



Report No.: FR0D1814AB

RADIO TEST REPORT

FCC ID

: TLZ-AM457-D

Equipment

: IEEE 802.11 1X1 a/b/g/n Wireless LAN + Bluetooth

5.1 Combo LGA Module

Brand Name

: AzureWave

Model Name

: AW-AM457-D

Applicant

: AzureWave Technologies, Inc.

8F., No.94, Baozhong Rd., Xindian Dist., New

Taipei City, Taiwan 231

Manufacturer

: AzureWave Technologies, Inc.

8F., No.94, Baozhong Rd., Xindian Dist., New

Taipei City, Taiwan 231

Standard

: 47 CFR FCC Part 15.247

The product was received on Dec. 26, 2020, and testing was started from Dec. 26, 2020 and completed on Feb. 23, 2021. 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.

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.)

TEL: 886-3-656-9065

FAX: 886-3-656-9085

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: Apr. 20, 2021

Report Version

: 02

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Photographs of EUT v01

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History of this test report

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Report No.	Version	Description	Issued Date
FR0D1814AB	01	Initial issue of report	Apr. 19, 2021
FR0D1814AB	02	Revised the FCC test site designation no. on section 1.3.	Apr. 20, 2021

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Summary of Test Result

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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	-

Declaration of Conformity:

The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.

Comments and Explanations:

The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

Reviewed by: Sam Chen Report Producer: Wendy Pan

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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]

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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

	Ant.	Port	Brand	Model Name	Antenna Type	Connector	Gain (dBi)
	1	1	Molex	1461531050	Dipole	I-PEX	Note 1
1	Ant.	Port	Brand Holder	Model Name	Antenna Type	Connector	Gain (dBi)
	2	1	MAG. LAYERS SCIENTIFIC-TECHNI CS CO., LTD	MSA-4008-25GC1-A2	PIFA	I-PEX	Note 1

Note1:

Ant.		Antenna Gain (dBi)			
Ant.	WLAN 2.4GHz WLAN 5GHz Bluetooth				
1	3.2	4.25	3.2		
2	2.98	5.16	2.98		

Note2: The above information was declared by manufacturer.

For conducted test, only the highest antenna gain has been tested and recorded in the test report. For AC Power-line Conducted Emissions and radiated test, Ant.1 ~ Ant.2 antenna has been tested and recorded in the test report.

The EUT has two sets of antenna type and there are two antennas for each set and on the EUT has two antenna connectors and support different functions separately, one port is WLAN function and the other port is bluetooth function.

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1.1.3 Mode Test Duty Cycle

Mode	DC	DCF(dB)	T(s)	VBW(Hz) ≥ 1/T
BT-LE(1Mbps)	0.624	2.05	390u	3k

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Note:

- DC is Duty Cycle.
- DCF is Duty Cycle Factor.

1.1.4 EUT Operational Condition

EUT Power Type	From host system					
Function Point-to-multipoint		Point-to-multipoint		Point-to-point		
Test Software Version		DutApiSisoBt V1.0.0.09				
	\boxtimes	LE 1M PHY: 1 Mb/s				
Support Mode	\boxtimes	∠ LE Coded PHY (S=2): 500 Kb/s				
Support Mode	\boxtimes	LE Coded PHY (S=8): 125 Kb/s				
	\boxtimes	LE 2M PHY: 2 Mb/s				

Note: The above information was declared by manufacturer.

1.1.5 Table for Multiple Listing

The difference for each EUT is shown as below:

Model Name	EUT	Diplexer Brand	Low power filter Brand
	EUT 1	Murata	Murata
AW-AM457-D	EUT 2	Murata	Walsin
AVV-AIVI457-D	EUT 3	Walsin	Murata
	EUT 4	Walsin	Walsin

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1.2 Applicable Standards

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

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- 47 CFR FCC Part 15
- 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.

Test site registered number IC 4086D with Industry Canada.

Test Condition	Test Site No.	Test Engineer	Test Environment (°C / %)	Test Date
RF Conducted	TH03-CB	Jeff Wu	23.3-23.8 / 46-47	Jan. 16, 2021 ~ Jan. 27, 2021
Radiated<1GHz	03CH05-CB	Cola Fan	20.4-21.4 / 55-57	Feb. 09, 2021
Radiated>1GHz	03CH02-CB	Lance Wu	22.3-23.6 / 56-58	Dec. 26, 2020 ~ Feb. 18, 2021
AC Conduction	CO01-CB	Max Lin	22~23 / 56~57	Feb. 23, 2021

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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

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level (based on a coverage factor (k=2)

Test Items	Uncertainty	Remark
Conducted Emission (150kHz ~ 30MHz)	2.0 dB	Confidence levels of 95%
Radiated Emission (9kHz ~ 30MHz)	3.8 dB	Confidence levels of 95%
Radiated Emission (30MHz ~ 1,000MHz)	5.6 dB	Confidence levels of 95%
Radiated Emission (1GHz ~ 18GHz)	5.0 dB	Confidence levels of 95%
Radiated Emission (18GHz ~ 40GHz)	4.9 dB	Confidence levels of 95%
Conducted Emission	2.8 dB	Confidence levels of 95%
Output Power Measurement	1.4 dB	Confidence levels of 95%
Power Density Measurement	2.8 dB	Confidence levels of 95%
Bandwidth Measurement	0.4%	Confidence levels of 95%

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2 Test Configuration of EUT

2.1 Test Channel Mode

Mode	Power Setting
BT-LE(1Mbps)	-
2402MHz	4
2440MHz	4
2480MHz	4

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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		
Operating Mode	Normal Link		
1	EUT 1 + WLAN 2.4GHz + Bluetooth + Dipole antenna		
2 EUT 1 + WLAN 5GHz + Bluetooth + Dipole antenna			
Mode 1 has been evaluate follow this same test modern	ted to be the worst case between Mode 1~2, thus measurement for Mode 3 ~ 5 will le.		
3	EUT 2 + WLAN 2.4GHz + Bluetooth + Dipole antenna		
4	EUT 3 + WLAN 2.4GHz + Bluetooth + Dipole antenna		
5	EUT 4 + WLAN 2.4GHz + Bluetooth + Dipole antenna		
Mode 1 has been evaluat this same test mode.	ed to be the worst case among Mode 1~5, thus measurement for Mode 6 will follow		
6	EUT 1 + WLAN 2.4GHz + Bluetooth + PIFA antenna		
For operating mode 1 is t	he worst case and it was record in this test report.		

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TI	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		
	Conducted measurement at transmit chains		
Test Condition	The EUT 4 has been evaluated to be the worst-case from EUT 1~EUT 4. Therefore, the EUT 4 has selected to test.		
1	EUT 4 + Ant.1		

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Th	e Worst Case Mode for Following Conformance Tests
Tests Item	Emissions in Restricted Frequency Bands
Test Condition	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
1	EUT 1 in Z axis + WLAN 2.4GHz + Bluetooth + Dipole antenna
2	EUT 1 in Y axis + WLAN 2.4GHz + Bluetooth + Dipole antenna
Mode 2 has been evaluate follow this same test mode	ed to be the worst case between Mode 1~2, thus measurement for Mode 3 will
3	EUT 1 in Y axis + WLAN 5GHz + Bluetooth + Dipole antenna
Mode 2 has been evaluate follow this same test mode	ed to be the worst case among Mode 1~3, thus measurement for Mode 4~6 will
4 EUT 2 in Y axis + WLAN 2.4GHz + Bluetooth + Dipole antenna	
5	EUT 3 in Y axis + WLAN 2.4GHz + Bluetooth + Dipole antenna
6	EUT 4 in Y axis + WLAN 2.4GHz + Bluetooth + Dipole antenna
Mode 4 has been evaluated to be the worst case among Mode 1~6, thus measurement for Mode 7 will this same test mode.	
7	EUT 2 in Y axis + WLAN 2.4GHz + Bluetooth + PIFA antenna
For operating mode 4 is the	e worst case and it was record in this test report.
	СТХ
Operating Mode > 1GHz	The EUT 4 has been evaluated to be the worst-case from EUT 1~EUT 4. Therefore, the EUT 4 has selected to test. The EUT 4 was performed at X axis, Y axis and Z axis position, and the worst case as below:
1	EUT 4 + Ant.1 (Bandedge at Z axis / Radiated emission at X axis)
2	EUT 4 + Ant.2 (Bandedge at X axis / Radiated emission at Y axis)

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The Worst Case Mode for Following Conformance Tests		
Tests Item	Tests Item Simultaneous Transmission Analysis - Co-location RF Exposure Evaluation	
Operating Mode		
1	Bluetooth + WLAN 2.4GHz	
2	Bluetooth + WLAN 5GHz	
Refer to Sporton Test Repo	ort No.: FA0D1814 for Co-location RF Exposure Evaluation.	

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2.3 EUT Operation during Test

For CTX Mode:

The EUT was programmed to be in continuously transmitting mode.

For Normal Link:

During the test, the EUT operation to normal function.

2.4 Accessories

N/A

2.5 Support Equipment

For AC Conduction:

	Support Equipment				
No.	Equipment	Brand Name	Model Name	FCC ID	
Α	NB	DELL	E6430	N/A	
В	Fixture	AzureWave	AW2457-15	N/A	
С	AP Router	ASUS	RP-N53	N/A	
D	Earphone	SHYARO CHI	MIC-04	N/A	
Е	Mouse	HP	FM100	N/A	
F	iPad	Apple	A1430	BCGA1430	
G	AP Router NB	DELL	E6430	N/A	

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For Radiated (below 1GHz):

	Support Equipment				
No.	Equipment	Brand Name	Model Name	FCC ID	
Α	Notebook	DELL	E4300	N/A	
В	Notebook	DELL	E4300	N/A	
С	WLAN AP	D-LINK	DIR860L	KA2IR860LA1	
D	iPad	Apple	A1430	BCGA1430	
Е	Earphone	SHYARO CHI	MIC-04	N/A	
F	Mouse	Logitech	M-U0026	N/A	
G	Fixture	AzureWave	AW2457-15	N/A	

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For Radiated (above 1GHz):

	Support Equipment				
No.	Equipment	Brand Name	Model Name	FCC ID	
Α	Fixture	AzureWave	AW2457-15	N/A	
В	Notebook	DELL	E4300	N/A	
С	Notebook	DELL	E4300	N/A	

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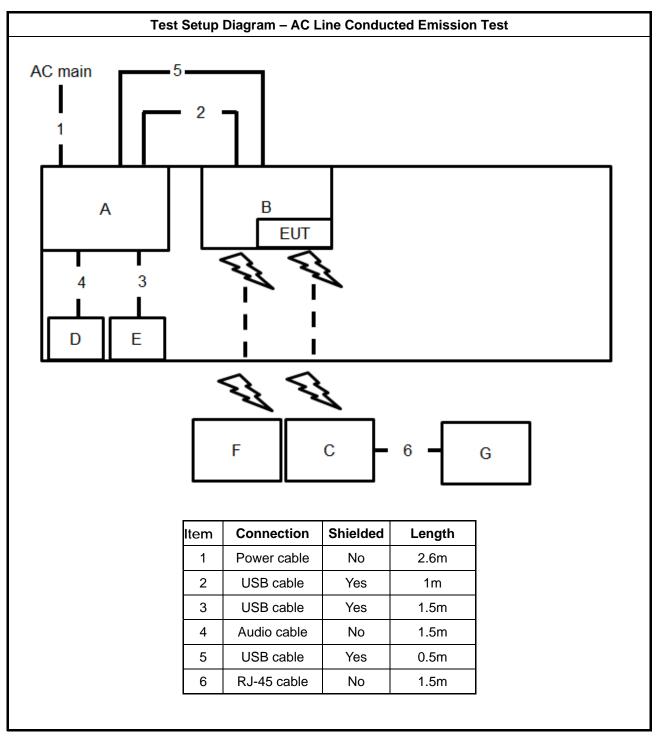
For RF Conducted:

Support Equipment				
No.	Equipment	Brand Name	Model Name	FCC ID
Α	Notebook	DELL	E4300	N/A
В	Notebook	DELL	E4300	N/A
С	Fixture	AzureWave	AW2457-15	N/A

