

Report No. : FR320110AC



RADIO TEST REPORT

FCC ID	: RAXAIOS7
Equipment	: HEOS 7.0 Platform Module
Brand Name	: Arcadyan
Model Name	: WN9722OAX22-DM (AIOS7.0)
Applicant	: Arcadyan Technology Corporation No.8, Sec.2, Guangfu Rd., Hsinchu, 30071 Taiwan
Manufacturer	: Arcadyan Technology Corporation No.8, Sec.2, Guangfu Rd., Hsinchu, 30071 Taiwan
Standard	: 47 CFR FCC Part 15.247

The product was received on Feb. 02, 2023, and testing was started from Feb. 10, 2023 and completed on Mar. 08, 2023. We, Sporton International Inc. Hsinchu Laboratory, would like to declare that the tested sample has been evaluated in accordance with the procedures given in ANSI C63.10-2013 and shown compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. Hsinchu Laboratory, the test report shall not be reproduced except in full.

an

Approved by: Sam Chen

Sporton International Inc. Hsinchu Laboratory No.8, Ln. 724, Bo'ai St., Zhubei City, Hsinchu County 302010, Taiwan (R.O.C.)

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Appendix H. Photographs of EUT



History of this test report

Report No.	Version	Description	Issued Date
FR320110AC	01	Initial issue of report	Oct. 19, 2023
FR320110AC	02	Updating Test Result on Appendix F.	Nov. 06, 2023



Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
1.1.2	15.203	Antenna Requirement	PASS	-
3.1	15.207	AC Power-line Conducted Emissions	PASS	-
3.2	15.247(a)	DTS Bandwidth	PASS	-
3.3	15.247(b)	Maximum Conducted Output Power	PASS	-
3.4	15.247(e)	Power Spectral Density	PASS	-
3.5	15.247(d)	Emissions in Non-restricted Frequency Bands	PASS	-
3.6	15.247(d)	Emissions in Restricted Frequency Bands	PASS	-

Conformity Assessment Condition:

- 1. The test results (PASS/FAIL) with all measurement uncertainty excluded are presented against the regulation limits or in accordance with the requirements stipulated by the applicant/manufacturer who shall bear all the risks of non-compliance that may potentially occur if measurement uncertainty is taken into account.
- 2. The measurement uncertainty please refer to each test result in the chapter "Measurement Uncertainty".

Disclaimer:

The product specifications of the EUT presented in the test report that may affect the test assessments are declared by the manufacturer who shall take full responsibility for the authenticity.

Reviewed by: Sam Chen Report Producer: Cathy Chiu



1 General Description

1.1 Information

1.1.1 RF General Information

Frequency Range (MHz)	Bluetooth Mode	Ch. Frequency (MHz)	Channel Number
2400-2483.5	LE	2402-2480	0-39 [40]

Band	Mode	BWch (MHz)	Nant
2.4-2.4835GHz	BT-LE(1Mbps)	1.0	1TX
2.4-2.4835GHz	BT-LE(500Kb/s)	1.0	1TX
2.4-2.4835GHz	BT-LE(125Kb/s)	1.0	1TX
2.4-2.4835GHz	BT-LE(2Mbps)	2.0	1TX

Note:

- Bluetooth LE uses a GFSK modulation.
- BWch is the nominal channel bandwidth.



1.1.2 Antenna Information

0	A -= 1	Arri Dari		Durand		Antenna		Gain (dBi)			
Set	Ant.	Port	Port Brand	Model Name Type	Connector	2.4GHz	5GHz	6GHz	Bluetooth		
	1	1	WIESON	ARY196-0383-005- 00	Dipole Antenna	I-PEX	-	-	-	2.1	
1	2	1	WIESON	ARY196-0383-006- 00	Dipole Antenna	I-PEX	2.2	2.7	2.8	-	
	3	2	WIESON	ARY196-0383-007- 00	Dipole Antenna	I-PEX	1.7	1.6	1.7	-	
	1	1	WIESON	ARY196-0383-008- 00	Dipole Antenna	I-PEX	-	-	-	1.7	
2	2	1	WIESON	ARY196-0383-009- 00	Dipole Antenna	I-PEX	2.0	2.2	2.3	-	
	3	2	WIESON	ARY196-0383-010- 00	Dipole Antenna	I-PEX	1.1	1.0	0.9	-	

Note1: The above information was declared by manufacturer.

Note2: The EUT has two sets of antennas and there are three antennas for each set.

Set 1~2 are the same type antenna. Only the highest gain Set 1 antenna was selected to test and record in this report.



Note 3: Directional gain information

Туре	Maximum Output Power	Power Spectral Density
Non-BF	Directional gain = Max.gain + array gain. For power measurements on IEEE 802.11 devices Array Gain = 0 dB (i.e., no array gain) for N ANT ≤ 4	$DirectionalGain = 10 \cdot \log \left[\frac{\sum_{j=1}^{N_{SN}} \left\{ \sum_{k=1}^{N_{SNT}} \mathcal{E}_{j,k} \right\}^2}{N_{ANT}} \right]$
BF	$DirectionalGain = 10 \cdot \log \left[\frac{\sum_{j=1}^{N_{SST}} \left\{ \sum_{k=1}^{N_{SST}} g_{j,k} \right\}^2}{N_{ANT}} \right]$	$DirectionalGain = 10 \cdot \log \left[\frac{\sum_{j=1}^{N_{SST}} \left\{ \sum_{k=1}^{N_{SST}} g_{j,k} \right\}^2}{N_{ANT}} \right]$

Ex.

Directional Gain (NSS1) formula :

$$DirectionalGain = 10 \cdot \log \left[\frac{\sum_{j=1}^{N_{abst}} \mathcal{Z}_{j,k}}{N_{abst}} \right]^{2}$$

NSS1(g1,1) = $10^{G1/20}$; NSS1(g1,2)= $10^{G2/20}$;

 $gj,k = (Nss1(g1,1) + Nss1(g1,2))^2$

DG = $10 \log[(Nss1(g1,1) + Nss1(g1,2))^2 / N_{ANT}] \Rightarrow 10 \log[(10^{G1/20} + 10^{G2/20})^2 / N_{ANT}]$ Where :

2.4G G1= 2.2 dBi ; G2= 1.7 dBi ;DG= 4.96dBi

5G G1= 2.7 dBi ; G2= 1.6 dBi ;DG= 5.18dBi

6G G1= 2.8 dBi ; G2= 1.7 dBi ;DG= 5.28dBi

For 2.4GHz function:

For IEEE 802.11b/g/n/VHT/ax (2TX/2RX):

Port 1 and Port 2 can be used as transmitting/receiving antenna. Port 1 and Port 2 could transmit/receive simultaneously.

For 5GHz function:

For IEEE 802.11a/n/ac/ax (2TX/2RX):

Port 1 and Port 2 can be used as transmitting/receiving antenna. Port 1 and Port 2 could transmit/receive simultaneously.

For 6GHz function:

For IEEE 802.11ax (2TX/2RX):

Port 1 and Port 2 can be used as transmitting/receiving antenna. Port 1 and Port 2 could transmit/receive simultaneously.

For Bluetooth function (1TX/1RX):

Only Port 1 can be used as transmitting/receiving antenna.



1.1.3 Mode Test Duty Cycle

Mode	DC	DCF(dB)	T(s)	VBW(Hz) ≥ 1/T
BT-LE(1Mbps)	0.853	0.69	2.134m	1k
BT-LE(2Mbps)	0.579	2.37	1.073m	1k

Note:

• DC is Duty Cycle.

DCF is Duty Cycle Factor.

1.1.4 EUT Operational Condition

EUT Power Type	Form host system			
Function	Point-to-multipoint Depint-to-point			
Test Software Version	DOS [ver 6.1.7601]			
	LE 1M PHY: 1 Mb/s			
Support Mode	LE Coded PHY (S=2): 500 Kb/s			
Support Mode	LE Coded PHY (S=8): 125 Kb/s			
	LE 2M PHY: 2 Mb/s			

Note: The above information was declared by manufacturer.



1.2 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- 47 CFR FCC Part 15.247
- ANSI C63.10-2013

The following reference test guidance is not within the scope of accreditation of TAF.

- FCC KDB 558074 D01 v05r02
- FCC KDB 414788 D01 v01r01

1.3 Testing Location Information

Testing Location Information					
Test Lab. : Sporton International Inc. Hsinchu Laboratory					
Hsinchu	ADD: No.8, Ln. 724, Bo'ai St., Zhubei City, Hsinchu County 302010, Taiwan (R.O.C.)				
(TAF: 3787)	TEL: 886-3-656-9065 FAX: 886-3-656-9085				
	Test site Designation No. TW3787 with FCC.				
	Conformity Assessment Body Identifier (CABID) TW3787 with ISED.				

Test Condition	Test Site No.	Test Engineer	Test Environment (°C / %)	Test Date
RF Conducted	TH02-CB	Mason Chan	21.7~23.4 / 60~63	Feb. 17, 2023~ Feb. 21, 2023
Radiated (Below 1GHz)	03CH05-CB	Chris Li	20.2~21.3 / 56~57	Mar. 04, 2023
Radiated (Above 1GHz)	03CH02-CB	Stim Sung	20-21 / 55-58	Feb. 10, 2023~ Feb. 17, 2023
AC Conduction	CO01-CB	Dean Chang	22~23 / 50~51	Mar. 08, 2023

1.4 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2)

Test Items	Uncertainty	Remark
Conducted Emission (150kHz ~ 30MHz)	3.4 dB	Confidence levels of 95%
Radiated Emission (9kHz ~ 30MHz)	3.4 dB	Confidence levels of 95%
Radiated Emission (30MHz ~ 1,000MHz)	5.6 dB	Confidence levels of 95%
Radiated Emission (1GHz ~ 18GHz)	5.2 dB	Confidence levels of 95%
Radiated Emission (18GHz ~ 40GHz)	4.7 dB	Confidence levels of 95%
Conducted Emission	3.2 dB	Confidence levels of 95%
Output Power Measurement	0.8 dB	Confidence levels of 95%
Power Density Measurement	3.2 dB	Confidence levels of 95%
Conducted Emission (150kHz ~ 30MHz)	3.4 dB	Confidence levels of 95%



2 Test Configuration of EUT

2.1 Test Channel Mode

Mode	Power Setting
BT-LE(1Mbps)	-
2402MHz	15
2440MHz	14
2480MHz	11
BT-LE(2Mbps)	-
2402MHz	18
2440MHz	14
2480MHz	11



2.2 The Worst Case Measurement Configuration

Т	The Worst Case Mode for Following Conformance Tests		
Tests Item	AC power-line conducted emissions		
Condition AC power-line conducted measurement for line and neutral Test Voltage: 120Vac / 60Hz			
Operating Mode	Mode Normal Link		
1	EUT with antenna set 1 + 2.4GHz + Bluetooth		
2	EUT with antenna set 1 + 5GHz + Bluetooth		
3 EUT with antenna set 1 + 6GHz + Bluetooth			
For operating mode 2 is t	he worst case and it was record in this test report.		

Th	The Worst Case Mode for Following Conformance Tests	
Tests Item	DTS Bandwidth Maximum Conducted Output Power Power Spectral Density Emissions in Non-restricted Frequency Bands	
Test Condition	Conducted measurement at transmit chains	

Th	e Worst Case Mode for Following Conformance Tests	
Tests Item	Emissions in Restricted Frequency Bands	
Test Condition	Pondition Radiated measurement If EUT consist of multiple antenna assembly (multiple antenna are used in EUT regardless of spatial multiplexing MIMO configuration), the radiated test should be performed with highest antenna gain of each antenna type.	
Operating Mode < 1GHz	Normal Link	
After evaluating, the worst case was found at Y axis, thus the measurement will follow this same configuration.		
1	UT at Y axis with antenna set 1 + 2.4GHz + Bluetooth	
2	EUT at Y axis with antenna set 1 + 5GHz + Bluetooth	
3	EUT at Y axis with antenna set 1 + 6GHz + Bluetooth	
For operating mode 1 is the worst case and it was record in this test report.		
Operating Mode > 1GHz CTX		
After evaluating, the wors measurement will follow th	t case was found at Y axis for bandedge and X axis for harmonic. Thus the is same test configuration.	
1	EUT with antenna set 1 + Bluetooth (Bandedge in Y axis) / (Harmonic in X axis)	



The Worst Case Mode for Following Conformance Tests		
Tests Item Simultaneous Transmission Analysis - Co-location RF Exposure Evaluation		
Operating Mode		
1	WLAN 2.4GHz + Bluetooth	
2 WLAN 5GHz + Bluetooth		
3 WLAN 6GHz + Bluetooth		
Refer to Sporton Test Report No.: FA320110 for Co-location RF Exposure Evaluation.		

