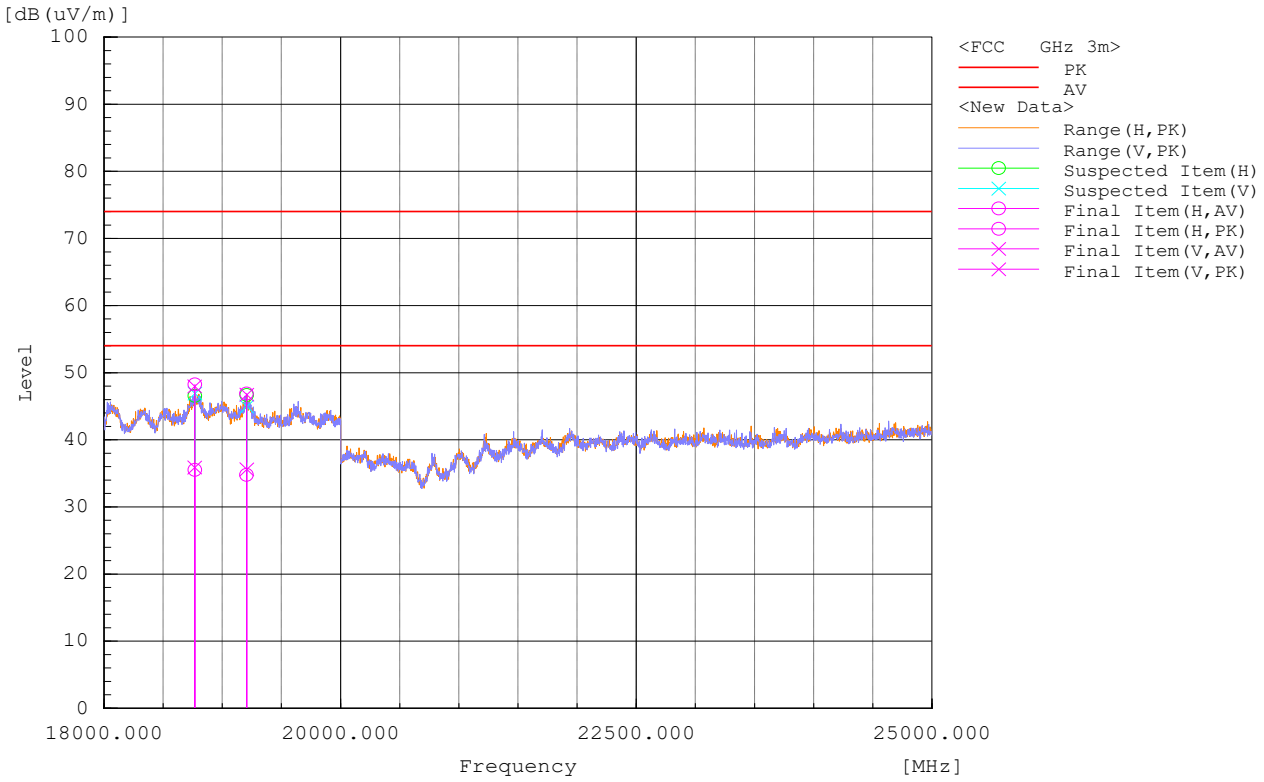


REMARKS:

1. Level (dBuV/m) = 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)

CHANNEL	TX Channel 20	DETECTOR FUNCTION	Peak Average
FREQUENCY RANGE	18 ~ 25GHz		

Frequency [MHz]	Pol V/H	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]
18767.10	V	21.2	33.3	14.7	35.9	48.0	54	74	-18.1	-26.0
18767.30	H	20.8	33.5	14.7	35.5	48.2	54	74	-18.5	-25.8
19205.00	H	20.9	33.0	13.9	34.8	46.9	54	74	-19.2	-27.1
19207.14	V	21.6	32.7	14.0	35.6	46.7	54	74	-18.4	-27.3