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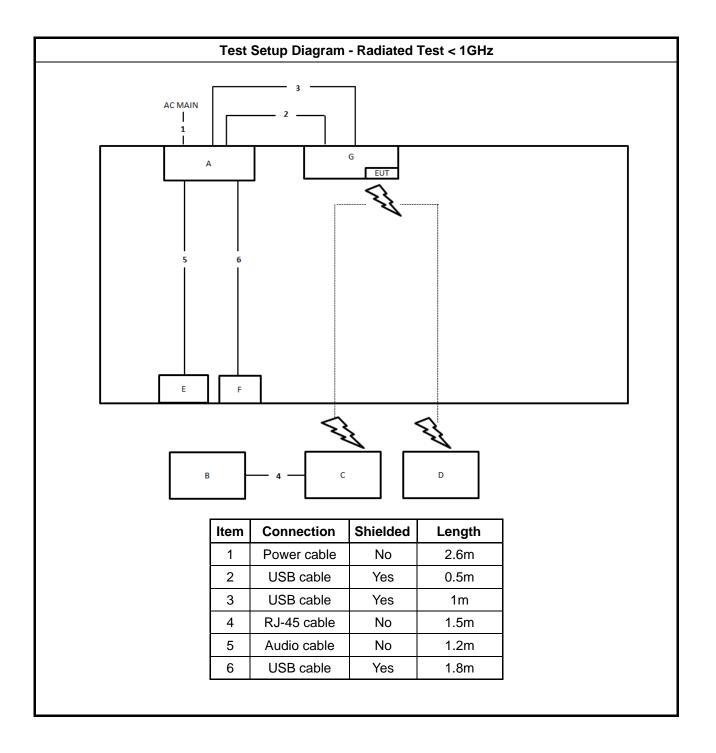


2.6 Test Setup Diagram



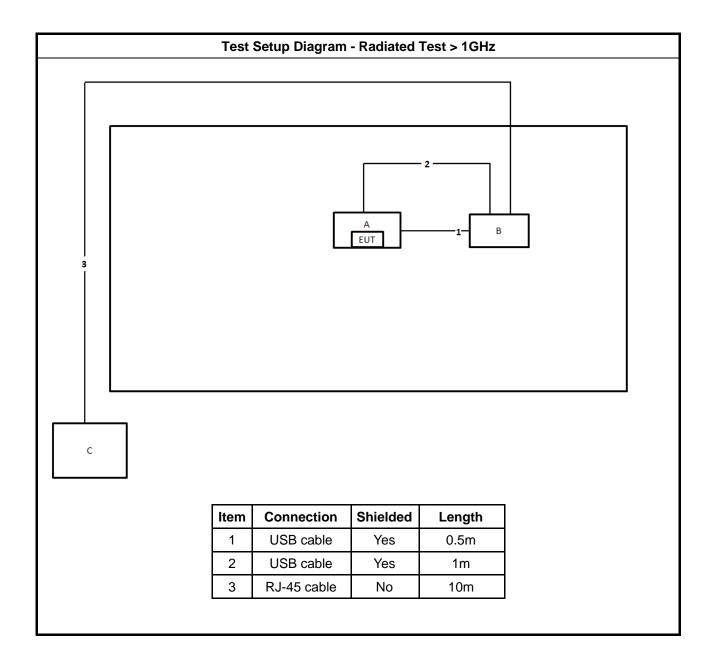
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3 Transmitter Test Result

3.1 AC Power-line Conducted Emissions

3.1.1 AC Power-line Conducted Emissions Limit

AC Powe	er-line Conducted Emissions L	_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.	

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3.1.2 Measuring Instruments

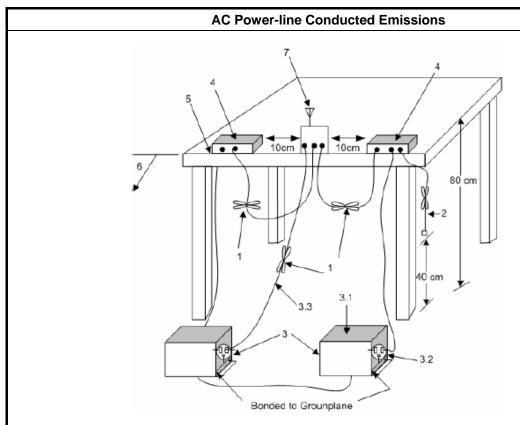
Refer a test equipment and calibration data table in this test report.

3.1.3 Test Procedures

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

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3.1.4 **Test Setup**



-Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 cm to 40 cm long.

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- The I/O cables that are not connected to an accessory shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
- 3—EUT connected to one LISN. Unused LISN measuring port connectors shall be terminated in 50 Ω loads. LISN may be placed on top of, or immediately beneath, reference ground plane.
- 3.1—All other equipment powered from additional LISN(s).
- 3.2—A multiple-outlet strip may be used for multiple power cords of non-EUT equipment. 3.3—LISN at least 80 cm from nearest part of EUT chassis.
- 4—Non-EUT components of EUT system being tested.
- -Rear of EUT, including peripherals, shall all be aligned and flush with edge of tabletop.
 -Edge of tabletop shall be 40 cm removed from a vertical conducting plane that is bonded to the ground
- 7—Antenna can be integral or detachable. If detachable, then the antenna shall be attached for this test.

1.1.1. Measurement Results Calculation

The measured Level is calculated using:

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

Test Result of AC Power-line Conducted Emissions 3.1.5

Refer as Appendix A

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3.2 DTS Bandwidth

3.2.1 6dB Bandwidth Limit

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

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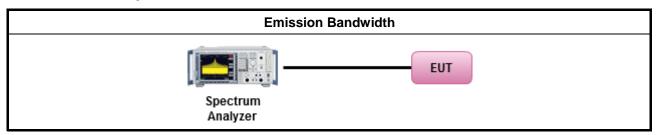
3.2.2 Measuring Instruments

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

3.2.3 Test Procedures

	Test Method								
•	For the emission bandwidth shall be measured using one of the options below:								
	\boxtimes	Refer as FCC KDB 558074, clause 8.2 & C63.10 clause 11.8.1 Option 1 for 6 dB bandwidth measurement.							
		Refer as FCC KDB 558074, clause 8.2 & C63.10 clause 11.8.2 Option 2 for 6 dB bandwidth measurement.							
		Refer as ANSI C63.10, clause 6.9.1 for occupied bandwidth testing.							

3.2.4 Test Setup



3.2.5 Test Result of Emission Bandwidth

Refer as Appendix B

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3.3 Maximum Conducted Output Power

3.3.1 Maximum Conducted Output Power Limit

Maximum Conducted Output Power Limit

- If $G_{TX} \le 6$ dBi, then $P_{Out} \le 30$ dBm (1 W)
- Point-to-multipoint systems (P2M): If $G_{TX} > 6$ dBi, then $P_{Out} = 30 (G_{TX} 6)$ dBm
- 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 $G_{TX} > 6$ dBi, then $P_{Out} = 30 (G_{TX} 6)/3$ dBm
 - Aggregate power on all beams: If $G_{TX} > 6$ dBi, then $P_{Out} = 30 (G_{TX} 6)/3 + 8$ dB dBm

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 \mathbf{P}_{Out} = maximum peak conducted output power or maximum conducted output power in dBm, \mathbf{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.

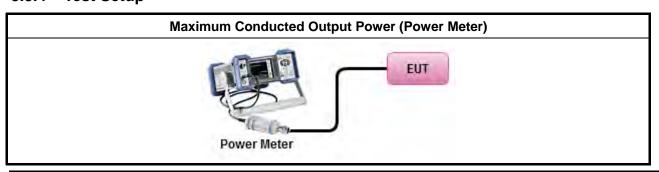
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3.3.3 Test Procedures

	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							
	[duty	/ 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: $P_{total} = P_1 + P_2 + \ldots + P_n$ (calculated in linear unit [mW] and transfer to log unit [dBm]) $EIRP_{total} = P_{total} + DG$							

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3.3.4 Test Setup



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3.3.5 Test Result of Maximum Conducted Output Power

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Refer as Appendix C

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3.4 Power Spectral Density

3.4.1 Power Spectral Density Limit

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

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3.4.2 Measuring Instruments

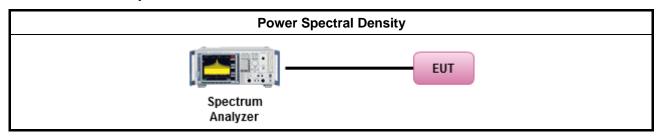
Refer a test equipment and calibration data table in this test report.

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).								
	⊠ I	Refer as FCC KDB 558074, clause 8.4 & C63.10 clause 11.10 Method Max. PSD.							
	[duty	cycle ≥ 98% or external video / power trigger]							
•	For co	onducted measurement.							
	• 1	f The 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.							

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3.4.4 Test Setup



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3.4.5 Test Result of Power Spectral Density

Refer as Appendix D

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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)			
Peak output power procedure	20			
Average output power procedure	30			

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- 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.

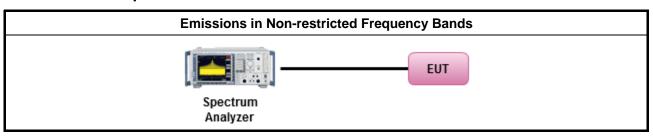
3.5.2 Measuring Instruments

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

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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 Distance (m)				
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				

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- 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 ELIT
- 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.

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3.6.3 Test Procedures

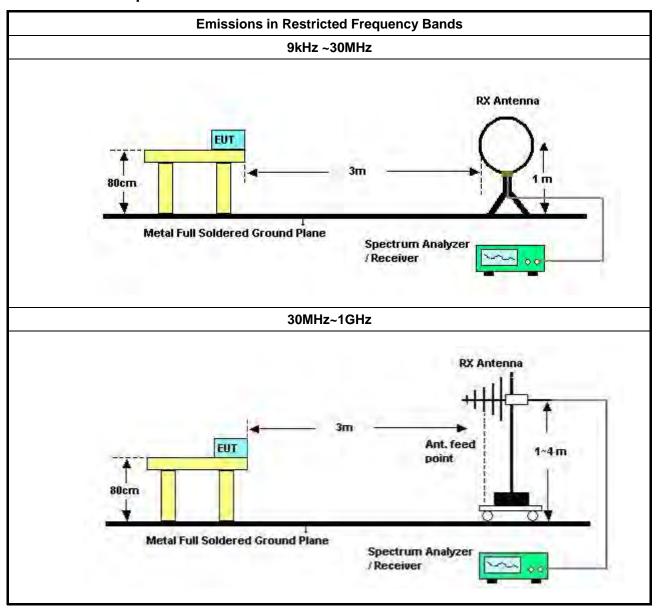
		Test Method							
•	The	average emission levels shall be measured in [duty cycle ≥ 98 or duty factor].							
•		er as ANSI C63.10, clause 6.10.3 band-edge testing shall be performed at the lowest frequency nnel and highest frequency channel within the allowed operating band.							
•	For the transmitter 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 ≥ 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.							

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3.6.4 Test Setup



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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

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4 Test Equipment and Calibration Data

Instrument	Brand	Model No.	Serial No.	Characteristics	Calibration Date	Calibration Due Date	Remark
EMI Receiver	Agilent	N9038A	My52260123	9kHz ~ 8.4GHz	Feb. 26, 2020	Feb. 25, 2021	Conduction (CO01-CB)
LISN	F.C.C.	FCC-LISN-50- 16-2	04083	150kHz ~ 100MHz	Jan. 06, 2021	Jan. 05, 2022	Conduction (CO01-CB)
LISN	Schwarzbeck	NSLK 8127	8127647	9kHz ~ 30MHz	Feb. 25, 2020	Feb. 24, 2021	Conduction (CO01-CB)
Pulse Limiter	Rohde&Schwa rz	ESH3-Z2	100430	9kHz ~ 30MHz	Jan. 30, 2021	Jan. 29, 2022	Conduction (CO01-CB)
COND Cable	Woken	Cable	Low cable-CO01	9kHz ~ 30MHz	May 20, 2020	May 19, 2021	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	Apr. 13, 2020	Apr. 12, 2021	Radiation (03CH05-CB)
3m Semi Anechoic Chamber NSA	TDK	SAC-3M	03CH05-CB	30 MHz ~ 1 GHz	Aug. 10, 2020	Aug. 09, 2021	Radiation (03CH05-CB)
Bilog Antenna with 6dB Attenuator	TESEQ & EMCI	CBL 6112D & N-6-06	35236 & AT-N0610	30MHz ~ 2GHz	Mar. 27, 2020	Mar. 26, 2021	Radiation (03CH05-CB)
Pre-Amplifier	EMCI	EMC330N	980331	20MHz ~ 3GHz	Apr. 28, 2020	Apr. 27, 2021	Radiation (03CH05-CB)
Spectrum Analyzer	R&S	FSP40	100304	9kHz ~ 40GHz	Nov. 10, 2020	Nov. 09, 2021	Radiation (03CH05-CB)
EMI Test Receiver	R&S	ESCS	826547/017	9kHz ~ 2.75GHz	May 13, 2020	May 12, 2021	Radiation (03CH05-CB)
RF Cable-low	Woken	RG402	Low Cable-04+23	30MHz~1GHz	Oct. 05, 2020	Oct. 04, 2021	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 3m	Mar. 28, 2020	Mar. 27, 2021	Radiation (03CH02-CB)
Horn Antenna	EMCO	3115	9610-4976	1GHz ~ 18GHz	Apr. 21, 2020	Apr. 20, 2021	Radiation (03CH02-CB)
Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170252	15GHz ~ 40GHz	Jul. 21, 2020	Jul. 20, 2021	Radiation (03CH02-CB)
Pre-Amplifier	Agilent	83017A	MY39501305	1GHz ~ 26.5GHz	Jul. 13, 2020	Jul. 12, 2021	Radiation (03CH02-CB)
Pre-Amplifier	MITEQ	TTA1840-35-H G	1864479	18GHz ~ 40GHz	Jul. 08, 2020	Jul. 07, 2021	Radiation (03CH02-CB)
Spectrum analyzer	R&S	FSU	100015	9kHz~26GHz	Oct. 15, 2020	Oct. 14, 2021	Radiation (03CH02-CB)
RF Cable-high	Woken	RG402	High Cable-18	1GHz ~ 18GHz	Oct. 05, 2020	Oct. 04, 2021	Radiation (03CH02-CB)