2.3 EUT Operation during Test

For CTX Mode:

The EUT was programmed to be in continuously transmitting mode.

For Normal Link Mode:

During the test, the EUT operation to normal function.

2.4 Accessories

N/A



Support Equipment 2.5

For AC Conduction:

		Support Equ	ipment	
No.	No. Equipment Brand Name Model Name FCC ID		FCC ID	
А	Test Fixture	Arcadyan	N0IDM9922001J	N/A
В	LAN NB	DELL	E6430	N/A
С	BT Test Set	Anritsu	MT8852B	N/A
D	WLAN AP	TP-Link	Archer AX10 N/A	
Е	WLAN NB	DELL	E6430	N/A
F	Test Fixture	MASIMO HEOS	AIOS7 LPP	N/A

For Radiated (below 1GHz):

	Support Equipment			
No.	No. Equipment Brand Name Model Name FCC ID		FCC ID	
А	Test Fixture	Arcadyan	N0IDM9922001J	N/A
В	NB	Lenovo	L440	N/A
С	BT Test Set	Anritsu	MT8852B	N/A
D	WLAN AP	LINKSYS	NKSYS DIVO N/A	
Е	NB	NB DELL E4300 N/A		N/A
F	Test Fixture	MASIMO HEOS	AIOS7 LPP	N/A

For Radiated (above 1GHz):

	Support Equipment			
No.	No. Equipment Brand Name Model Name FCC ID			
А	NB	DELL	E4300	N/A
В	Test Fixture Arcadyan N0IDM9922001J N/A		N/A	
С	Test Fixture	MASIMO HEOS	AIOS7 LPP	N/A

For RF Conducted:

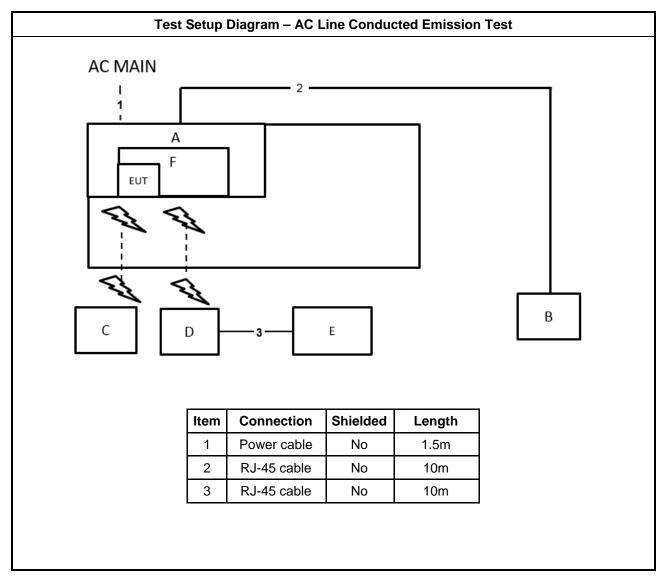
Support Equipment				
No.	No. Equipment Brand Name Model Name FCC ID			
А	NB	DELL	E4300	N/A
В	Test Fixture MASIMO HEOS AIOS7 LPP N/A		N/A	
С	Test Fixture	Arcadyan	N0IDM9922001J	N/A

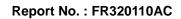
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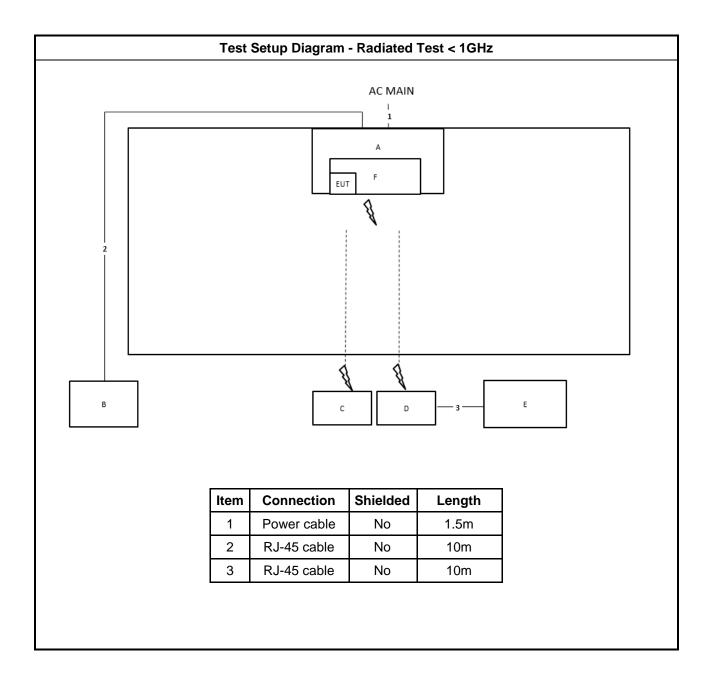


2.6 Test Setup Diagram

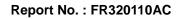


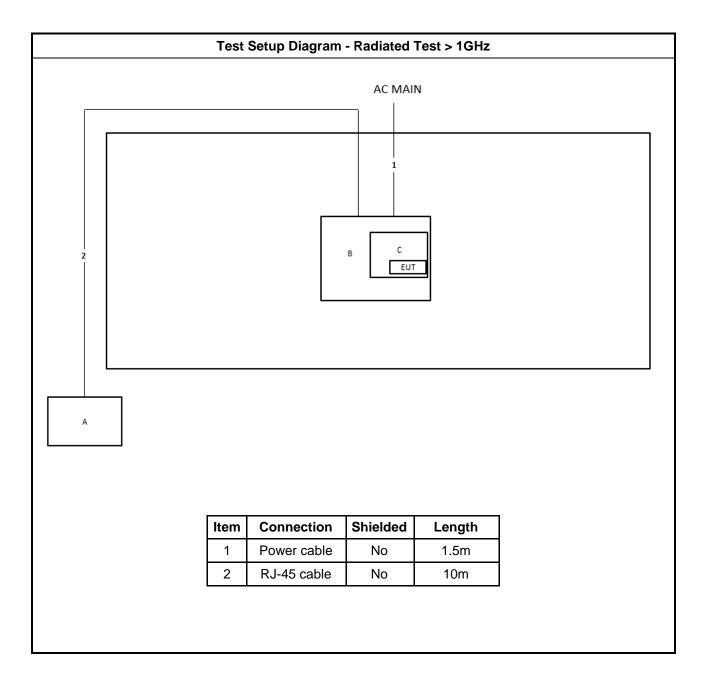














3 Transmitter Test Result

3.1 AC Power-line Conducted Emissions

3.1.1 AC Power-line Conducted Emissions Limit

AC Powe	er-line Conducted Emissions I	_imit
Frequency Emission (MHz)	Quasi-Peak	Average
0.15-0.5	66 - 56 *	56 - 46 *
0.5-5	56	46
5-30	60	50
Note 1: * Decreases with the logarithm of	of the frequency.	

3.1.2 Measuring Instruments

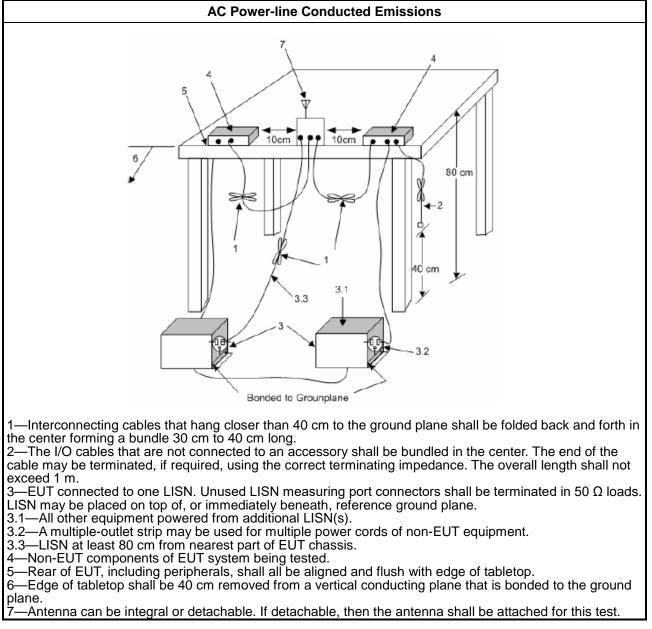
Refer a test equipment and calibration data table in this test report.

3.1.3 Test Procedures

Test Method

• Refer as ANSI C63.10-2013, clause 6.2 for AC power-line conducted emissions.

3.1.4 Test Setup



1.1.1. Measurement Results Calculation

The measured Level is calculated using:

- a. Corrected Reading: LISN Factor (LISN) + Attenuator (AT/AUX) + Cable Loss (CL) + Read Level (Raw) = Level
- b. Margin = -Limit + Level

3.1.5 Test Result of AC Power-line Conducted Emissions

Refer as Appendix A



3.2 **DTS Bandwidth**

3.2.1 6dB Bandwidth Limit

6dB Bandwidth Limit
Systems using digital modulation techniques:
 6 dB bandwidth ≥ 500 kHz.

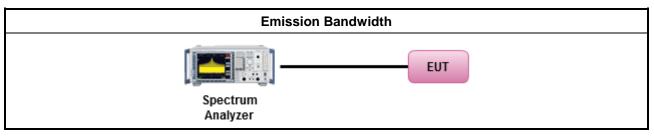
3.2.2 **Measuring Instruments**

Refer a test equipment and calibration data table in this test report.

3.2.3 **Test Procedures**

 For the emission bandwidth shall be measured using one of the options below: Refer as FCC KDB 558074, clause 8.2 & C63.10 clause 11.8.1 Option 1 for 6 dB bandwid measurement. Refer as FCC KDB 558074, clause 8.2 & C63.10 clause 11.8.2 Option 2 for 6 dB bandwid measurement. Refer as ANSI C63.10, clause 6.9.1 for occupied bandwidth testing. 		Test Method									
 measurement. Refer as FCC KDB 558074, clause 8.2 & C63.10 clause 11.8.2 Option 2 for 6 dB bandwid measurement. 	•	 For the emission bandwidth shall be measured using one of the options below: 									
measurement.		Refer as FCC KDB 558074, clause 8.2 & C63.10 clause 11.8.1 Option 1 for 6 dB bandwidt measurement.									
Peter on ANSI C62 10, plause 6.0.1 for exclusive handwidth testing											
Refer as ANSI Cos. 10, clause 6.9.1 for occupied bandwidth testing.											

3.2.4 Test Setup



Test Result of Emission Bandwidth 3.2.5

Refer as Appendix B



3.3 Maximum Conducted Output Power

3.3.1 Maximum Conducted Output Power Limit

Maximum Conducted Output Power Limit

• If $G_{TX} \le 6 \text{ dBi}$, then $P_{Out} \le 30 \text{ dBm} (1 \text{ W})$	
• Point-to-multipoint systems (P2M): If $G_{TX} > 6$ dBi, then $P_{Out} = 30 - (G_{TX} - 6)$ dB	ßm
• Point-to-point systems (P2P): If $G_{TX} > 6$ dBi, then $P_{Out} = 30 - (G_{TX} - 6)/3$ dBm	

- Smart antenna system (SAS):
 - Single beam: If $G_{TX} > 6$ dBi, then $P_{Out} = 30 (G_{TX} 6)/3$ dBm
 - Overlap beam: If $G_{TX} > 6 \text{ dBi}$, then $P_{Out} = 30 (G_{TX} 6)/3 \text{ dBm}$
 - Aggregate power on all beams: If $G_{TX} > 6$ dBi, then $P_{Out} = 30 (G_{TX} 6)/3 + 8$ dB dBm

 P_{out} = maximum peak conducted output power or maximum conducted output power in dBm, G_{TX} = the maximum transmitting antenna directional gain in dBi.