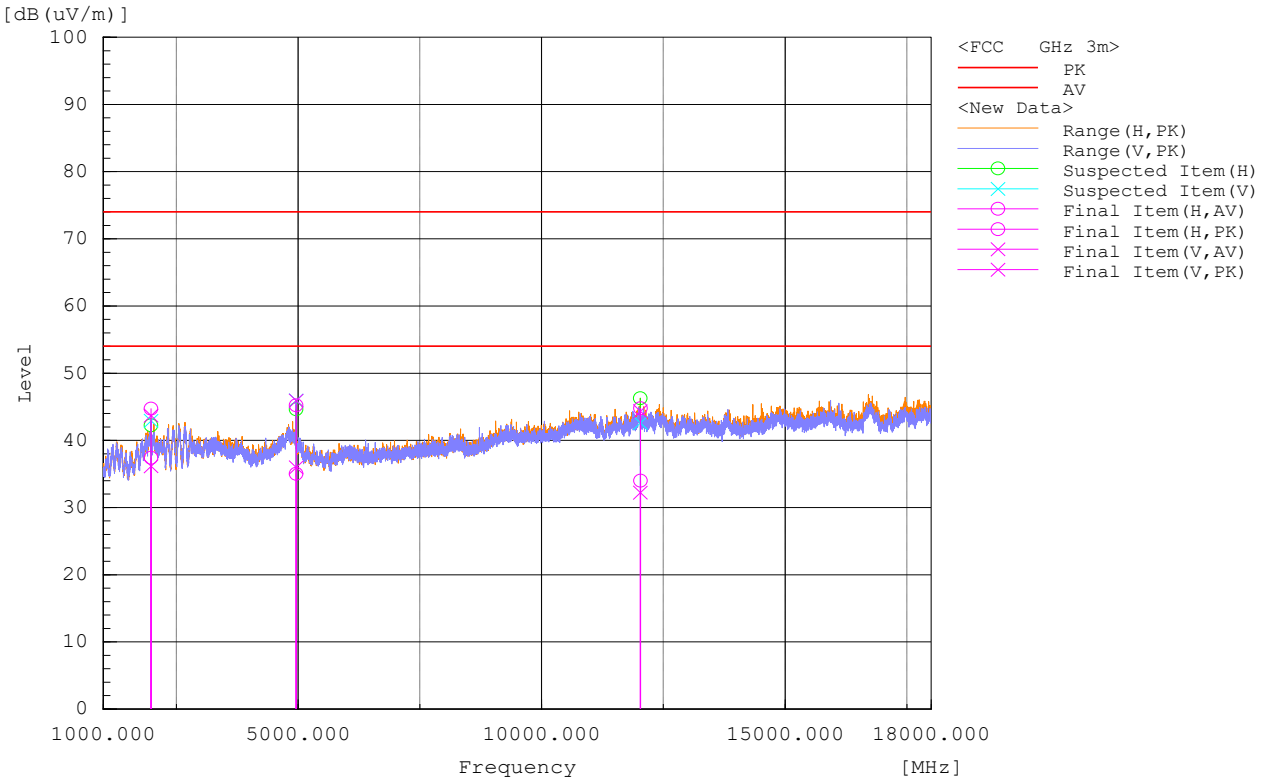


REMARKS:

1. Level (dBuV/m) = 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)

CHANNEL	TX Channel 39	DETECTOR FUNCTION	Peak Average
FREQUENCY RANGE	1GHz ~ 18GHz		

Frequency [MHz]	Pol V/H	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]
1980.07	V	47.9	55.4	-11.7	36.2	43.7	54	74	-17.8	-30.3
1980.01	H	49.1	56.4	-11.7	37.4	44.7	54	74	-16.6	-29.3
4959.99	V	44.9	54.8	-8.9	36.0	45.9	54	74	-18.0	-28.1
4960.00	H	43.9	54.1	-8.9	35.0	45.2	54	74	-19.0	-28.8
12029.41	H	33.9	44.7	0.1	34.0	44.8	54	74	-20.0	-29.2
12026.30	V	32.2	44.3	0.0	32.2	44.3	54	74	-21.8	-29.7