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Report Version : 02

Calibration Calibration Model No. Serial No. Characteristics Instrument Brand Remark Date **Due Date** Radiation High RF Cable-high Woken RG402 1GHz ~ 18GHz Oct. 05, 2020 Oct. 04, 2021 Cable-18+19 (03CH02-CB) High Radiation RF Cable-high Woken RG402 18GHz ~ 40 GHz Jul. 16, 2020 Jul. 15, 2021 Cable-40G#1 (03CH02-CB) Radiation High RF Cable-high RG402 18GHz ~ 40 GHz Jul. 16, 2020 Jul. 15, 2021 Woken Cable-40G#2 (03CH02-CB) Radiation V5.10 N.C.R. N.C.R. **SPORTON Test Software** SENSE (03CH02-CB) Signal Conducted FSV40 9kHz ~ 40GHz May 14, 2020 May 13, 2021 R&S 101903 Analyzer (TH03-CB) Spectrum Conducted R&S FSV40 101028 9kHz~40GHz Dec. 31, 2020 Dec. 30, 2021 (TH03-CB) analyzer Conducted 300MHz~40GHz Aug. 17, 2020 Power Sensor Anritsu MA2411B 1726195 Aug. 16, 2021 (TH03-CB) Conducted ML2495A 1035008 300MHz~40GHz Power Meter Anritsu Aug. 17, 2020 Aug. 16, 2021 (TH03-CB) Conducted RF Cable-high Woken RG402 High Cable-11 1 GHz –18 GHz Oct. 05, 2020 Oct. 04, 2021 (TH03-CB) Conducted RF Cable-high Oct. 05, 2020 Oct. 04, 2021 Woken RG402 High Cable-12 1 GHz -18 GHz (TH03-CB) Conducted RF Cable-high Woken RG402 High Cable-13 1 GHz -18 GHz Oct. 05, 2020 Oct. 04, 2021 (TH03-CB) Conducted RF Cable-high Woken RG402 High Cable-14 1 GHz -18 GHz Oct. 05, 2020 Oct. 04, 2021 (TH03-CB) Conducted RF Cable-high Oct. 05, 2020 Oct. 04, 2021 Woken RG402 High Cable-15 1 GHz -18 GHz (TH03-CB) Conducted

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

SENSE

V5.10

N.C.R.

N.C.R.

(TH03-CB)

N.C.R. means Non-Calibration required.

SPORTON

Test Software

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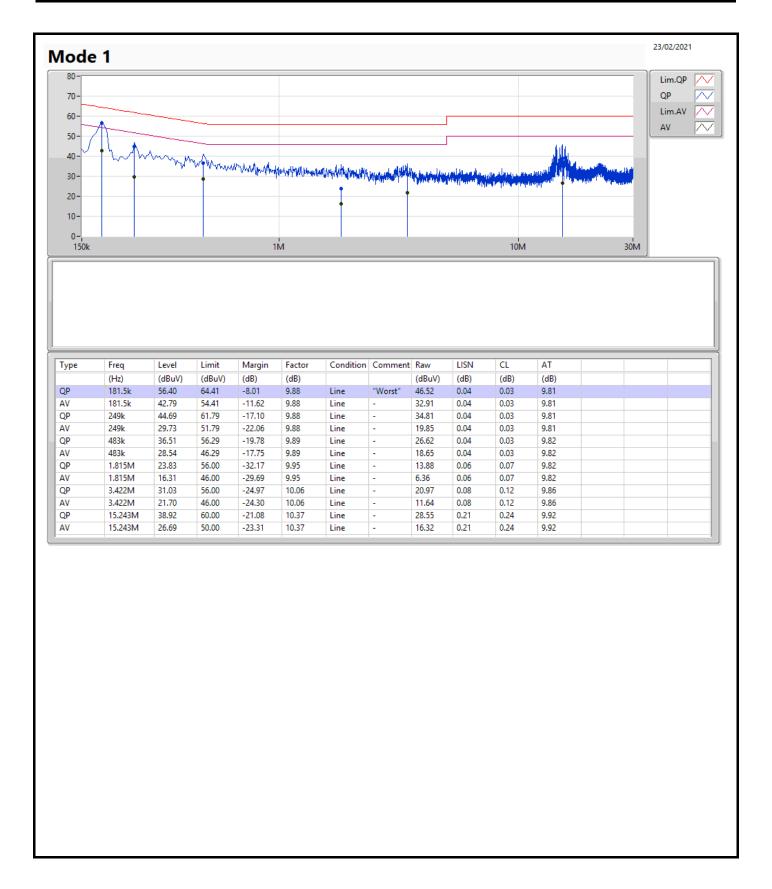
Conducted Emissions at Powerline

Appendix A

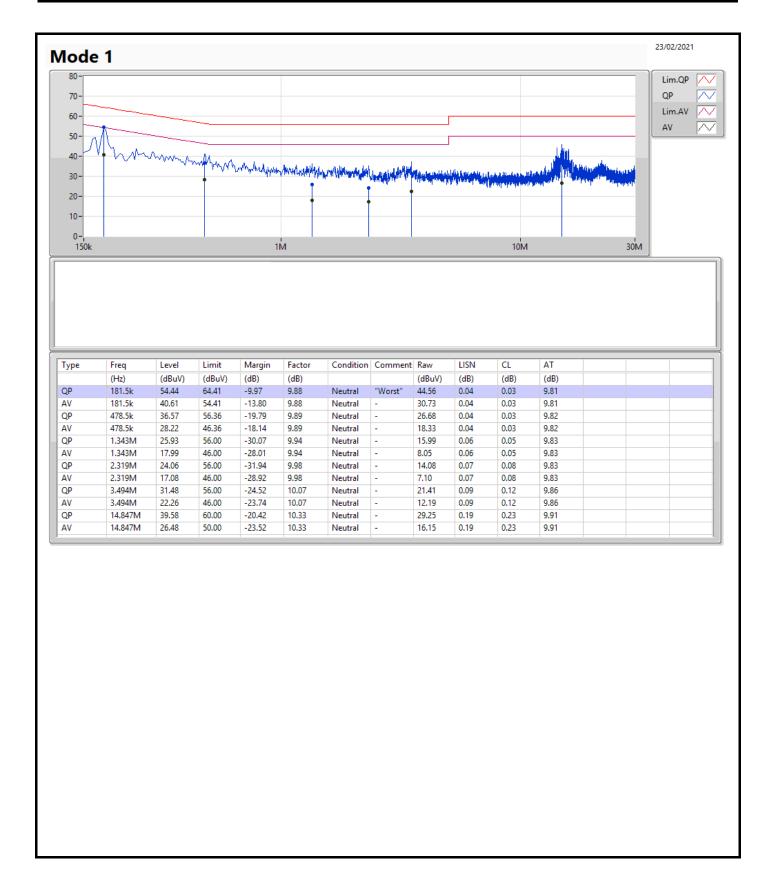
Summary

Mode	Result	Туре	Freq (Hz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Condition
Mode 1	Pass	QP	181.5k	56.40	64.41	-8.01	Line











EBW-DTS Appendix B.1

Summary

Mo	ode	Max-N dB	Max-OBW	ITU-Code	Min-N dB	Min-OBW
		(Hz)	(Hz)		(Hz)	(Hz)
2.4-2.4	1835GHz	-	-	-	-	-
BT-LE((1Mbps)	675k	1.026M	1M03F1D	672.5k	1.023M

Max-N dB = Maximum 6dB down bandwidth; Max-OBW = Maximum 99% occupied bandwidth; Min-N dB = Minimum 6dB down bandwidth; Min-OBW = Minimum 99% occupied bandwidth;

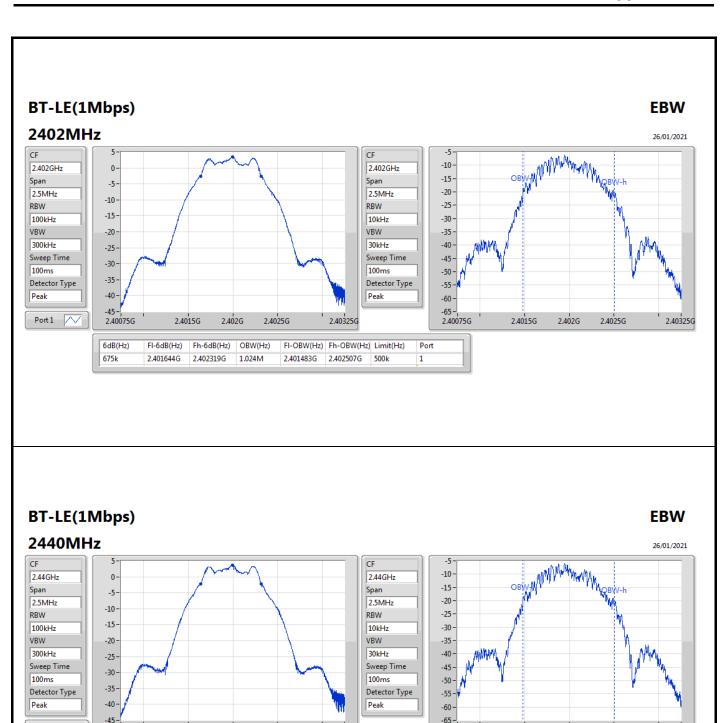


EBW-DTS Appendix B.1

Result

Mode	Result	Limit	Port 1-N dB	Port 1-OBW
		(Hz)	(Hz)	(Hz)
BT-LE(1Mbps)	-	-	-	-
2402MHz	Pass	500k	675k	1.024M
2440MHz	Pass	500k	675k	1.026M
2480MHz	Pass	500k	672.5k	1.023M

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



2.43875G

6dB(Hz)

2.4395G

2.439644G 2.440319G

FI-6dB(Hz) Fh-6dB(Hz) OBW(Hz)

2.44G

1.026M

2.4405G

2.44125G

FI-OBW(Hz) Fh-OBW(Hz) Limit(Hz)

2.439482G 2.440507G 500k

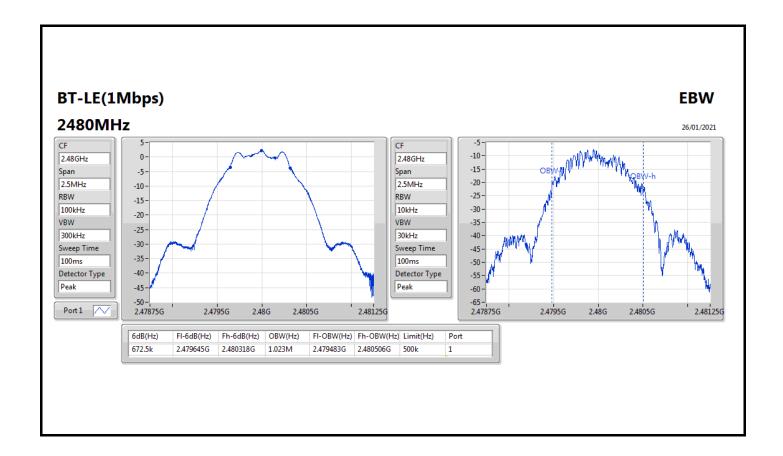
2.43875G

Port1

2.4395G

2.44G

2.4405G





Summary

Mode	Max-N dB	Max-OBW	ITU-Code	Min-N dB	Min-OBW
	(Hz)	(Hz)		(Hz)	(Hz)
2.4-2.4835GHz	-	-	-	-	-
BT-LE(2Mbps)	1.163M	2.049M	2M05F1D	1.163M	2.046M

Max-N dB = Maximum 6dB down bandwidth; Max-OBW = Maximum 99% occupied bandwidth; Min-N dB = Minimum 6dB down bandwidth; Min-OBW = Minimum 99% occupied bandwidth;