3.3.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

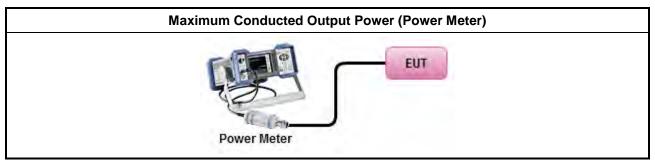


3.3.3 Test Procedures

		Test Method
•	Max	imum Peak Conducted Output Power
		Refer as FCC KDB 558074, clause 8.3.1.1 & C63.10 clause 11.9.1.1 (RBW ≥ EBW method).
		Refer as FCC KDB 558074, clause 8.3.1.3 & C63.10 clause 11.9.1.3 (peak power meter).
•	Max	imum Conducted Output Power
	[dut	/ cycle ≥ 98% or external video / power trigger]
		Refer as FCC KDB 558074, clause 8.3.2.2 & C63.10 clause 11.9.2.2.2 Method AVGSA-1.
		Refer as FCC KDB 558074, clause 8.3.2.2 & C63.10 clause 11.9.2.2.3 Method AVGSA-1A. (alternative)
	duty	cycle < 98% and average over on/off periods with duty factor
		Refer as FCC KDB 558074, clause 8.3.2.2 & C63.10 clause 11.9.2.2.4 Method AVGSA-2.
		Refer as FCC KDB 558074, clause 8.3.2.2 & C63.10 clause 11.9.2.2.5 Method AVGSA-2A (alternative)
		Refer as FCC KDB 558074, clause 8.3.2.2 & C63.10 clause 11.9.2.2.6 Method AVGSA-3
		Refer as FCC KDB 558074, clause 8.3.2.2 & C63.10 clause 11.9.2.2.7 Method AVGSA-3A (alternative)
	Mea	surement using a power meter (PM)
		Refer as FCC KDB 558074, clause 8.3.2.3 & C63.10 clause 11.9.2.3.1 Method AVGPM (using an RF average power meter).
	\boxtimes	Refer as FCC KDB 558074, clause 8.3.2.3 & C63.10 clause 11.9.2.3.2 Method AVGPM-G (using an gate RF average power meter).
•	For	conducted measurement.
		If the EUT supports multiple transmit chains using options given below: Refer as FCC KDB 662911, In-band power measurements. Using the measure-and-sum approach, measured all transmit ports individually. Sum the power (in linear power units e.g., mW) of all ports for each individual sample and save them.
	•	If multiple transmit chains, EIRP calculation could be following as methods: $P_{total} = P_1 + P_2 + + P_n$ (calculated in linear unit [mW] and transfer to log unit [dBm]) EIRP _{total} = P _{total} + DG



3.3.4 Test Setup



3.3.5 Test Result of Maximum Conducted Output Power

Refer as Appendix C



3.4 **Power Spectral Density**

3.4.1 Power Spectral Density Limit

Power Spectral Density Limit	
Power Spectral Density (PSD)≤8 dBm/3kHz	

3.4.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

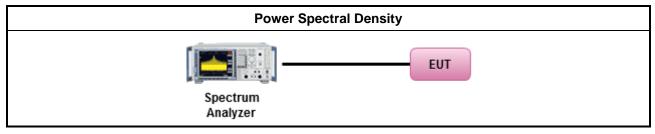
3.4.3 Test Procedures

•

	Test Method										
•	Peak power spectral density procedures that the same method as used to determine the conducted output power. If maximum peak conducted output power was measured to demonstrate compliance to the output power limit, then the peak PSD procedure below (Method PKPSD) shall be used. If maximum conducted output power was measured to demonstrate compliance to the output power limit, then one of the average PSD procedures shall be used, as applicable based on the following criteria (the peak PSD procedure is also an acceptable option).										
	Refer as FCC KDB 558074, clause 8.4 & C63.10 clause 11.10 Method Max. PSD.										
	[duty	/ сус	le ≥ 98% or external video / power trigger]								
•	For	cond	ucted measurement.								
	•	lf Th	ne EUT supports multiple transmit chains using options given below:								
			Option 1: Measure and sum the spectra across the outputs. Refer as FCC KDB 662911, In-band power spectral density (PSD). Sample all transmit ports simultaneously using a spectrum analyzer for each transmit port. Where the trace bin-by-bin of each transmit port summing can be performed. (i.e., in the first spectral bin of output 1 is summed with that in the first spectral bin of output 2 and that from the first spectral bin of output 3, and so on up to the NTX output to obtain the value for the first frequency bin of the summed spectrum.). Add up the amplitude (power) values for the different transmit chains and use this as the new data trace.								
			Option 2: Measure and sum spectral maxima across the outputs. With this technique, spectra are measured at each output of the device at the required resolution bandwidth. The maximum value (peak) of each spectrum is determined. These maximum values are then summed mathematically in linear power units across the outputs. These operations shall be performed separately over frequency spans that have different out-of-band or spurious emission limits,								
			Option 3: Measure and add 10 log(N) dB, where N is the number of transmit chains. Refer as FCC KDB 662911, In-band power spectral density (PSD). Performed at each transmit chains and each transmit chains shall be compared with the limit have been reduced with 10 log(N). Or each transmit chains shall be add 10 log(N) to compared with the limit.								



3.4.4 Test Setup



3.4.5 Test Result of Power Spectral Density

Refer as Appendix D



3.5 Emissions in Non-restricted Frequency Bands

3.5.1 Emissions in Non-restricted Frequency Bands Limit

Un-restricted Band Emissions Limit						
RF output power procedure Limit (dBc)						
20						
30						

Note 1: If the peak output power procedure is used to measure the fundamental emission power to demonstrate compliance to requirements, then the peak conducted output power measured within any 100 kHz outside the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum measured in-band peak PSD level.

Note 2: If the average output power procedure is used to measure the fundamental emission power to demonstrate compliance to requirements, then the power in any 100 kHz outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum measured in-band average PSD level.

3.5.2 Measuring Instruments

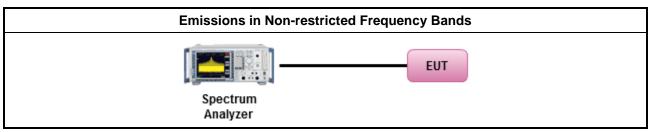
Refer a test equipment and calibration data table in this test report.

3.5.3 Test Procedures

Test Method

Refer as FCC KDB 558074, clause 8.5 for unwanted emissions into non-restricted bands.

3.5.4 Test Setup



3.5.5 Test Result of Emissions in Non-restricted Frequency Bands

Refer as Appendix E



3.6 Emissions in Restricted Frequency Bands

3.6.1 Emissions in Restricted Frequency Bands Limit

Restricted Band Emissions Limit								
Frequency Range (MHz) Field Strength (uV/m) Field Strength (dBuV/m) Measure								
0.009~0.490	2400/F(kHz)	48.5 - 13.8	300					
0.490~1.705	24000/F(kHz)	33.8 - 23	30					
1.705~30.0	30	29	30					
30~88	100	40	3					
88~216	150	43.5	3					
216~960	200	46	3					
Above 960	500	54	3					

Note 1: Test distance for frequencies at or above 30 MHz, measurements may be performed at a distance other than the limit distance provided they are not performed in the near field and the emissions to be measured can be detected by the measurement equipment. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse of linear distance for field-strength measurements, inverse of linear distance-squared for power-density measurements).

Note 2: Test distance for frequencies at below 30 MHz, measurements may be performed at a distance closer than the EUT limit distance; however, an attempt should be made to avoid making measurements in the near field. When performing measurements below30 MHz at a closer distance than the limit distance, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two or more distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB / decade). The test report shall specify the extrapolation method used to determine compliance of the EUT.

Note 3: Using the distance of 1m during the test for above 18 GHz, and the test value to correct for the distance factor at 3m.

3.6.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

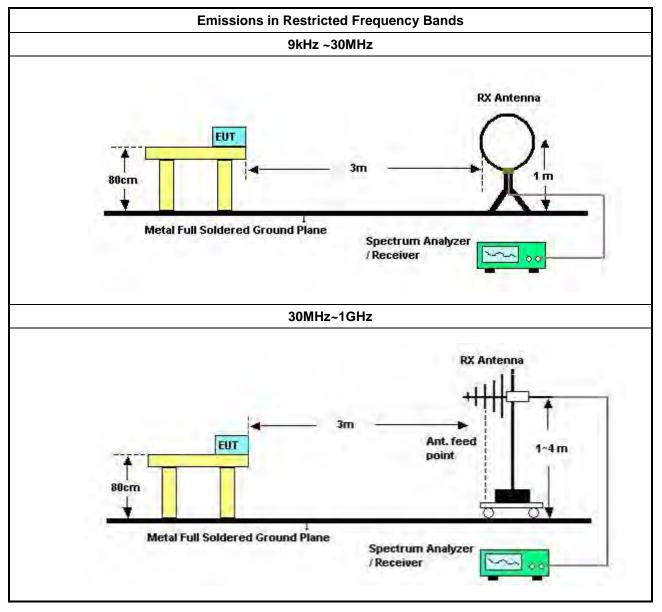


3.6.3 Test Procedures

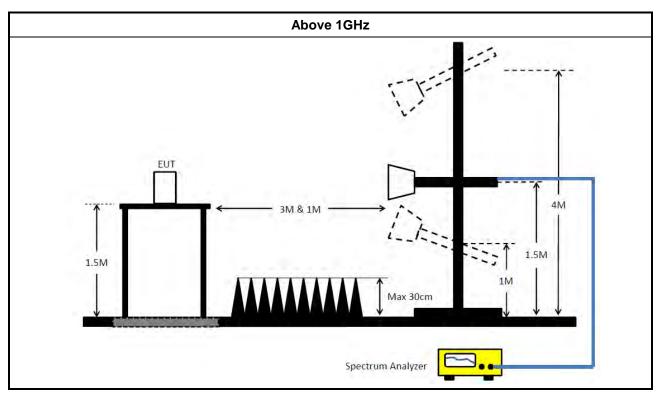
	Test Method									
•	The average emission levels shall be measured in [duty cycle \geq 98 or duty factor].									
•	 Refer as ANSI C63.10, clause 6.10.3 band-edge testing shall be performed at the lowest frequency channel and highest frequency channel within the allowed operating band. 									
•	For the transmitter unwanted emissions shall be measured using following options below:									
	 Refer as FCC KDB 558074, clause 8.6 for unwanted emissions into restricted bands. 									
	Refer as FCC KDB 558074, clause 8.6 & C63.10 clause 11.12.2.5.1(trace averaging for duty cycle ≥98%).									
	Refer as FCC KDB 558074, clause 8.6 & C63.10 clause 11.12.2.5.2(trace averaging + duty factor).									
	☑ Refer as FCC KDB 558074, clause 8.6 & C63.10 clause 11.12.2.5.3(Reduced VBW≥1/T).									
	□ Refer as ANSI C63.10, clause 11.12.2.5.3 (Reduced VBW). VBW \ge 1/T, where T is pulse time.									
	Refer as ANSI C63.10, clause 7.5 average value of pulsed emissions.									
	Refer as FCC KDB 558074, clause 8.6 & C63.10 clause 11.12.2.4 measurement procedure peak limit.									
•	For the transmitter band-edge emissions shall be measured using following options below:									
	 Refer as FCC KDB 558074 clause 8.7 & c63.10 clause 11.13.1, When the performing peak or average radiated measurements, emissions within 2 MHz of the authorized band edge may be measured using the marker-delta method described below. 									
	 Refer as FCC KDB 558074, clause 8.7 (ANSI C63.10, clause 6.10.6) for marker-delta method for band-edge measurements. 									
	 Refer as FCC KDB 558074, clause 8.7 for narrower resolution bandwidth (100kHz) using the band power and summing the spectral levels (i.e., 1 MHz). 									
	 For conducted unwanted emissions into restricted bands (absolute emission limits). Devices with multiple transmit chains using options given below: (1) Measure and sum the spectra across the outputs or (2) Measure and add 10 log(N) dB 									
	 For FCC KDB 662911 The methodology described here may overestimate array gain, thereby resulting in apparent failures to satisfy the out-of-band limits even if the device is actually compliant. In such cases, compliance may be demonstrated by performing radiated tests around the frequencies at which the apparent failures occurred. 									



3.6.4 Test Setup







3.6.5 Measurement Results Calculation

The measured Level is calculated using:

Corrected Reading: Antenna factor (AF) + Cable loss (CL) + Read level (Raw) - Preamp factor (PA)(if applicable) = Level.

3.6.6 Emissions in Restricted Frequency Bands (Below 30MHz)

There is a comparison data of both open-field test site and alternative test site - semi-Anechoic chamber according to KDB414788 Radiated Test Site, and the result came out very similar.

All amplitude of spurious emissions that are attenuated by more than 20 dB below the permissible value has no need to be reported.