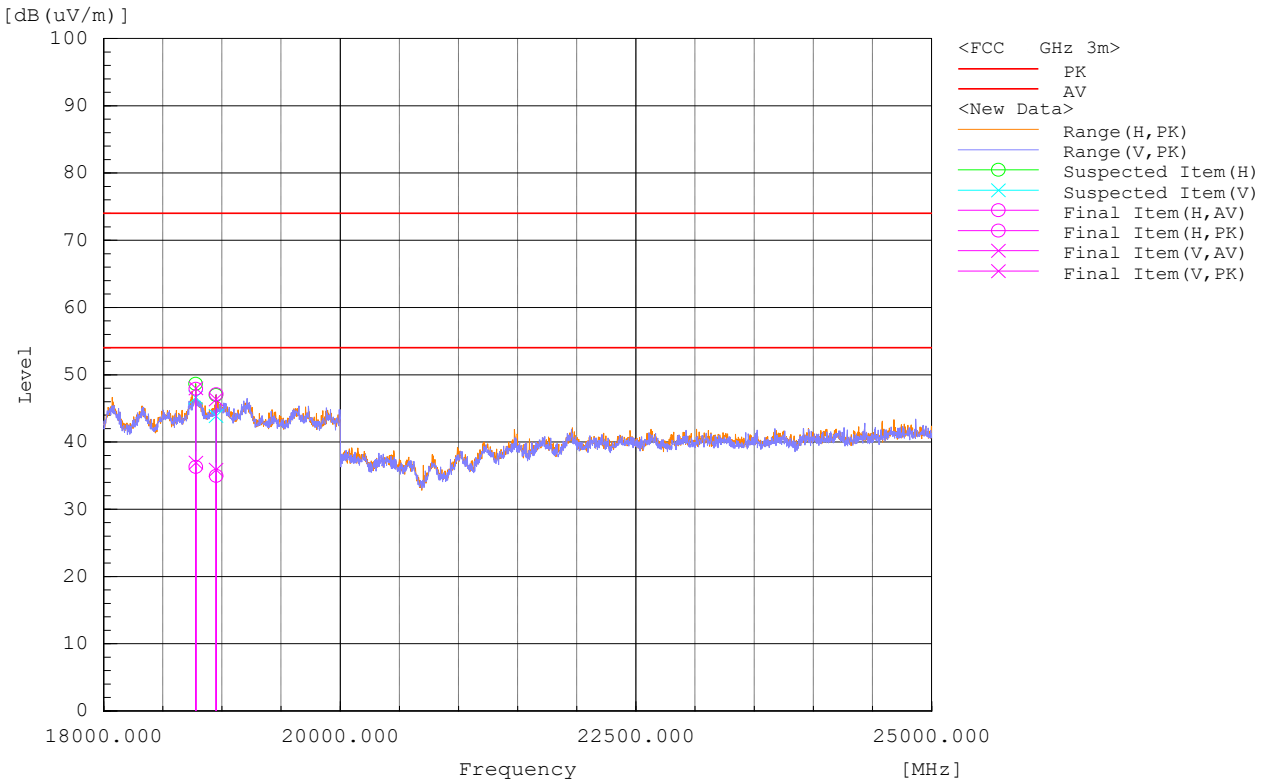


REMARKS:

1. Level (dBuV/m) = 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)

CHANNEL	TX Channel 39	**DETECTOR FUNCTION**	Peak Average
FREQUENCY RANGE	18 ~ 25GHz		

Frequency [MHz]	Pol V/H	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]
18778.43	V	22.2	33.3	14.7	36.9	48.0	54	74	-17.1	-26.0
18778.38	H	21.6	33.2	14.7	36.3	47.9	54	74	-17.7	-26.1
18951.38	H	21.1	33.2	13.9	35.0	47.1	54	74	-19.0	-26.9
18949.83	V	22.1	32.6	13.8	35.9	46.4	54	74	-18.1	-27.6