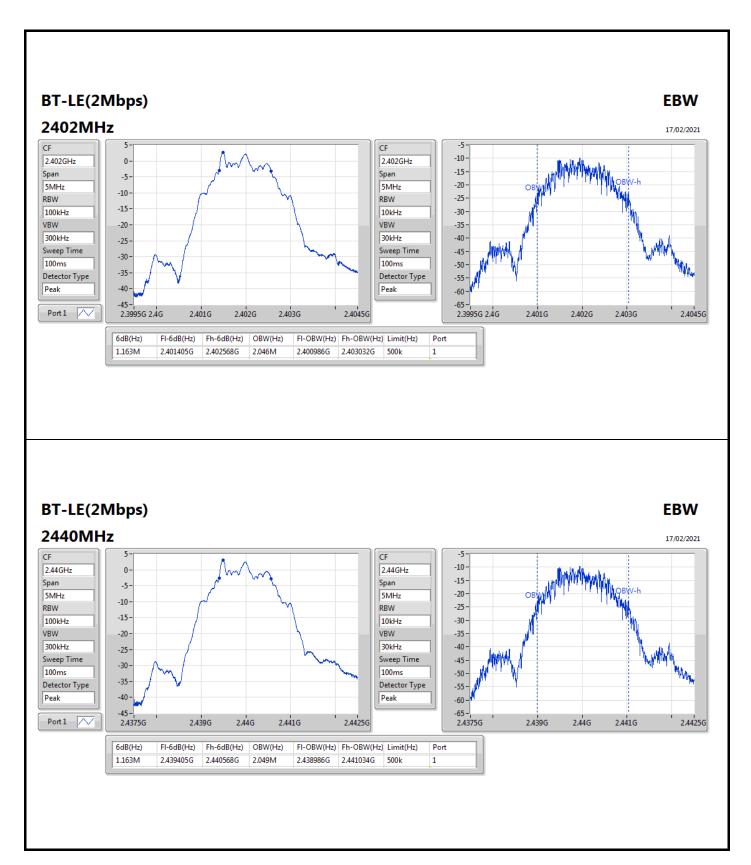


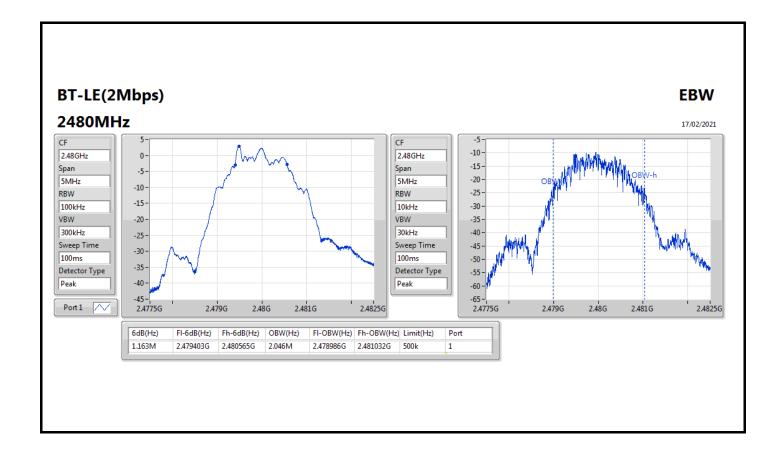
Result

Mode		Limit	Port 1-N dB	Port 1-OBW
		(Hz)	(Hz)	(Hz)
BT-LE(2Mbps)	-	-	-	-
2402MHz	Pass	500k	1.163M	2.046M
2440MHz	Pass	500k	1.163M	2.049M
2480MHz	Pass	500k	1.163M	2.046M

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









Average Power-DTS

Appendix C.1

Mode	Power (dBm)	Power (W)
2.4-2.4835GHz	-	-
BT-LE(1Mbps)	3.73	0.00236

Result

Mode		Gain	Power	Power Limit
		(dBi)	(dBm)	(dBm)
BT-LE(1Mbps)	-	-	-	-
2402MHz	Pass	3.20	3.73	30.00
2440MHz	Pass	3.20	3.35	30.00
2480MHz	Pass	3.20	3.16	30.00

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



Average Power-DTS

Appendix C.2

Mode	Power	Power
	(dBm)	(W)
2.4-2.4835GHz	-	-
BT-LE(2Mbps)	3.51	0.00224

Result

Mode		Gain	Power	Power Limit
		(dBi)	(dBm)	(dBm)
BT-LE(2Mbps)	-	-	-	-
2402MHz	Pass	3.20	3.28	30.00
2440MHz	Pass	3.20	3.51	30.00
2480MHz	Pass	3.20	2.29	30.00

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



PSD-DTS Appendix D.1

Summary

Mode	PD
	(dBm/RBW)
2.4-2.4835GHz	·
BT-LE(1Mbps)	-11.50

RBW=3 kHz.



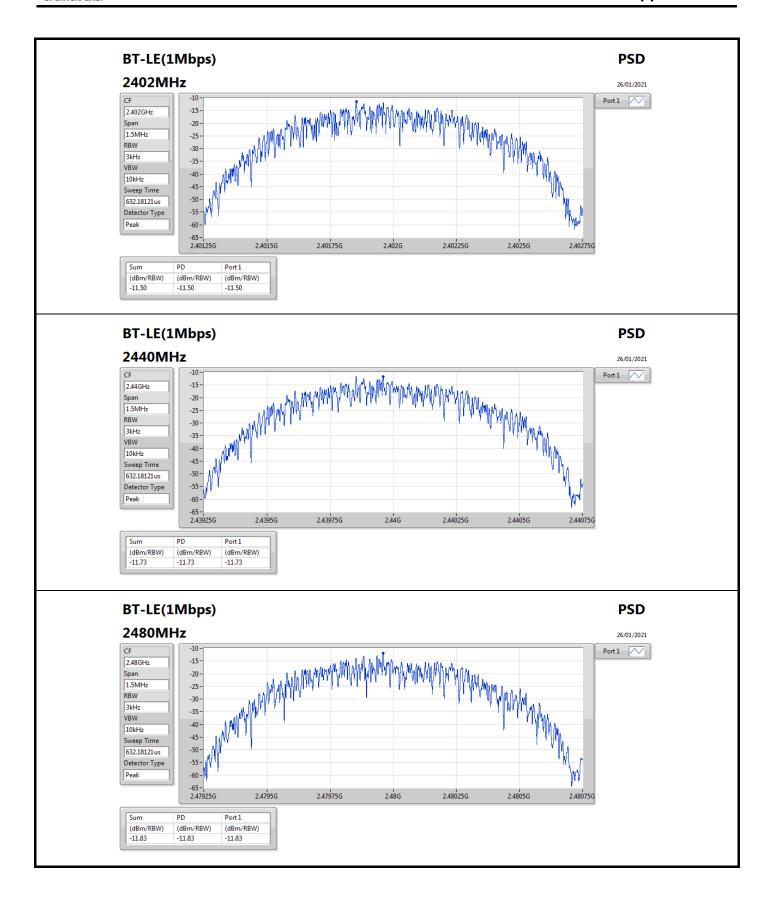
Appendix D.1 **PSD-DTS**

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Mode	Result	Gain	PD	PD Limit
		(dBi)	(dBm/RBW)	(dBm/RBW)
BT-LE(1Mbps)	-	-	-	-
2402MHz	Pass	3.20	-11.50	8.00
2440MHz	Pass	3.20	-11.73	8.00
2480MHz	Pass	3.20	-11.83	8.00

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

PSD-DTS Appendix D.1





PSD-DTS Appendix D.2

Summary

- Curring -	
Mode	PD
	(dBm/RBW)
2.4-2.4835GHz	·
BT-LE(2Mbps)	-13.04

RBW=3 kHz.



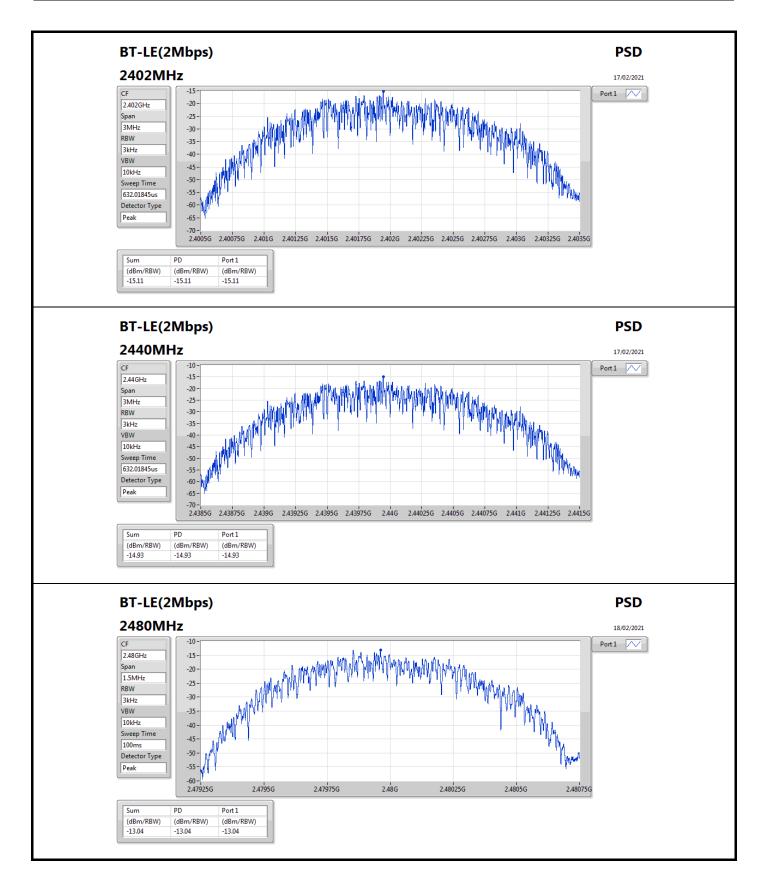
Appendix D.2 **PSD-DTS**

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Mode	Result	Gain	PD	PD Limit
		(dBi)	(dBm/RBW)	(dBm/RBW)
BT-LE(2Mbps)	-	-	-	-
2402MHz	Pass	3.20	-15.11	8.00
2440MHz	Pass	3.20	-14.93	8.00
2480MHz	Pass	3.20	-13.04	8.00

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







Appendix E.1

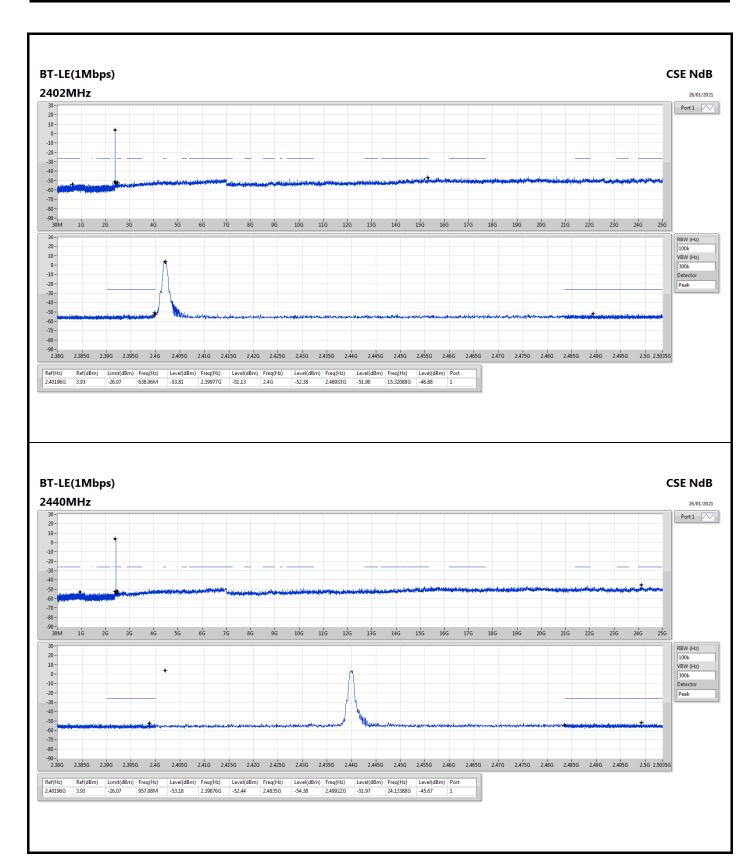
- Cullinary															
Mode	Result	Ref	Ref	Limit	Freq	Level	Freq	Level	Freq	Level	Freq	Level	Freq	Level	Port
		(Hz)	(dBm)	(dBm)	(Hz)	(dBm)	(Hz)	(dBm)	(Hz)	(dBm)	(Hz)	(dBm)	(Hz)	(dBm)	
2.4-2.4835GHz	-	-	-	-	-	-	-	-	-		-	-	-	-	-
BT-LE(1Mbps)	Pass	2.40196G	3.93	-26.07	638.06M	-53.81	2.39977G	-51.13	2.4G	-52.38	2.48933G	-51.90	15.32088G	-46.88	1