The radiated emissions were investigated from 9 kHz or the lowest frequency generated within the device, up to the 10th harmonic or 40 GHz, whichever is appropriate.

3.6.7 Test Result of Emissions in Restricted Frequency Bands

Refer as Appendix F



Test Equipment and Calibration Data 4

Instrument	Brand	Model No.	Serial No.	Characteristics	Calibration Date	Calibration Due Date	Remark
EMI Receiver	Agilent	N9038A	My52260123	9kHz ~ 8.4GHz	Feb. 20, 2023	Feb. 19, 2024	Conduction (CO01-CB)
LISN	F.C.C.	FCC-LISN-5 0-16-2	04083	150kHz ~ 100MHz	Feb. 16, 2023	Feb. 15, 2024	Conduction (CO01-CB)
LISN	Schwarzbeck	NSLK 8127	8127647	9kHz ~ 30MHz	Apr. 12, 2022	Apr. 11, 2023	Conduction (CO01-CB)
Pulse Limiter	Rohde&Schwarz	ESH3-Z2	100430	9kHz ~ 30MHz	Feb. 09, 2023	Feb. 08, 2024	Conduction (CO01-CB)
COND Cable	Woken	Cable	Low cable-CO01	9kHz ~ 30MHz	Oct. 18, 2022	Oct. 17, 2023	Conduction (CO01-CB)
Software	SPORTON	SENSE	V5.10	-	N.C.R.	N.C.R.	Conduction (CO01-CB)
Loop Antenna	Teseq	HLA 6120	24155	9kHz - 30 MHz	May 14, 2022	May 13, 2023	Radiation (03CH05-CB)
3m Semi Anechoic Chamber NSA	TDK	SAC-3M	03CH05-CB	30 MHz ~ 1 GHz	Aug. 03, 2022	Aug. 02, 2023	Radiation (03CH05-CB)
Bilog Antenna with 6dB Attenuator	TESEQ & EMCI	CBL 6112D & N-6-06	35236 & AT-N0610	30MHz ~ 2GHz	Mar. 25, 2022	Mar. 24, 2023	Radiation (03CH05-CB)
Pre-Amplifier	EMCI	EMC330N	980331	20MHz ~ 3GHz	Apr. 26, 2022	Apr. 25, 2023	Radiation (03CH05-CB)
Spectrum Analyzer	R&S	FSP40	100304	9kHz ~ 40GHz	Mar. 14, 2022	Mar. 13, 2023	Radiation (03CH05-CB)
EMI Test Receiver	R&S	ESCS	826547/017	9kHz ~ 2.75GHz	Jun. 17, 2022	Jun. 16, 2023	Radiation (03CH05-CB)
RF Cable-low	Woken	RG402	Low Cable-04+23	30MHz~1GHz	Oct. 03, 2022	Oct. 02, 2023	Radiation (03CH05-CB)
Test Software	SPORTON	SENSE	V5.10	-	N.C.R.	N.C.R.	Radiation (03CH05-CB)
3m Semi Anechoic Chamber VSWR	RIKEN	SAC-3M	03CH02-CB	1GHz ~18GHz	Mar. 26, 2022	Mar. 25, 2023	Radiation (03CH02-CB)
Horn Antenna	EMCO	3115	9610-4976	1GHz ~ 18GHz	Apr. 19, 2022	Apr. 18, 2023	Radiation (03CH02-CB)
Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170252	15GHz ~ 40GHz	Aug. 22, 2022	Aug. 21, 2023	Radiation (03CH02-CB)
Pre-Amplifier	Agilent	83017A	MY39501305	1GHz ~ 26.5GHz	Jul. 01, 2022	Jun. 30, 2023	Radiation (03CH02-CB)
Pre-Amplifier	SGH	SGH184	20221107-3	18GHz ~ 40GHz	Nov. 16, 2022	Nov. 15, 2023	Radiation (03CH02-CB)
Spectrum analyzer	R&S	FSU	100015	9kHz~26GHz	Dec. 05, 2022	Dec. 04, 2023	Radiation (03CH02-CB)

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Instrument	Brand	Model No.	Serial No.	Characteristics	Calibration Date	Calibration Due Date	Remark
RF Cable-high	Woken	RG402	High Cable-18	1GHz ~ 18GHz	Oct. 03, 2022	Oct. 02, 2023	Radiation (03CH02-CB)
RF Cable-high	Woken	RG402	High Cable-18+19	1GHz ~ 18GHz	Oct. 03, 2022	Oct. 02, 2023	Radiation (03CH02-CB)
High Cable	Woken	WCA0929M	40G#5+6	1GHz ~ 40 GHz	Dec. 07, 2022	Dec. 06, 2023	Radiation (03CH02-CB)
High Cable	Woken	WCA0929M	40G#5	1GHz ~ 40 GHz	Dec. 07, 2022	Dec. 06, 2023	Radiation (03CH02-CB)
High Cable	Woken	WCA0929M	40G#6	1GHz ~ 40 GHz	Dec. 07, 2022	Dec. 06, 2023	Radiation (03CH02-CB)
Test Software	SPORTON	SENSE	V5.10	-	N.C.R.	N.C.R.	Radiation (03CH02-CB)
Spectrum analyzer	R&S	FSV40	101027	9kHz~40GHz	Aug. 15, 2022	Aug. 14, 2023	Conducted (TH02-CB)
Power Sensor	Anritsu	MA2411B	1126203	300MHz~40GHz	Oct. 17, 2022	Oct. 16, 2023	Conducted (TH02-CB)
Power Meter	Anritsu	ML2495A	1210004	300MHz~40GHz	Oct. 17, 2022	Oct. 16, 2023	Conducted (TH02-CB)
RF Cable-high	Woken	RG402	High Cable-01	1 GHz – 18 GHz	Oct. 03, 2022	Oct. 02, 2023	Conducted (TH02-CB)
RF Cable-high	Woken	RG402	High Cable-02	1 GHz – 18 GHz	Oct. 03, 2022	Oct. 02, 2023	Conducted (TH02-CB)
RF Cable-high	Woken	RG402	High Cable-03	1 GHz – 18 GHz	Oct. 03, 2022	Oct. 02, 2023	Conducted (TH02-CB)
RF Cable-high	Woken	RG402	High Cable-04	1 GHz – 18 GHz	Oct. 03, 2022	Oct. 02, 2023	Conducted (TH02-CB)
RF Cable-high	Woken	RG402	High Cable-05	1 GHz – 18 GHz	Oct. 03, 2022	Oct. 02, 2023	Conducted (TH02-CB)
Switch	SPTCB	SP-SWI	SWI-02	1 GHz –26.5 GHz	Oct. 04, 2022	Oct. 03, 2023	Conducted (TH02-CB)
Test Software	SPORTON	SENSE	V5.10	-	N.C.R.	N.C.R.	Conducted (TH02-CB)

Note: Calibration Interval of instruments listed above is one year.

NCR means Non-Calibration required.



Conducted Emissions at Powerline

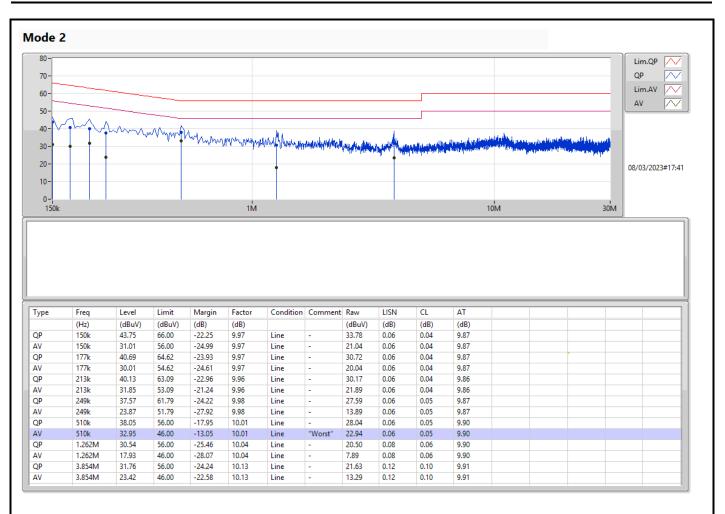
Appendix A

Summary	Summary										
Mode	Result	Туре	Freq	Level	Limit	Margin	Condition				
			(Hz)	(dBuV)	(dBuV)	(dB)					
Mode 2	Pass	AV	514.5k	36.10	46.00	-9.90	Neutral				



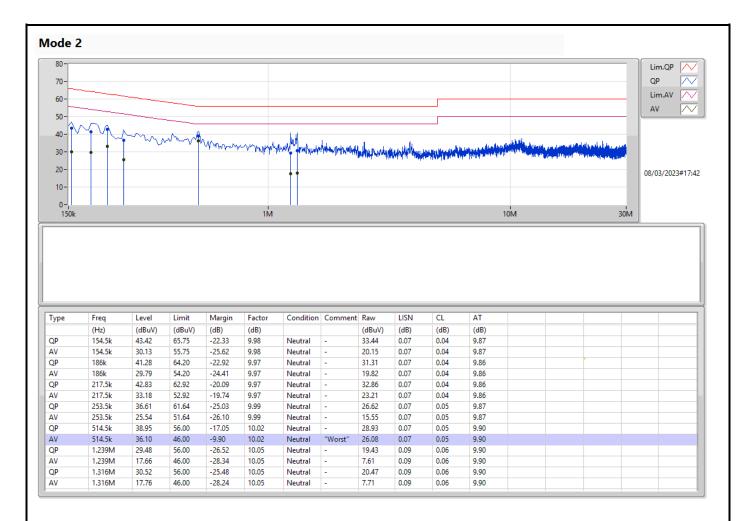
Conducted Emissions at Powerline

Appendix A











EBW-DTS

Summary

Mode	Max-N dB (Hz)	Max-OBW (Hz)	ITU-Code	Min-N dB (Hz)	Min-OBW (Hz)
2.4-2.4835GHz	-	-	-	-	(nz) -
BT-LE(1Mbps)	673.75k	1.029M	1M03F1D	668.75k	1.025M
BT-LE(2Mbps)	1.224M	2.021M	2M02F1D	1.214M	2.017M

 $\label{eq:max-NdB} Max\cdot N\, dB = Maximum 6dB \ down \ bandwidth; \ Max-OBW = Maximum 99\% \ occupied \ bandwidth; \ Min-OBW = Minimum 99\% \ occupied \ bandwidth; \ bandwidth \ bandwidth; \ bandwidth \ bandwidth$



EBW-DTS

Result

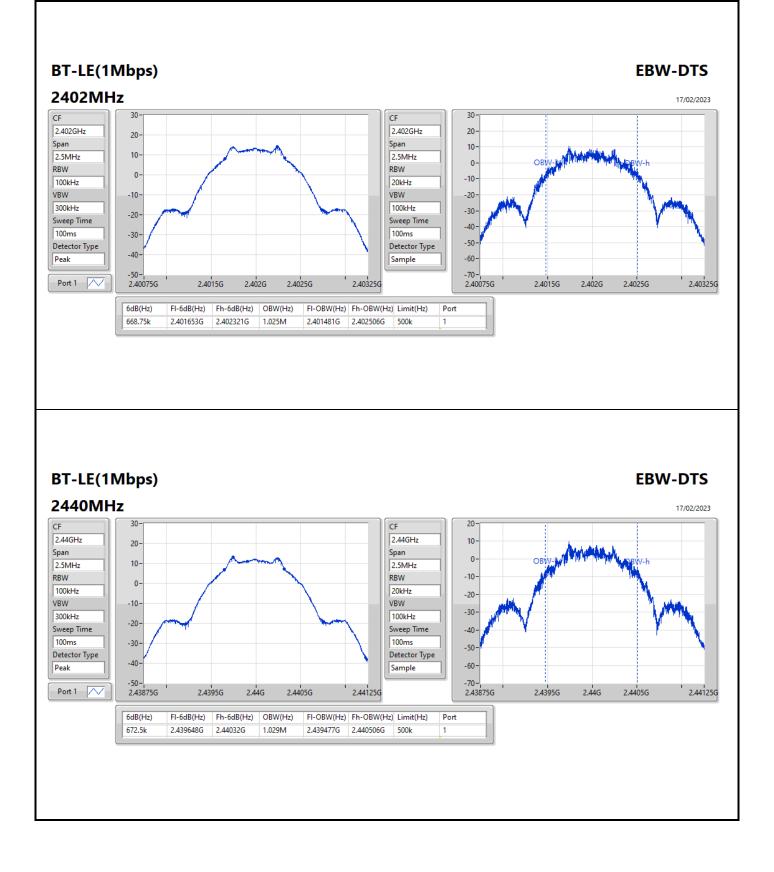
Mode	Result	Limit	Port 1-N dB	Port 1-OBW
		(Hz)	(Hz)	(Hz)
BT-LE(1Mbps)	-	-	-	-
2402MHz	Pass	500k	668.75k	1.025M
2440MHz	Pass	500k	672.5k	1.029M
2480MHz	Pass	500k	673.75k	1.027M
BT-LE(2Mbps)	-	-	-	-
2402MHz	Pass	500k	1.224M	2.018M
2440MHz	Pass	500k	1.214M	2.017M
2480MHz	Pass	500k	1.219M	2.021M