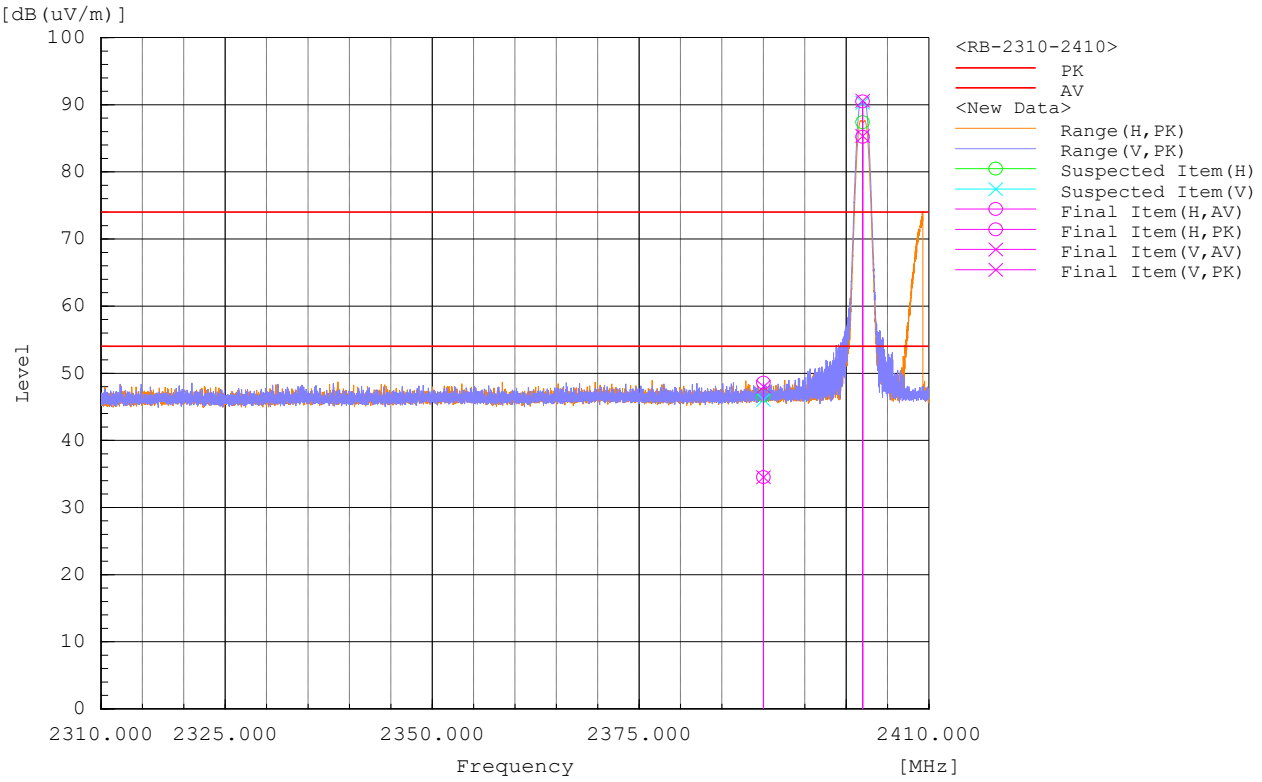


REMARKS:

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

RESTRICTED BAND (LOW CHANNEL)

Frequency [MHz]	Pol V/H	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]
2390	H	-2.0	12.1	36.5	34.5	48.6	54	74	-19.5	-25.4
2390	V	-2.0	11.5	36.5	34.5	48.0	54	74	-19.5	-26.0
2402	V	48.8	54.1	36.5	85.3	90.6				
2402	H	48.7	54.0	36.5	85.2	90.5				