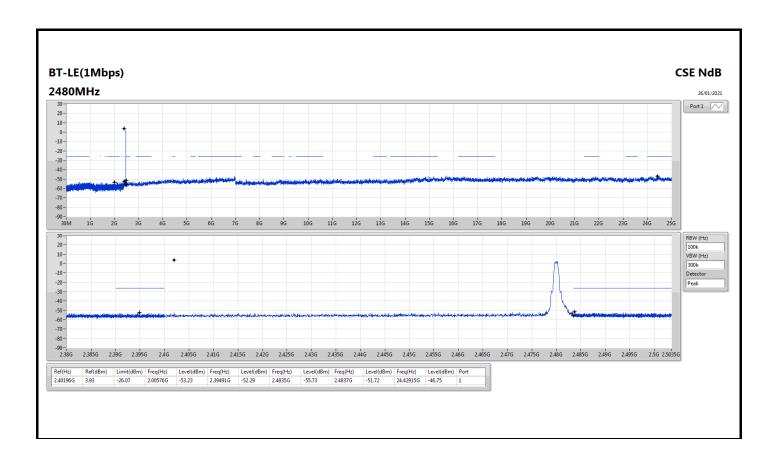


Appendix E.1

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	2.40196G	3.93	-26.07	638.06M	-53.81	2.39977G	-51.13	2.4G	-52.38	2.48933G	-51.90	15.32088G	-46.88	1
2440MHz	Pass	2.40196G	3.93	-26.07	957.08M	-53.18	2.39876G	-52.44	2.4835G	-54.38	2.49922G	-51.97	24.13388G	-45.67	1
2480MHz	Pass	2.40196G	3.93	-26.07	2.00576G	-53.23	2.39491G	-52.29	2.4835G	-55.73	2.4837G	-51.72	24.42915G	-46.75	1









Appendix E.2

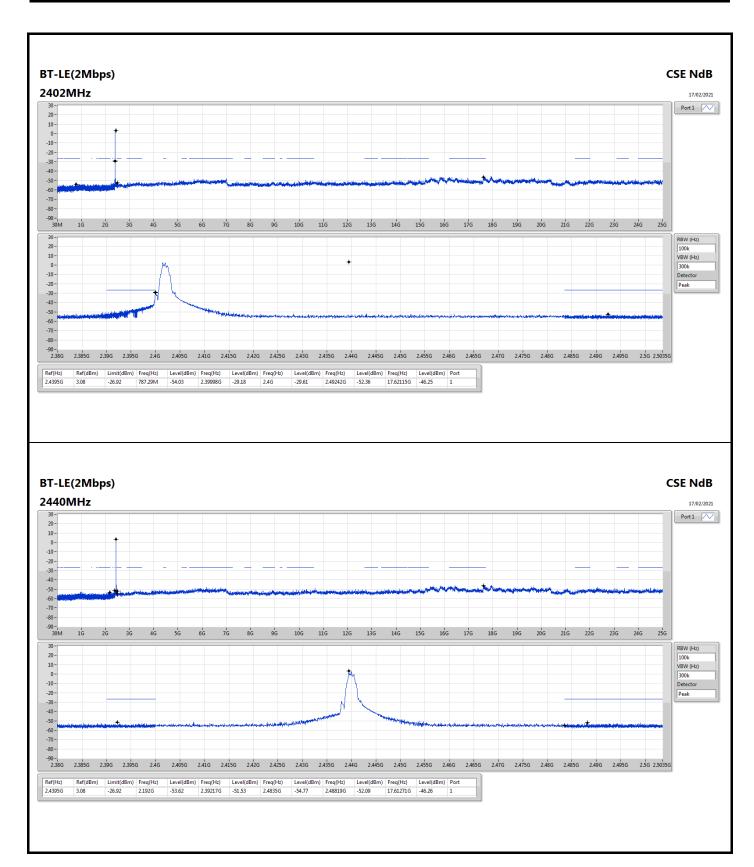
- Garrina y															
Mode	Result	Ref	Ref	Limit	Freq	Level	Freq	Level	Freq	Level	Freq	Level	Freq	Level	Port
		(Hz)	(dBm)	(dBm)	(Hz)	(dBm)	(Hz)	(dBm)	(Hz)	(dBm)	(Hz)	(dBm)	(Hz)	(dBm)	
2.4-2.4835GHz	-		-			-	-	-		-	-	-	-	-	-
BT-LE(2Mbps)	Pass	2.4395G	3.08	-26.92	787.29M	-54.03	2.39998G	-29.18	2.4G	-29.61	2.49242G	-52.36	17.62115G	-46.25	1

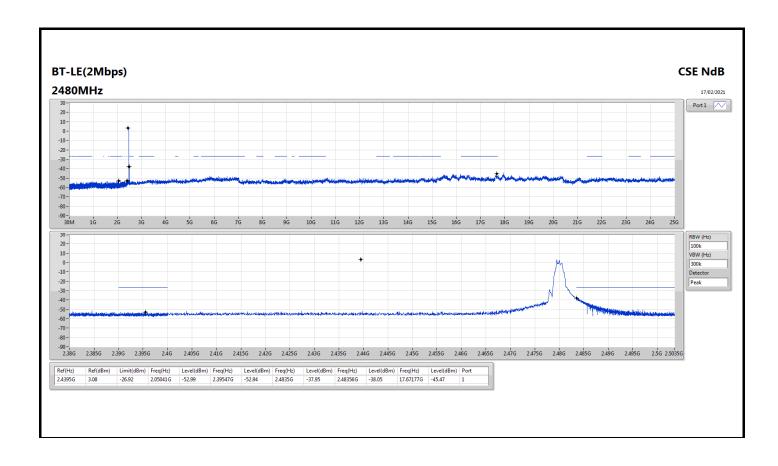


Appendix E.2

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(2Mbps)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2402MHz	Pass	2.4395G	3.08	-26.92	787.29M	-54.03	2.39998G	-29.18	2.4G	-29.61	2.49242G	-52.36	17.62115G	-46.25	1
2440MHz	Pass	2.4395G	3.08	-26.92	2.192G	-53.62	2.39217G	-51.53	2.4835G	-54.77	2.48819G	-52.09	17.61271G	-46.26	1
2480MHz	Pass	2.4395G	3.08	-26.92	2.05041G	-52.99	2.39547G	-52.94	2.4835G	-37.95	2.48356G	-38.05	17.67177G	-45.47	1







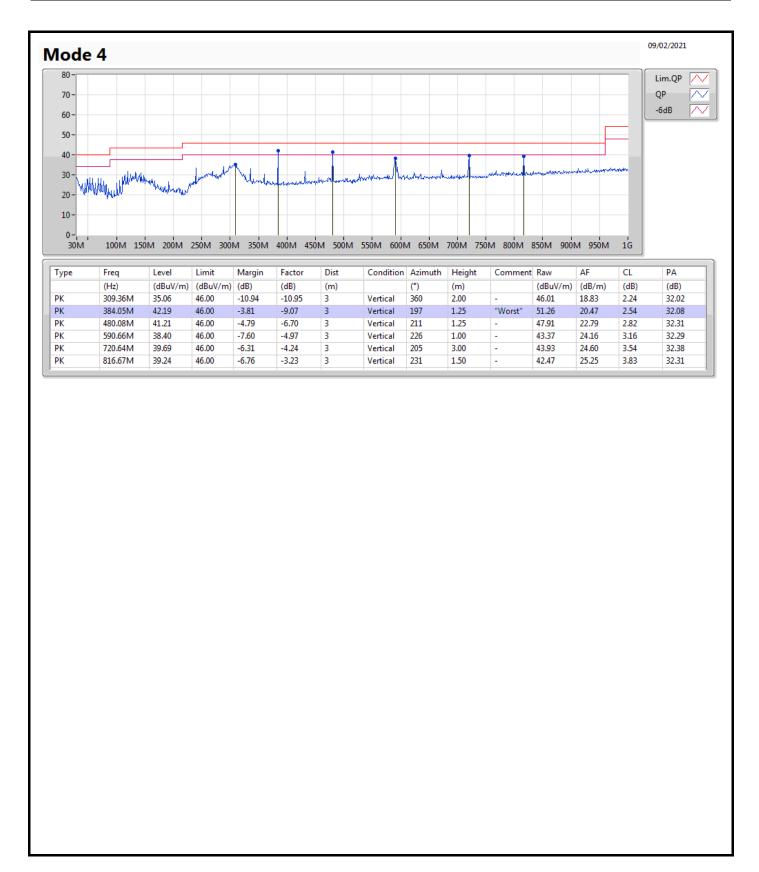


Radiated Emissions below 1GHz

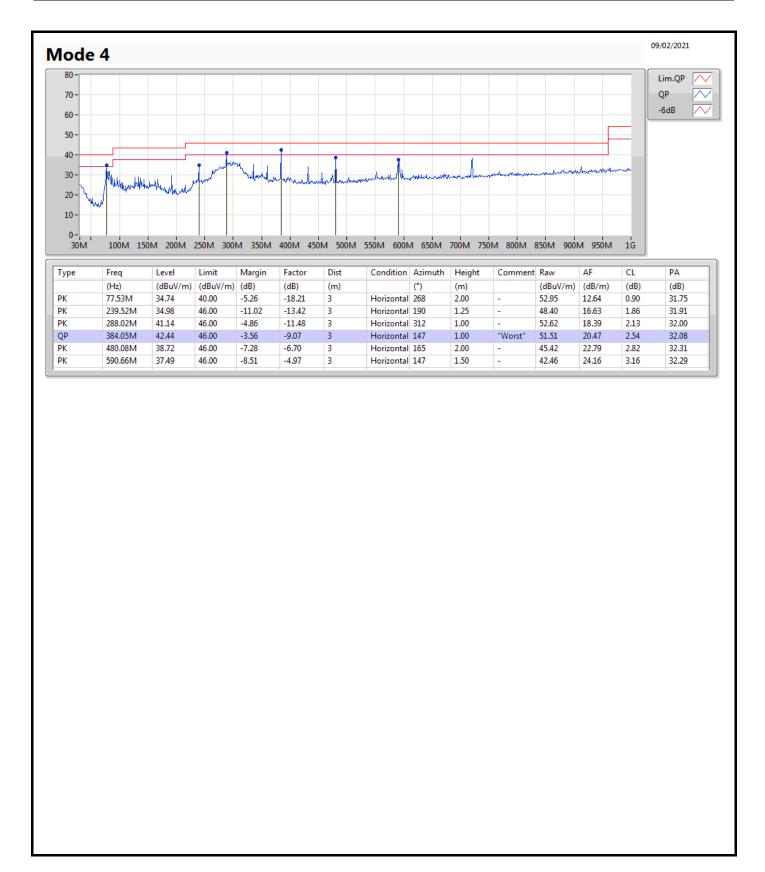
Appendix F.1

Mode	Result	Туре	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Condition	
Mode 4	Pass	QP	384.05M	42.44	46.00	-3.56	Horizontal	