Port X-N dB = Port X 6dB down bandwidth; Port X-OBW = Port X 99% occupied bandwidth



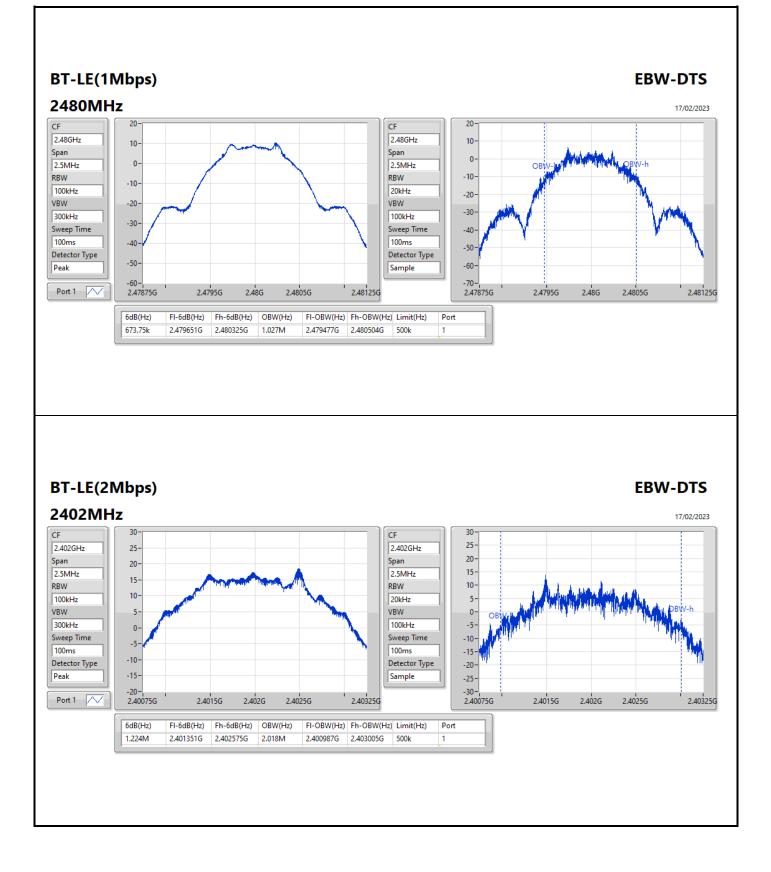








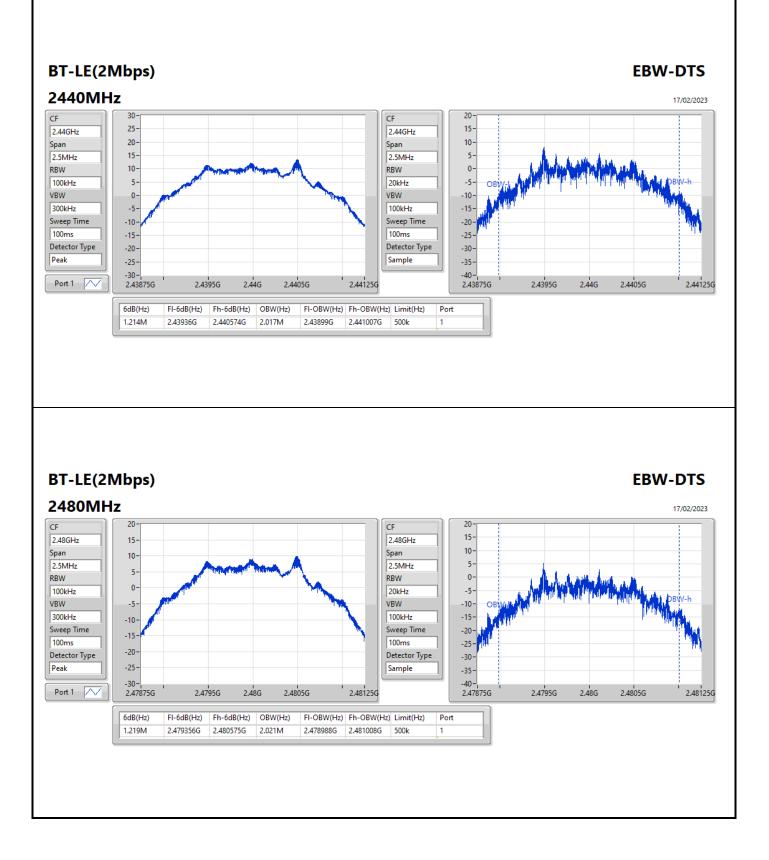














Summary

Mode	Power (dBm)	Power (W)
2.4-2.4835GHz	-	-
BT-LE(1Mbps)	14.91	0.03097
BT-LE(2Mbps)	18.94	0.07834



Average Power-DTS

Result

Mode	Result	Gain	Power	Power Limit
		(dBi)	(dBm)	(dBm)
BT-LE(1Mbps)	-	-	-	-
2402MHz	Pass	2.10	14.91	30.00
2440MHz	Pass	2.10	13.55	30.00
2480MHz	Pass	2.10	10.10	30.00
BT-LE(2Mbps)	-	-	-	-
2402MHz	Pass	2.10	18.94	30.00
2440MHz	Pass	2.10	13.34	30.00
2480MHz	Pass	2.10	10.02	30.00

DG = Directional Gain; Port X = Port X output power



Summary

Mode	PD (dBm/RBW)
2.4-2.4835GHz	-
BT-LE(1Mbps)	-3.65
BT-LE(2Mbps)	-0.87

RBW = 3kHz;



PSD-DTS

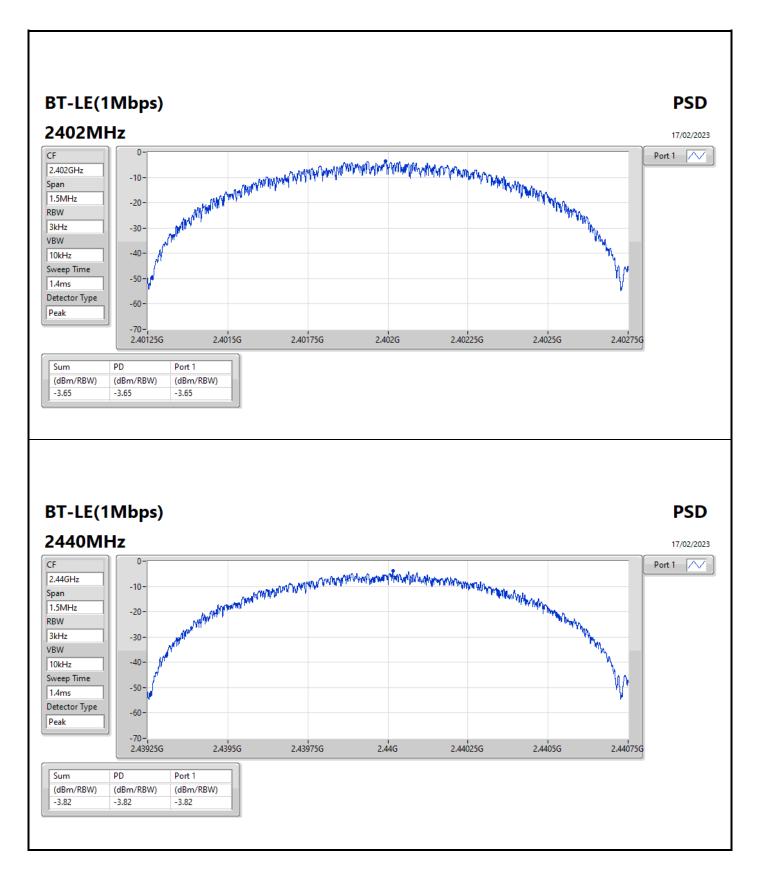
Result

Mode	Result	Gain	PD	PD Limit
		(dBi)	(dBm/RBW)	(dBm/RBW)
BT-LE(1Mbps)	-	-	-	-
2402MHz	Pass	2.10	-3.65	8.00
2440MHz	Pass	2.10	-3.82	8.00
2480MHz	Pass	2.10	-7.49	8.00
BT-LE(2Mbps)	-	-	-	-
2402MHz	Pass	2.10	-0.87	8.00
2440MHz	Pass	2.10	-8.39	8.00
2480MHz	Pass	2.10	-11.93	8.00

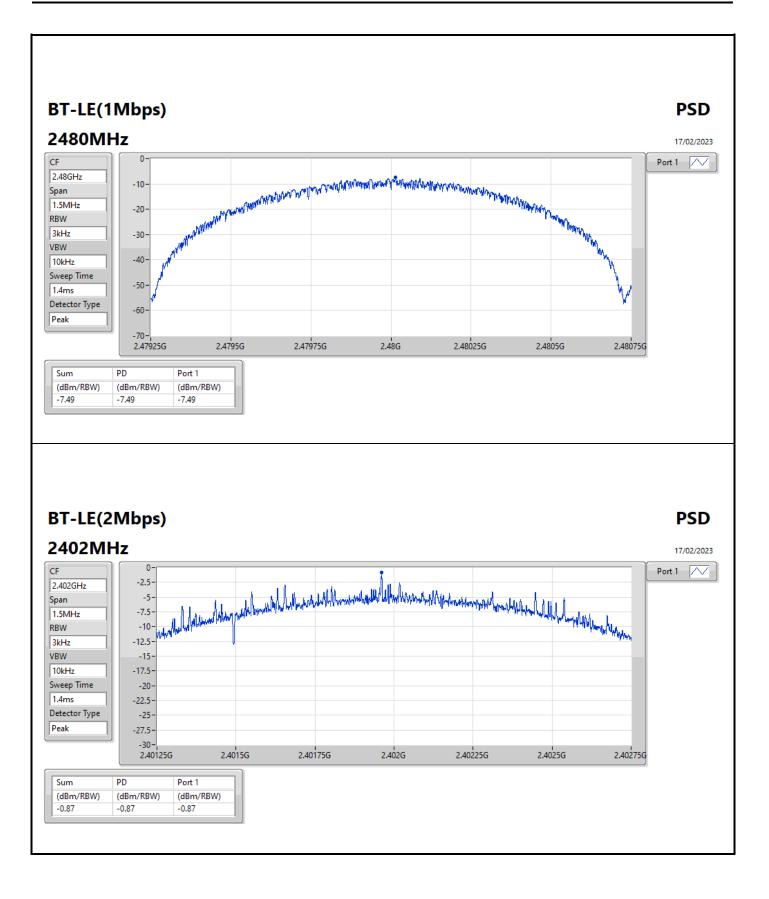
DG = Directional Gain: RBW = 3kHz; PD = trace bin-by-bin of each transmits port summing can be performed maximum power density; Port X = Port X Power Density;