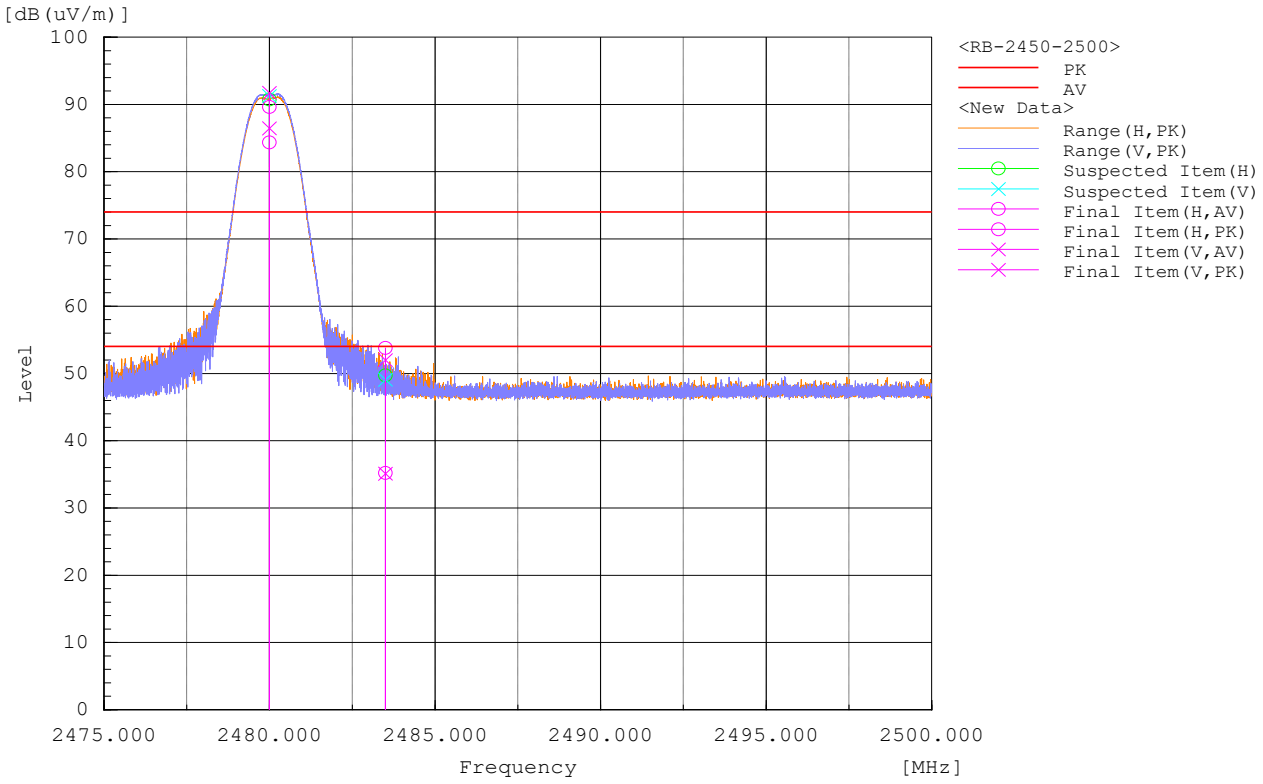


REMARKS:

1. Level (dBuV/m) = 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)

RESTRICTED BAND (HIGH CHANNEL)

Frequency [MHz]	Pol V/H	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]
2480.00	V	49.7	54.9	36.8	86.5	91.7				
2480.00	H	47.5	52.8	36.8	84.3	89.6				
2483.50	H	-1.6	17.0	36.8	35.2	53.8	54	74	-18.8	-20.2
2483.50	V	-1.7	15.2	36.8	35.1	52.0	54	74	-18.9	-22.0



REMARKS:

1. Level (dBuV/m) = 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)

4.7 ANTENNA REQUIREMENTS

Standard Applicable

If directional gain of transmitting antennas is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi. The use of permanent attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the rule.

Antenna Anti-Replacement Construction

Unique connector cable is used “Profectional installation required.”

Antenna Gain

The antenna peak gain of the EUT is 4 dBi which is less than 6dBi. Therefore, it is not necessary to reduce the maximum output power limit.

5 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:

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Tel: +1 408 526 1188

Sunnyvale OTA/Bluetooth Lab
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Tel: +1 669 600 5293

Littleton EMC/RF/Safety/Environmental Lab
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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.

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