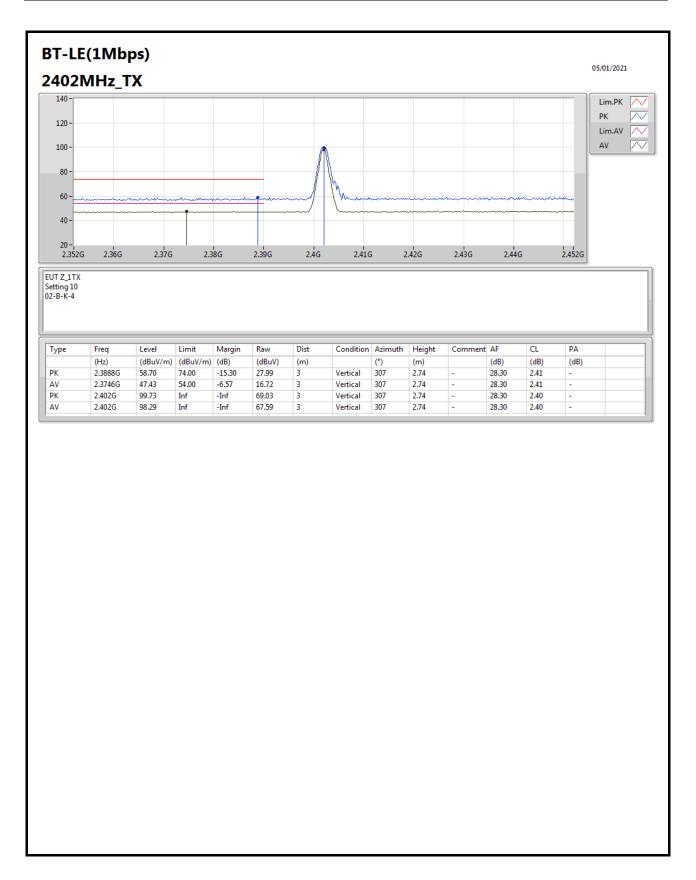


RSE TX above 1GHz_Ant.1

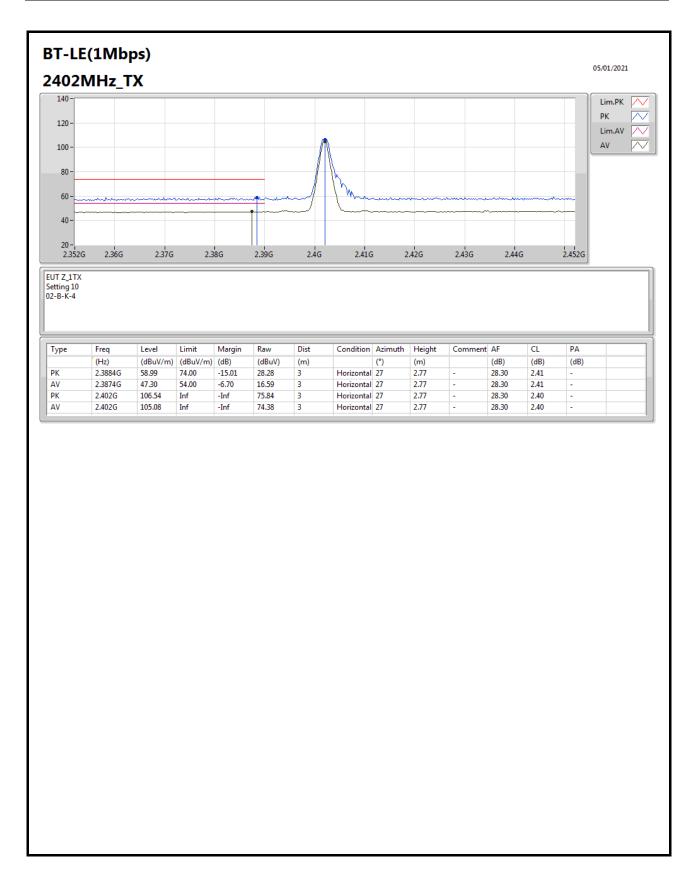
Appendix F.2

	Mode	Result	Туре	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Dist (m)	Condition	Azimuth	Height (m)	Comments
2.	.4-2.4835GHz	-	-	-	-	-	-	-	-	-	-	-
В	BT-LE(2Mbps)	Pass	PK	2.486G	72.54	74.00	-1.46	3	Horizontal	295	2.89	-