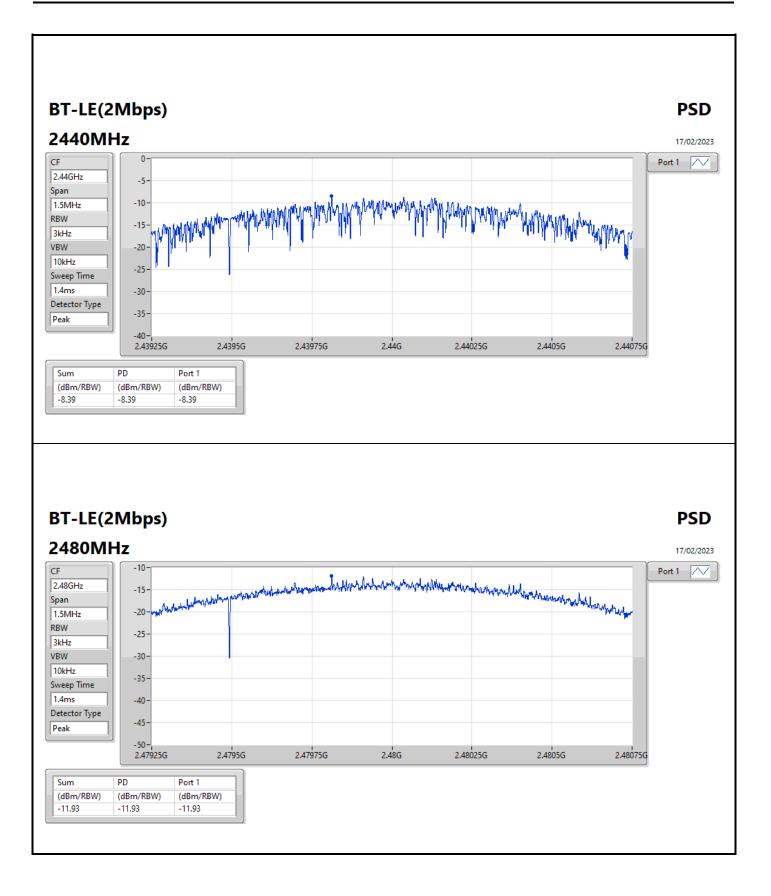














CSE NdB-DTS

Appendix E

Summary

Mode	Result	Ref (Hz)	Ref (dBm)	Limit (dBm)	Freq (Hz)	Level (dBm)	Port								
2.4-2.4835GHz	-		-	-		-	-	-	-	-	-	-	-	-	-
BT-LE(1Mbps)	Pass	2.40217G	13.92	-16.08	2.0322G	-53.26	2.39976G	-47.71	2.4G	-48.98	2.50262G	-52.19	7.20527G	-37.37	1
BT-LE(2Mbps)	Pass	2.40184G	17.36	-12.64	1.72553G	-53.35	2.39996G	-14.98	2.4G	-14.56	2.50178G	-52.48	7.20527G	-24.12	1



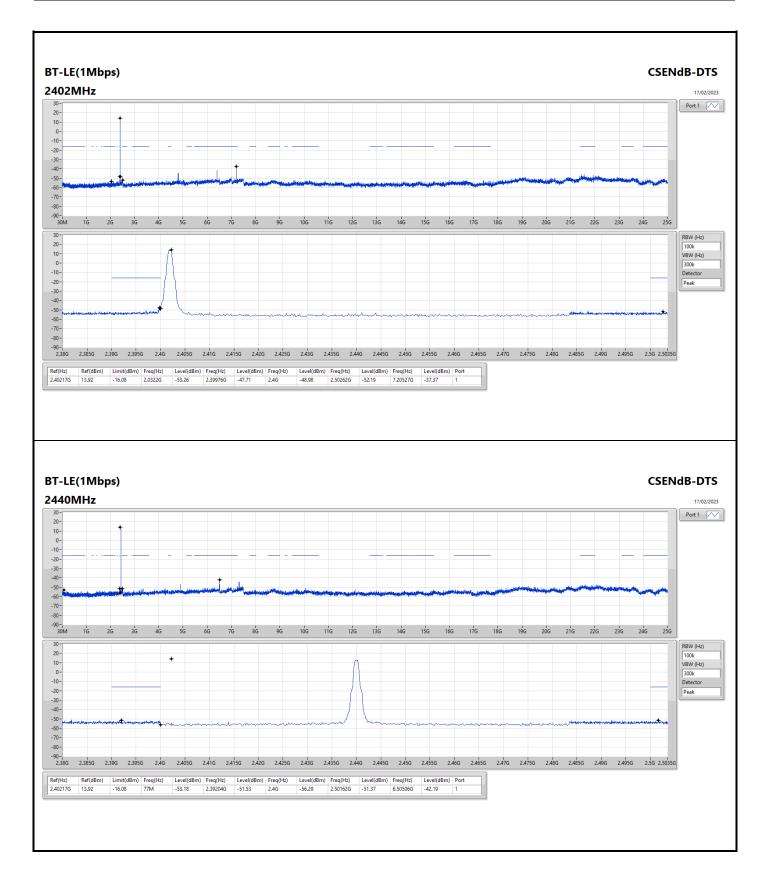
CSE NdB-DTS

Appendix E

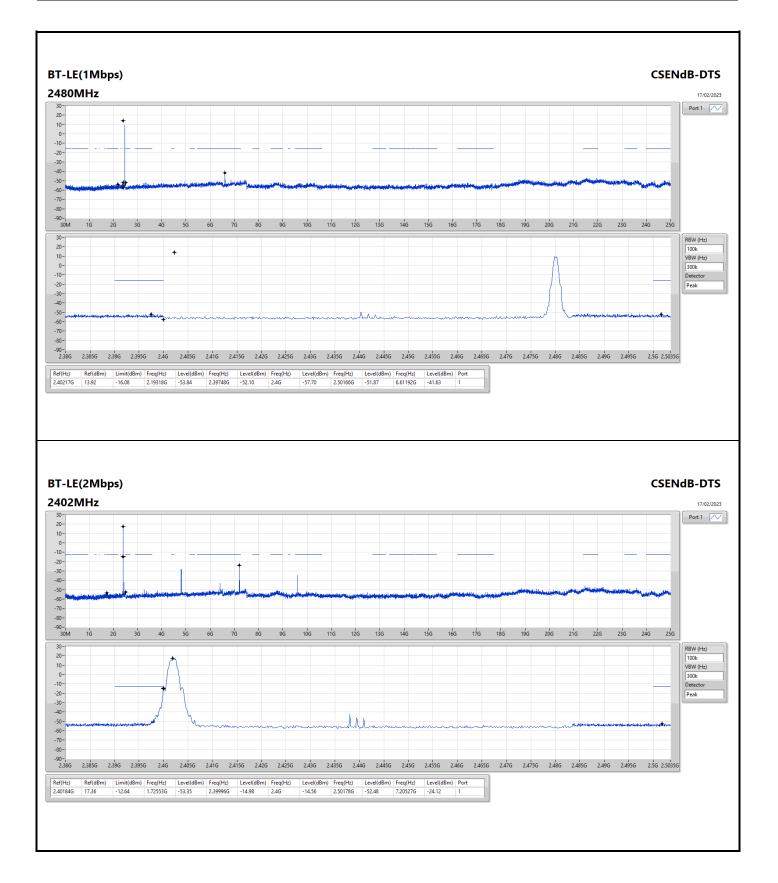
Result

Mode	Result	Ref	Ref	Limit	Freq	Level	Freq	Level	Freq	Level	Freq	Level	Freq	Level	Port
		(Hz)	(dBm)	(dBm)	(Hz)	(dBm)	(Hz)	(dBm)	(Hz)	(dBm)	(Hz)	(dBm)	(Hz)	(dBm)	
BT-LE(1Mbps)	-		-		-	-		-	-	-		-	-	-	-
2402MHz	Pass	2.40217G	13.92	-16.08	2.0322G	-53.26	2.39976G	-47.71	2.4G	-48.98	2.50262G	-52.19	7.20527G	-37.37	1
2440MHz	Pass	2.40217G	13.92	-16.08	77M	-53.18	2.39204G	-51.53	2.4G	-56.29	2.50162G	-51.37	6.50506G	-42.19	1
2480MHz	Pass	2.40217G	13.92	-16.08	2.19318G	-53.84	2.39748G	-52.10	2.4G	-57.70	2.50166G	-51.87	6.61192G	-41.63	1
BT-LE(2Mbps)	-	-	-	-	-	-	-	-	-	-	-	-		-	
2402MHz	Pass	2.40184G	17.36	-12.64	1.72553G	-53.35	2.39996G	-14.98	2.4G	-14.56	2.50178G	-52.48	7.20527G	-24.12	1
2440MHz	Pass	2.40184G	17.36	-12.64	41.75M	-53.52	2.39532G	-51.09	2.4G	-55.78	2.50334G	-52.54	6.50506G	-40.81	1
2480MHz	Pass	2.40184G	17.36	-12.64	1.98285G	-53.81	2.39892G	-51.78	2.4G	-56.48	2.50342G	-51.66	6.61192G	-40.80	1

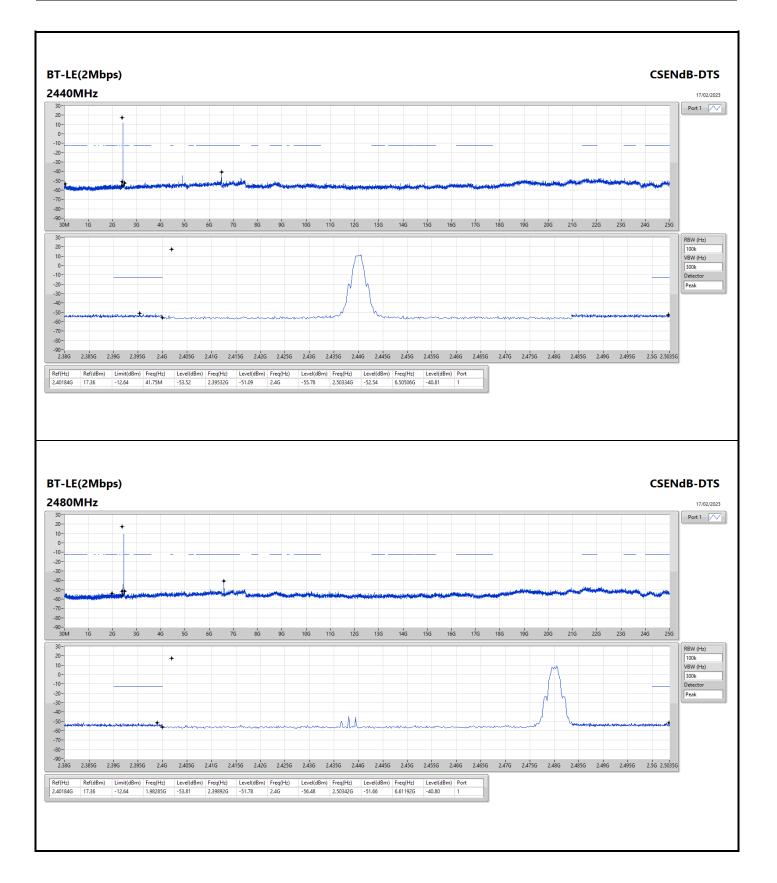












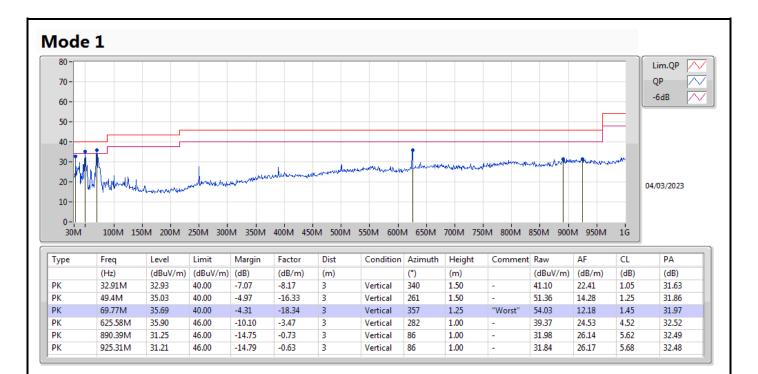


Radiated Emissions below 1GHz

Summary							-
Mode	Result	Туре	Freq	Level	Limit	Margin	Condition
			(Hz)	(dBuV/m)	(dBuV/m)	(dB)	
Mode 1	Pass	PK	69.77M	35.69	40.00	-4.31	Vertical