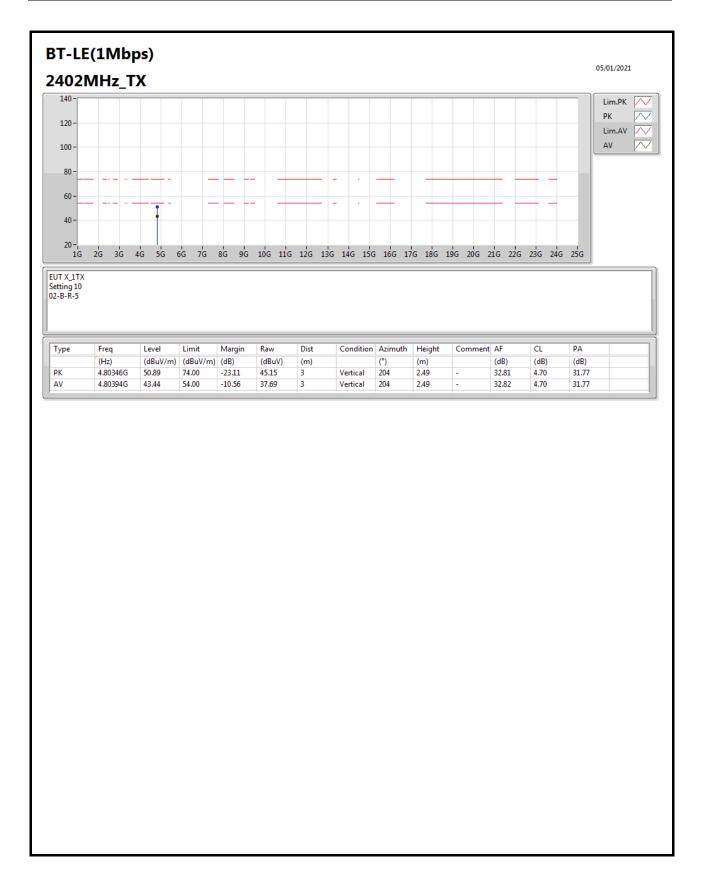




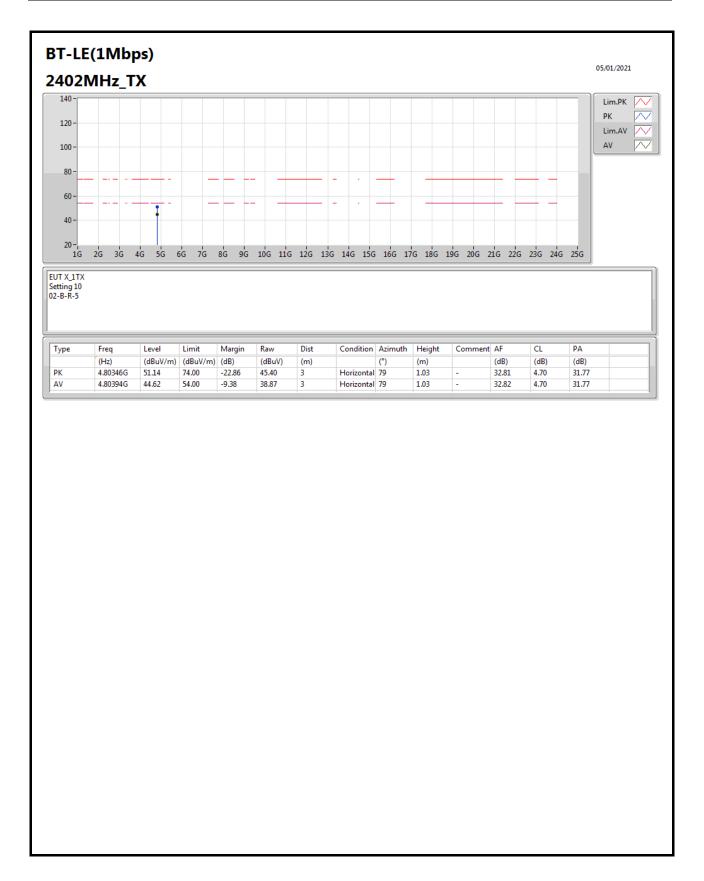




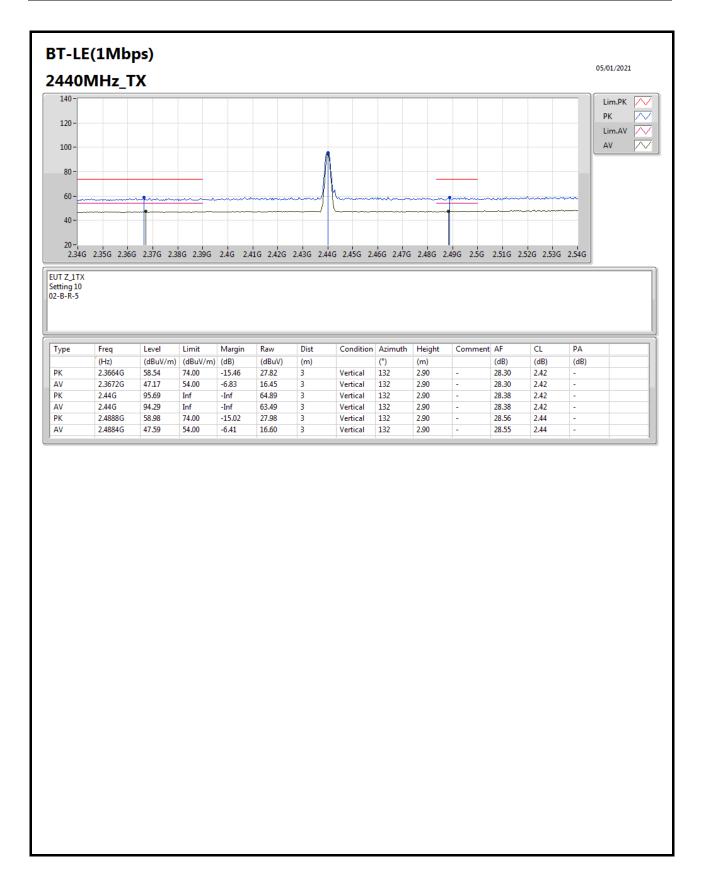




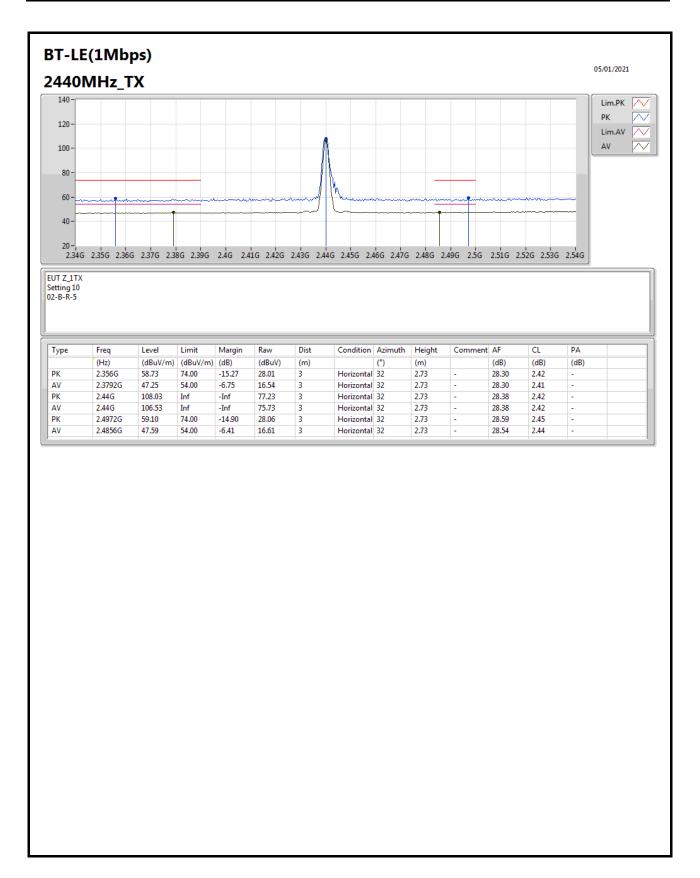




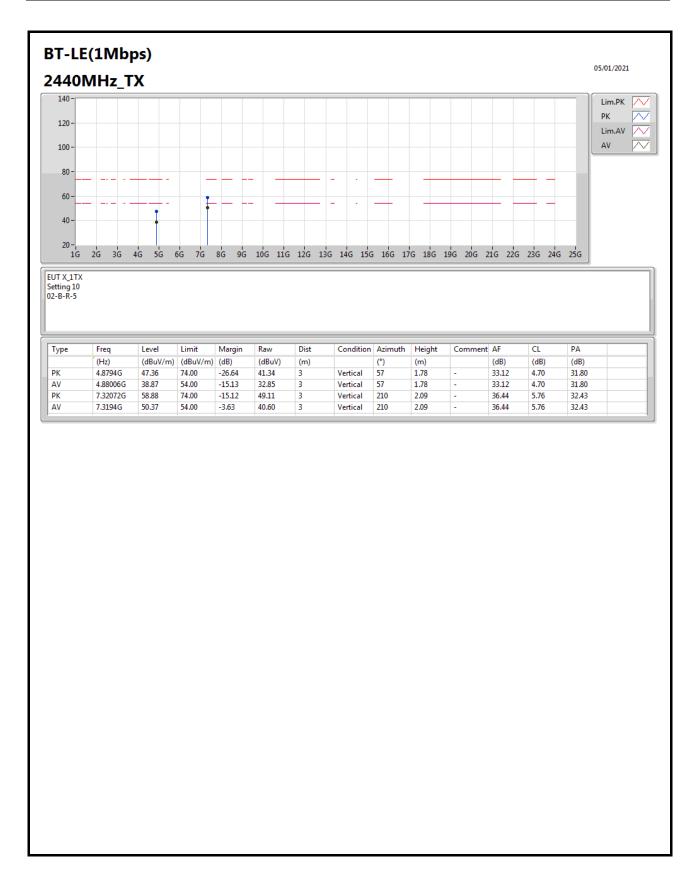




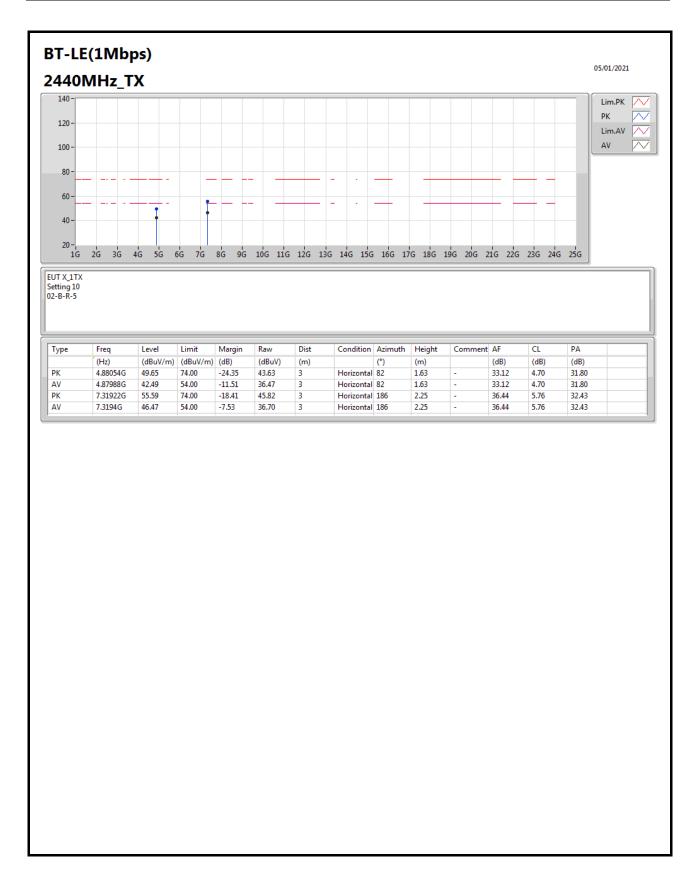




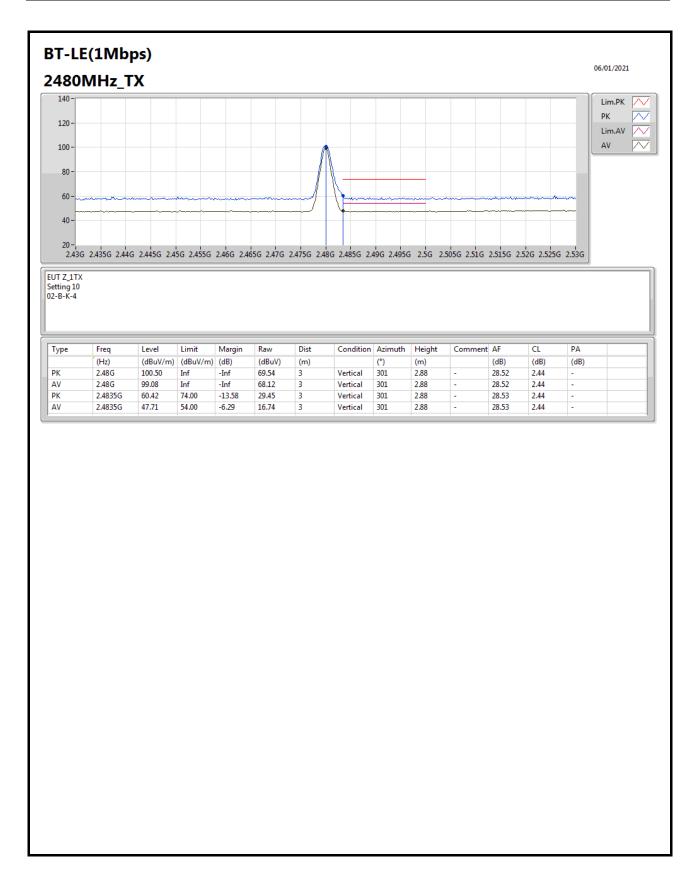




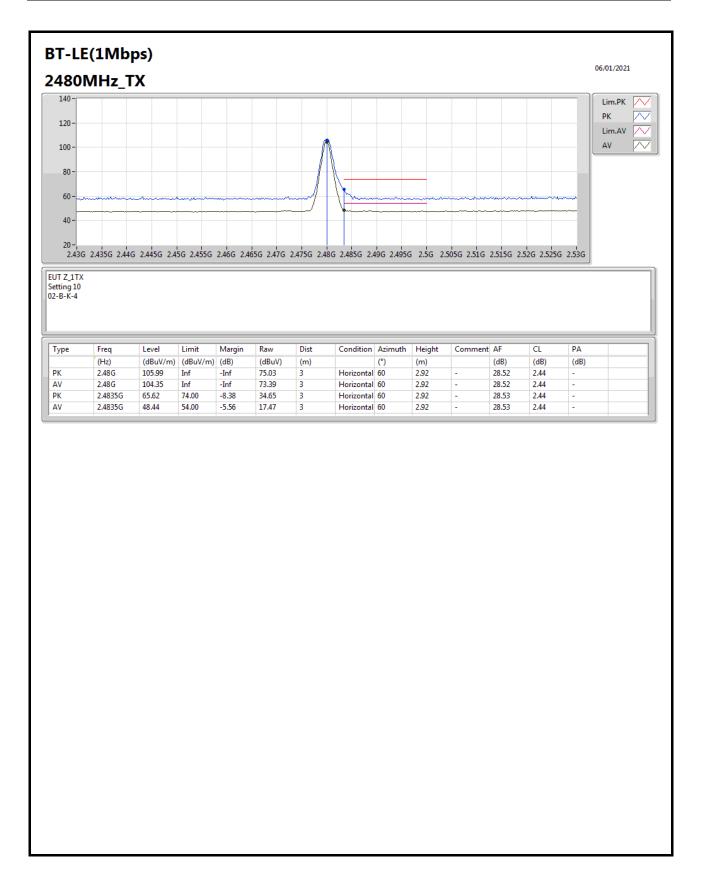




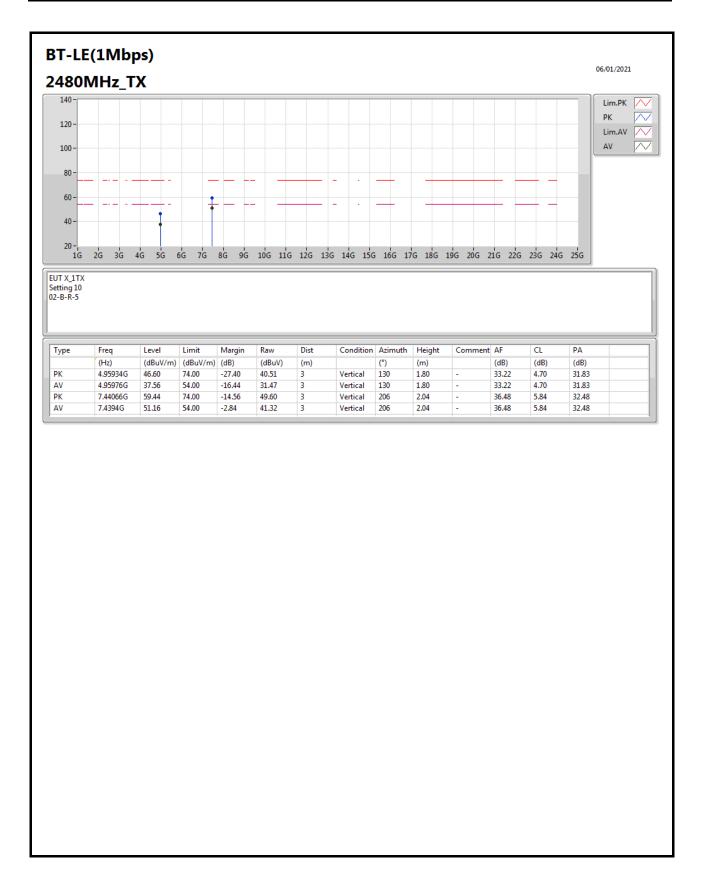