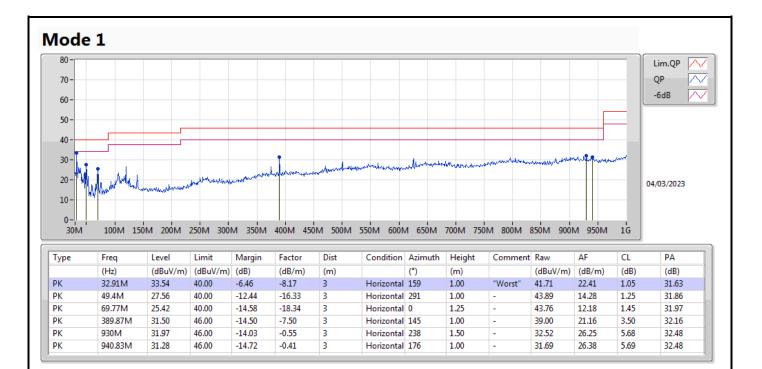


Radiated Emissions below 1GHz





Radiated Emissions below 1GHz





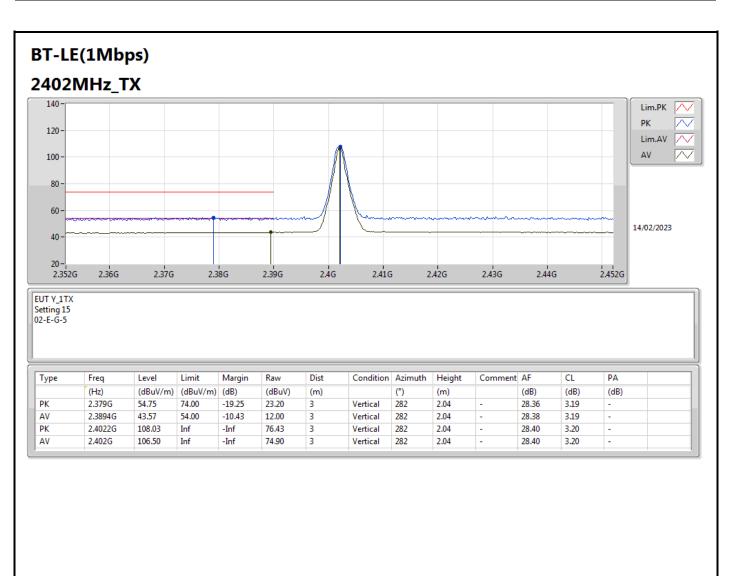
RSE TX above 1GHz

Appendix F.2

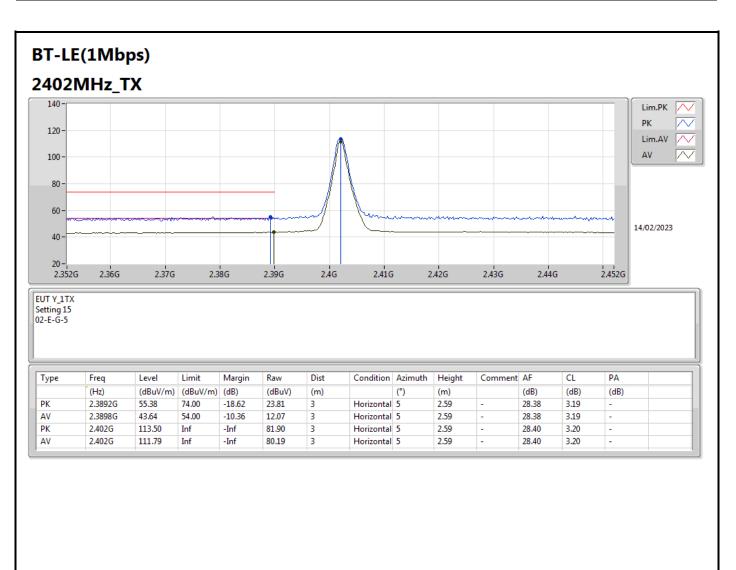
Summary

Mode	Result	Туре	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Dist (m)	Condition	Azimuth (°)	Height (m)	Comments
2.4-2.4835GHz	-	-	-	-	-	-	-	-	-	-	-
BT-LE(1Mbps)	Pass	AV	2.4835G	52.71	54.00	-1.29	3	Horizontal	24	2.05	-

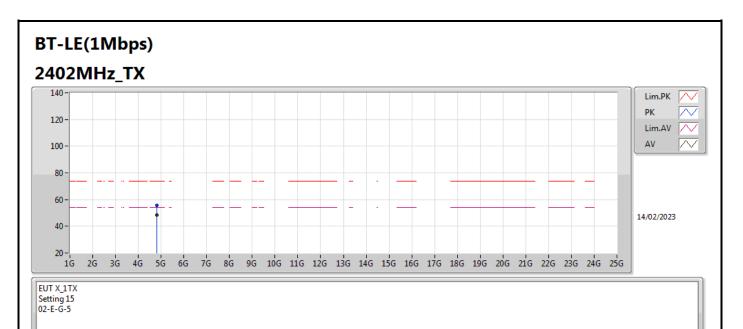






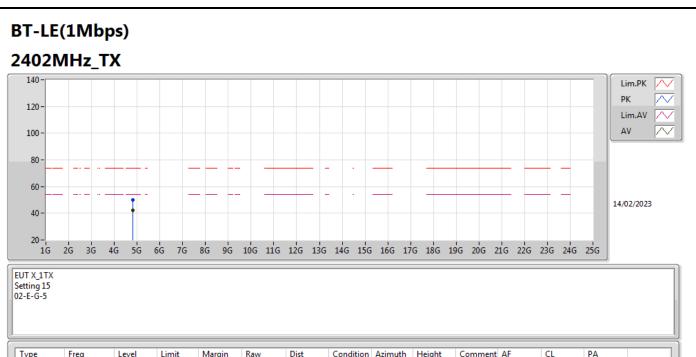






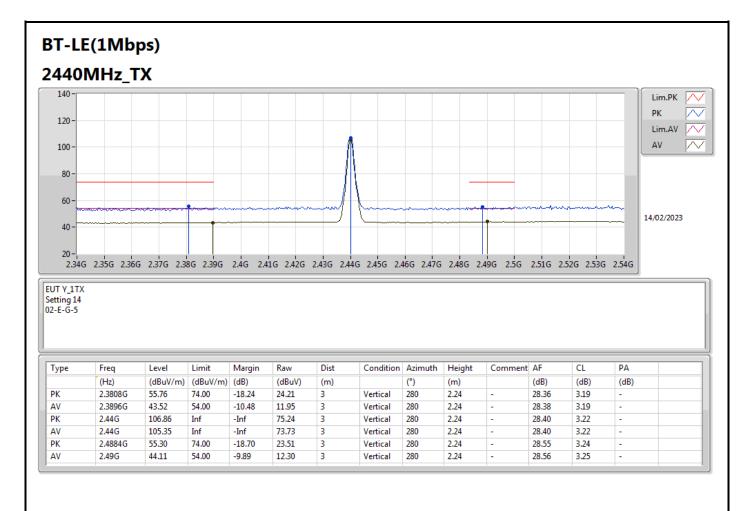
Туре	Freq	Level	Limit	Margin	Raw	Dist	Condition	Azimuth	Height	Comment	AF	CL	PA	
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dBuV)	(m)		(°)	(m)		(dB)	(dB)	(dB)	
РК	4.80388G	55.83	74.00	-18.17	48.22	3	Vertical	91	2.30	-	32.82	5.60	30.81	
AV	4.804G	48.66	54.00	-5.34	41.05	3	Vertical	91	2.30	-	32.82	5.60	30.81	



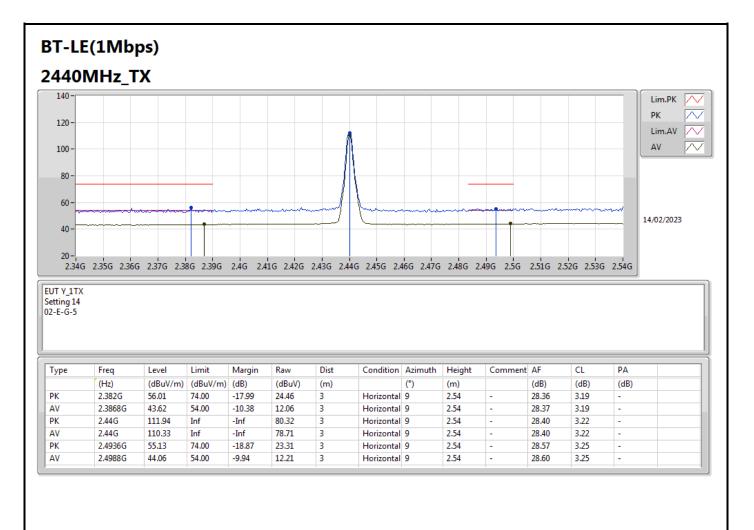


Freq	Level	Limit	Margin	Raw	Dist	Condition	Azimuth	Height	Comment	AF	CL	PA
(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dBuV)	(m)		(°)	(m)		(dB)	(dB)	(dB)
4.804G	49.81	74.00	-24.19	46.29	3	Horizontal	265	1.79	-	32.82	5.60	34.90
4.80406G	42.16	54.00	-11.84	38.64	3	Horizontal	265	1.79	-	32.82	5.60	34.90
	(Hz) 4.804G	(Hz) (dBuV/m) 4.804G 49.81	(Hz) (dBuV/m) (dBuV/m) 4.804G 49.81 74.00	(Hz) (dBuV/m) (dBuV/m) (dB) 4.804G 49.81 74.00 -24.19	(Hz) (dBuV/m) (dBuV/m) (dB) (dBuV) 4.804G 49.81 74.00 -24.19 46.29	(Hz) (dBuV/m) (dBuV/m) (dB) (dBuV) (m) 4.804G 49.81 74.00 -24.19 46.29 3	(Hz) (dBuV/m) (dBuV/m) (dB) (dBuV) (m) 4.804G 49.81 74.00 -24.19 46.29 3 Horizontal	(Hz) (dBuV/m) (dBuV/m) (dB) (dBuV) (m) (°) 4.804G 49.81 74.00 -24.19 46.29 3 Horizontal 265	(Hz) (dBuV/m) (dB) (dBuV) (m) (°) (m) 4.804G 49.81 74.00 -24.19 46.29 3 Horizontal 265 1.79	(Hz) (dBuV/m) (dB) (dBuV) (m) (*) (m) 4.804G 49.81 74.00 -24.19 46.29 3 Horizontal 265 1.79 -	(Hz) (dBuV/m) (dB) (dBuV) (m) (*) (m) (dB) 4.804G 49.81 74.00 -24.19 46.29 3 Horizontal 265 1.79 - 32.82	(Hz) (dBuV/m) (dB) (dBuV) (m) (°) (m) (dB) (dB) 4.804G 49.81 74.00 -24.19 46.29 3 Horizontal 265 1.79 - 32.82 5.60

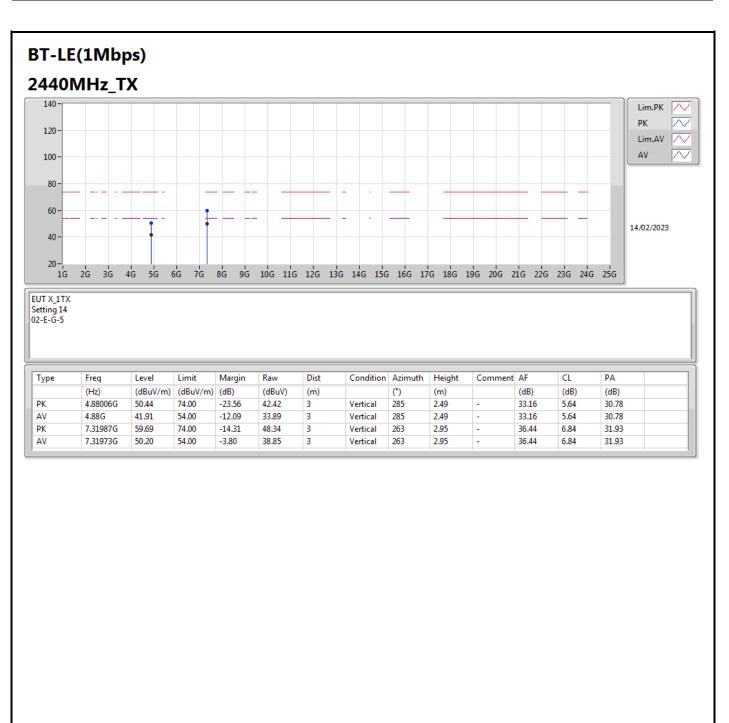




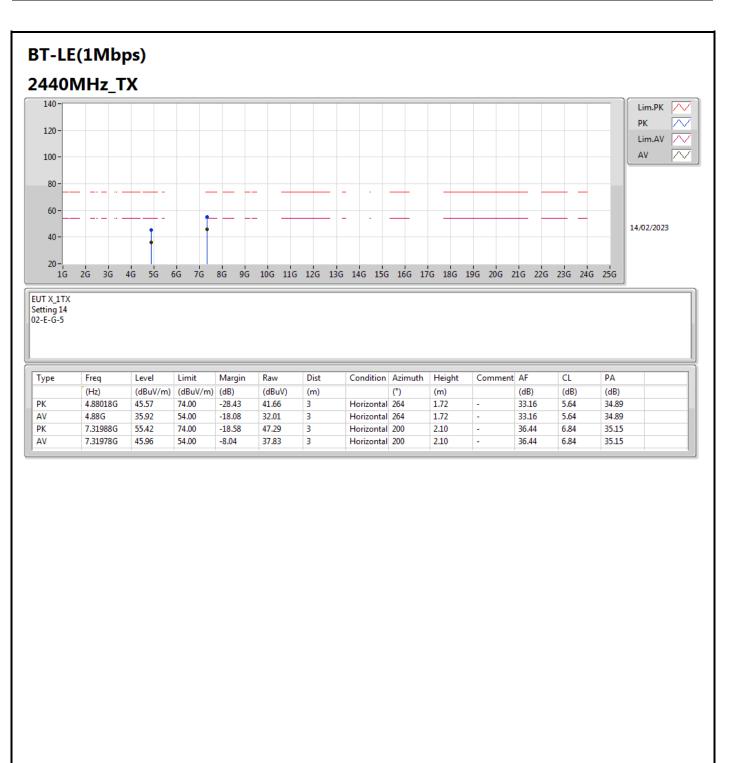




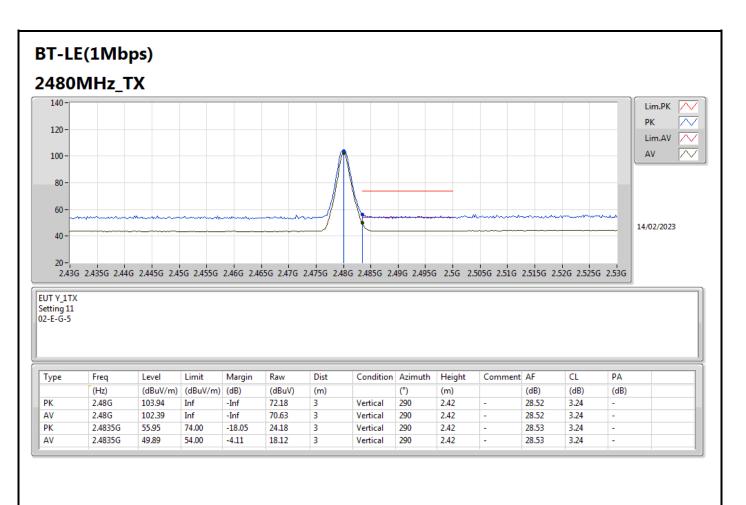




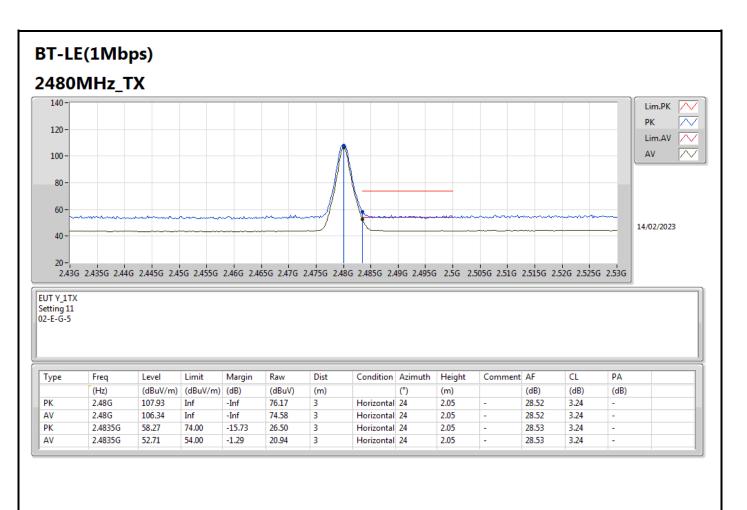




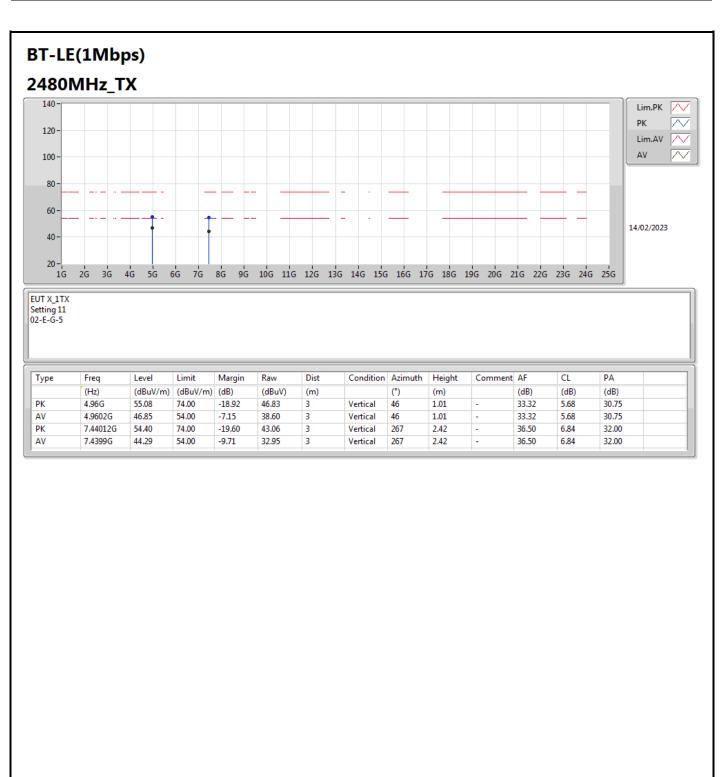




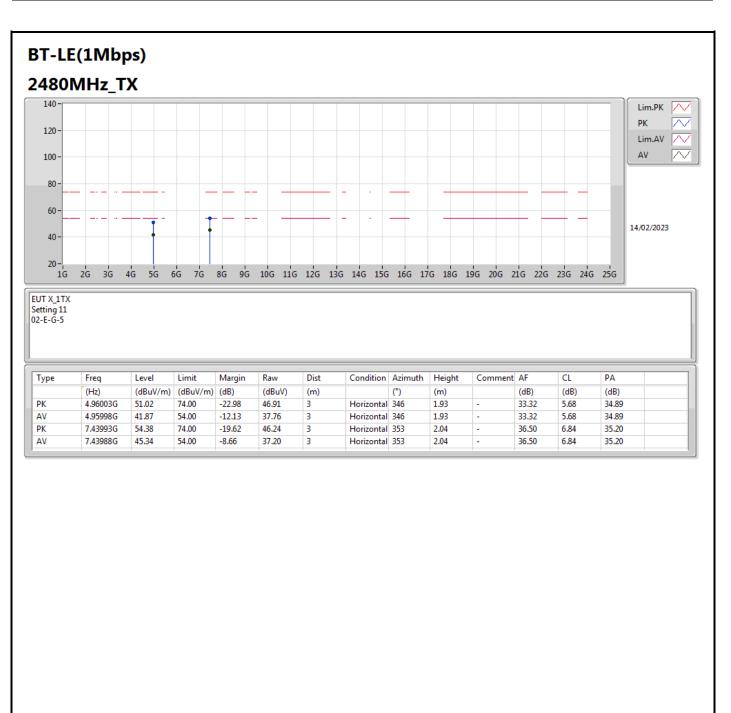




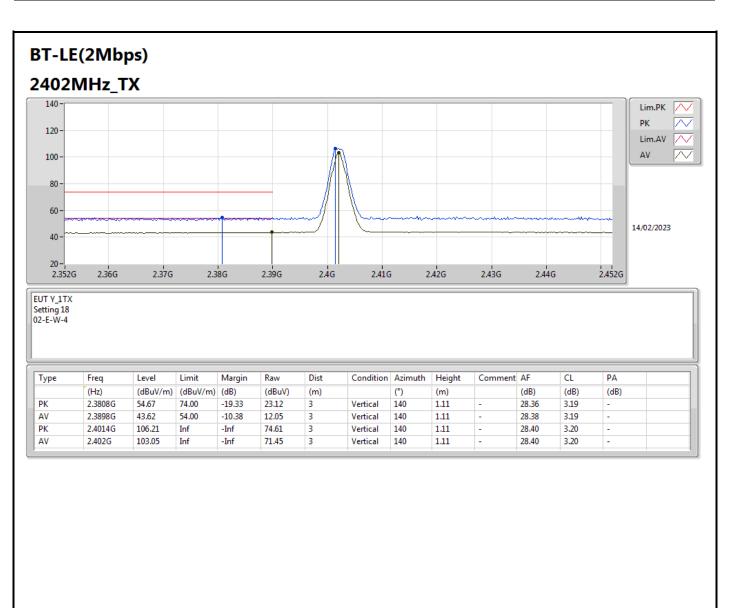




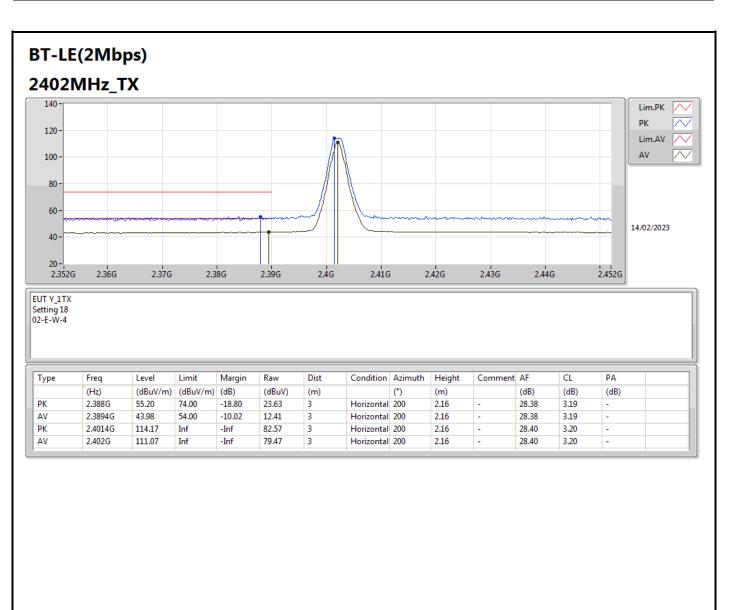




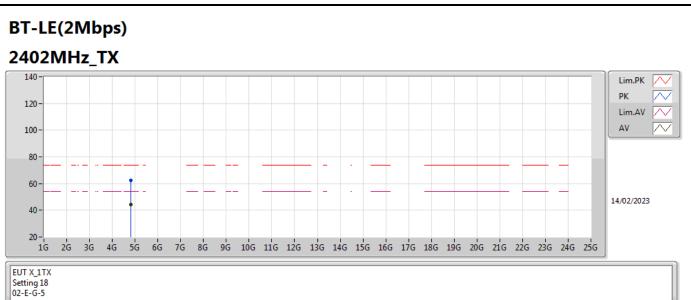






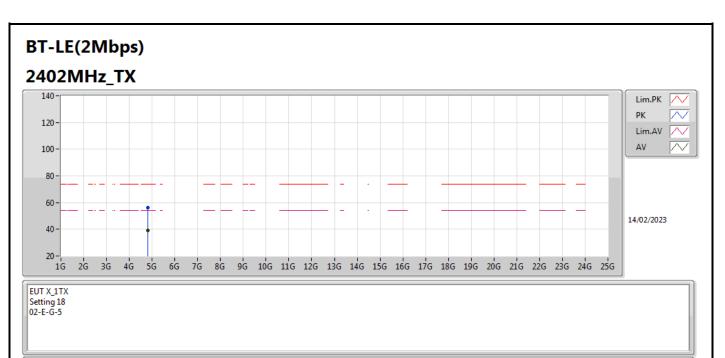






Туре	Freq	Level	Limit	Margin	Raw	Dist	Condition	Azimuth	Height	Comment	AF	CL	PA	
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dBuV)	(m)		(°)	(m)		(dB)	(dB)	(dB)	
PK	4.80291G	62.50	74.00	-11.50	54.89	3	Vertical	95	2.42	-	32.82	5.60	30.81	
AV	4.80436G	44.22	54.00	-9.78	36.60	3	Vertical	95	2.42	-	32.83	5.60	30.81	





Туре	Freq	Level	Limit	Margin	Raw	Dist	Condition	Azimuth	Height	Comment	AF	CL	PA
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dBuV)	(m)		(°)	(m)		(dB)	(dB)	(dB)
РК	4.80283G	56.36	74.00	-17.64	52.84	3	Horizontal	267	1.96	-	32.82	5.60	34.90
AV	4.80356G	38.94	54.00	-15.06	35.42	3	Horizontal	267	1.96	-	32.82	5.60	34.90