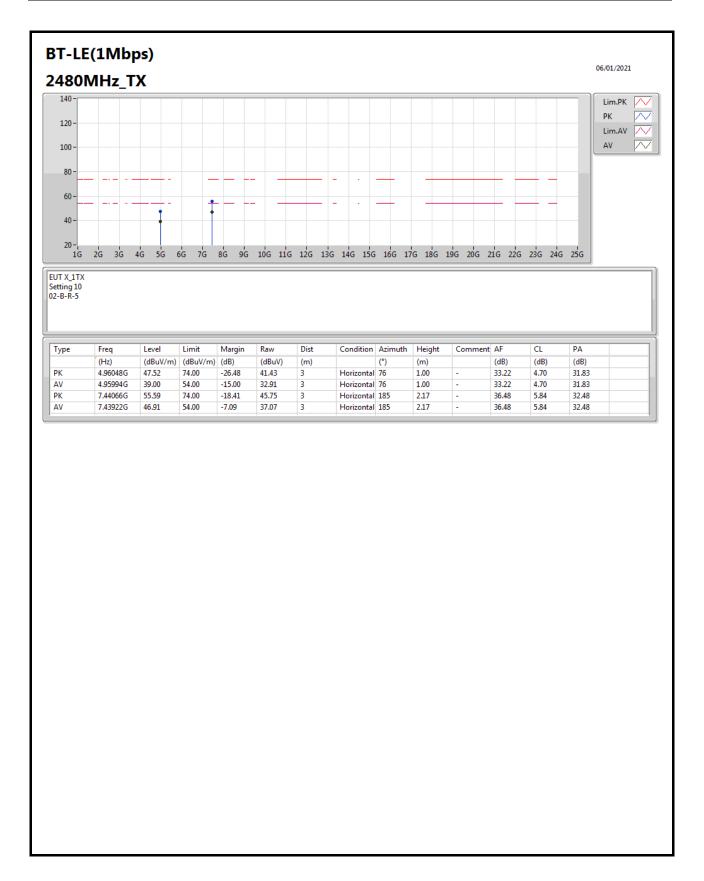




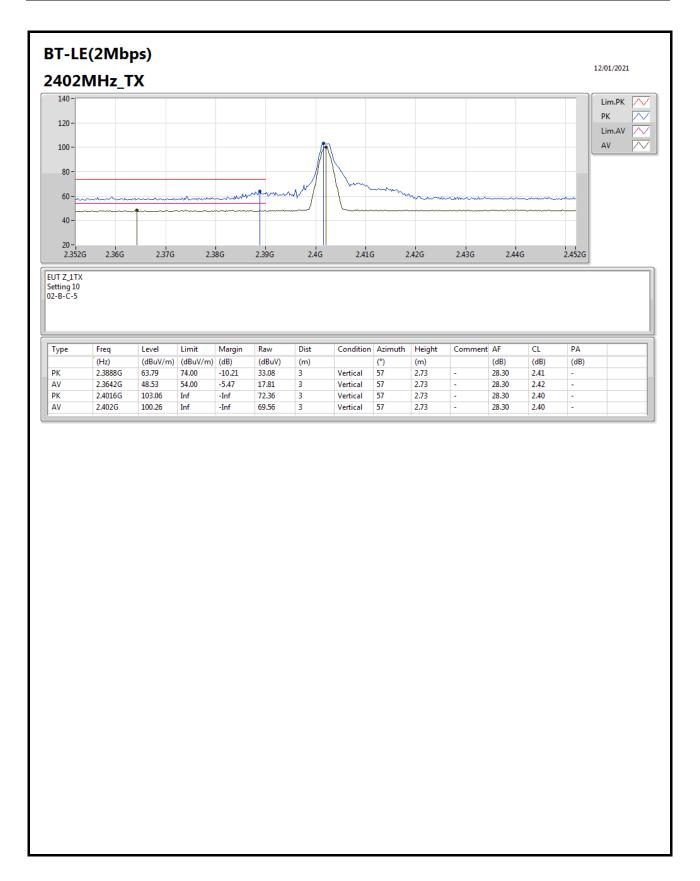




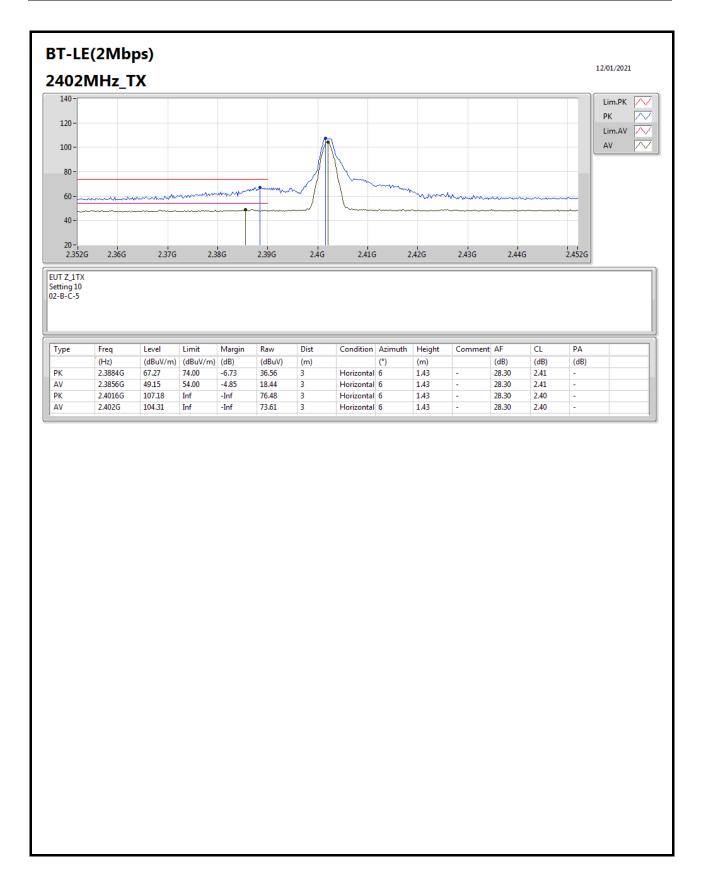




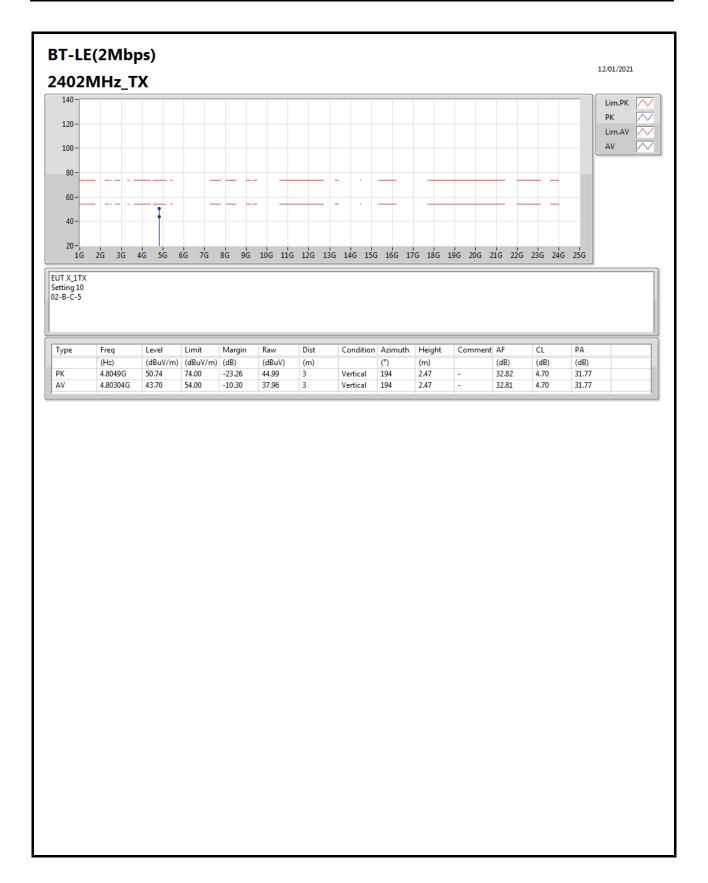




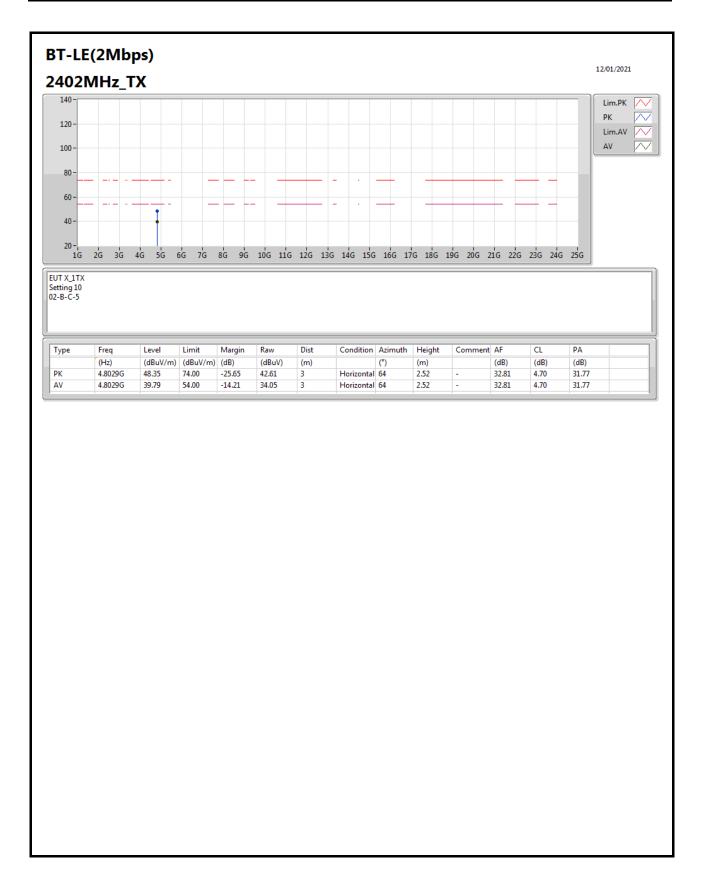




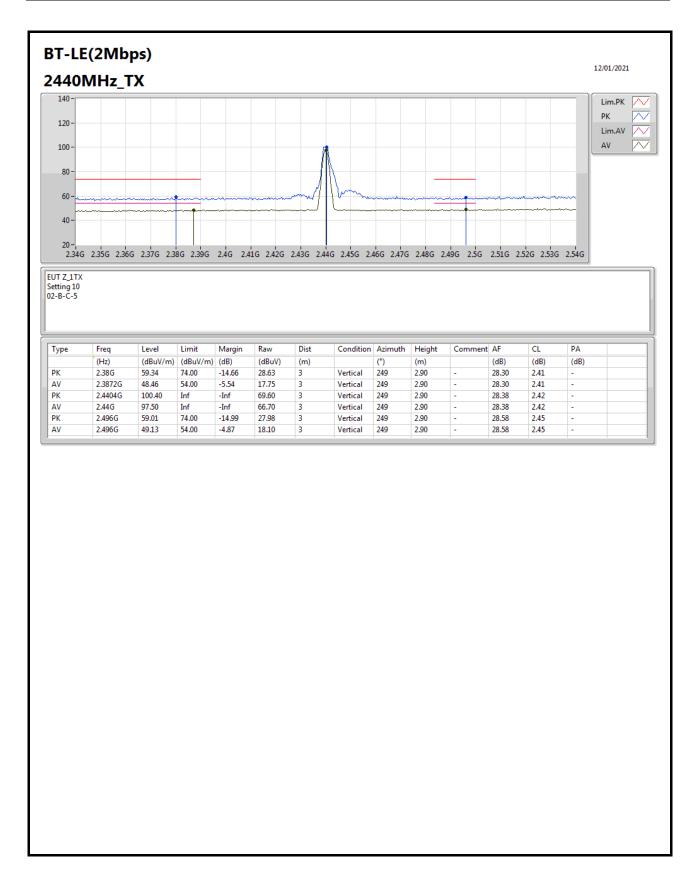




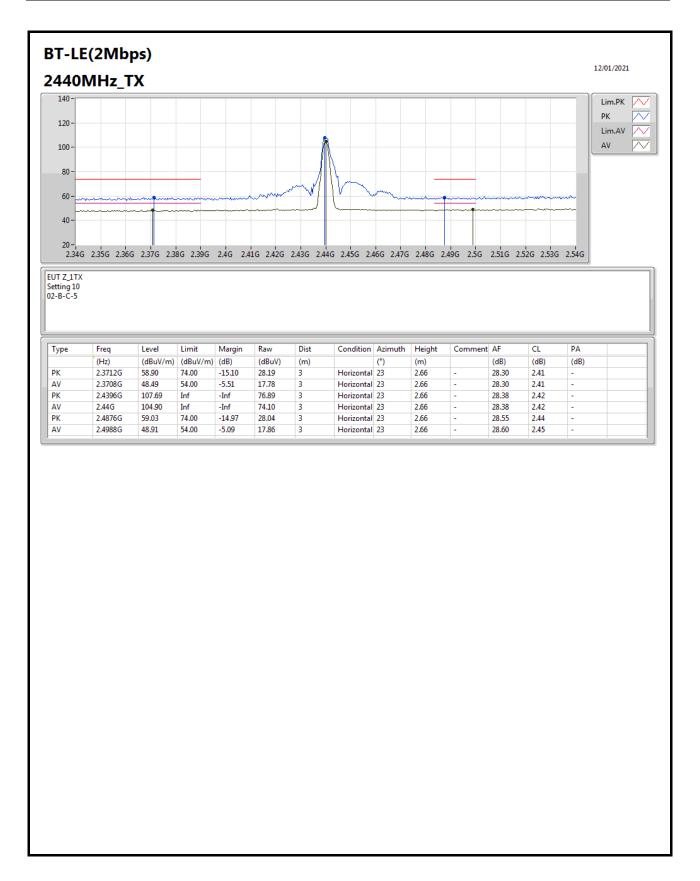




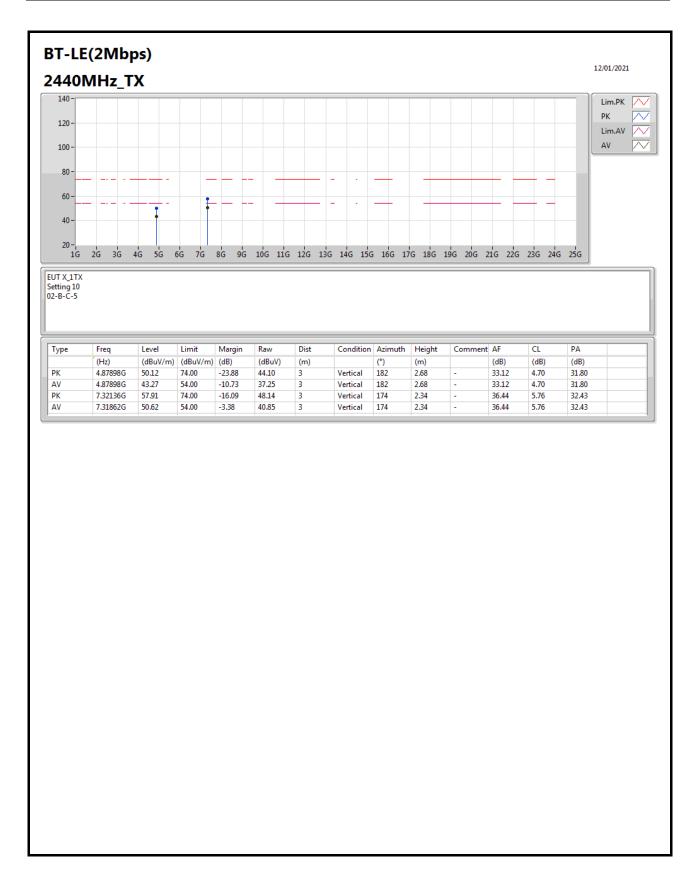




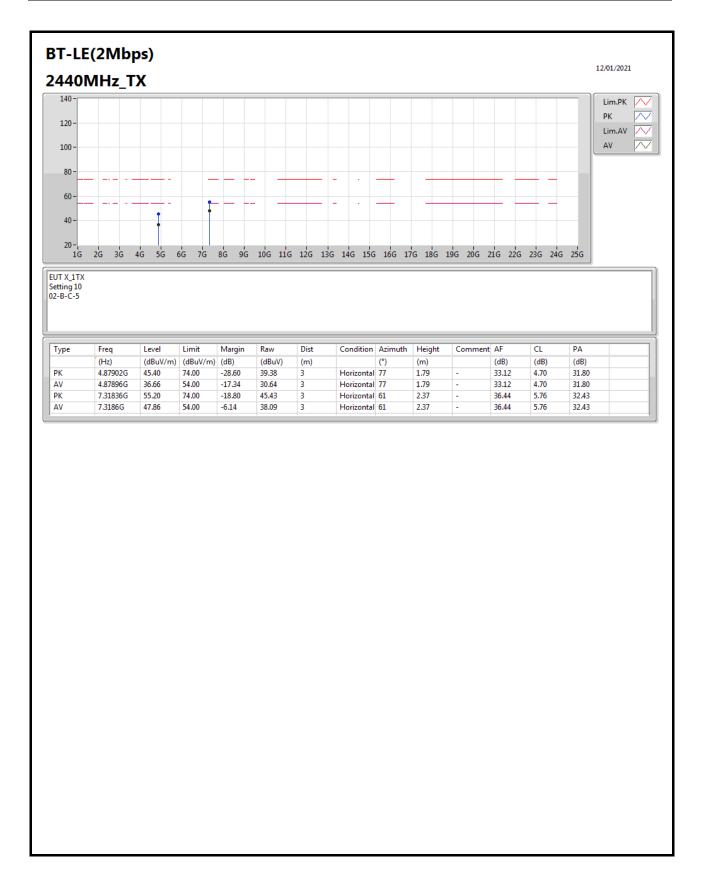




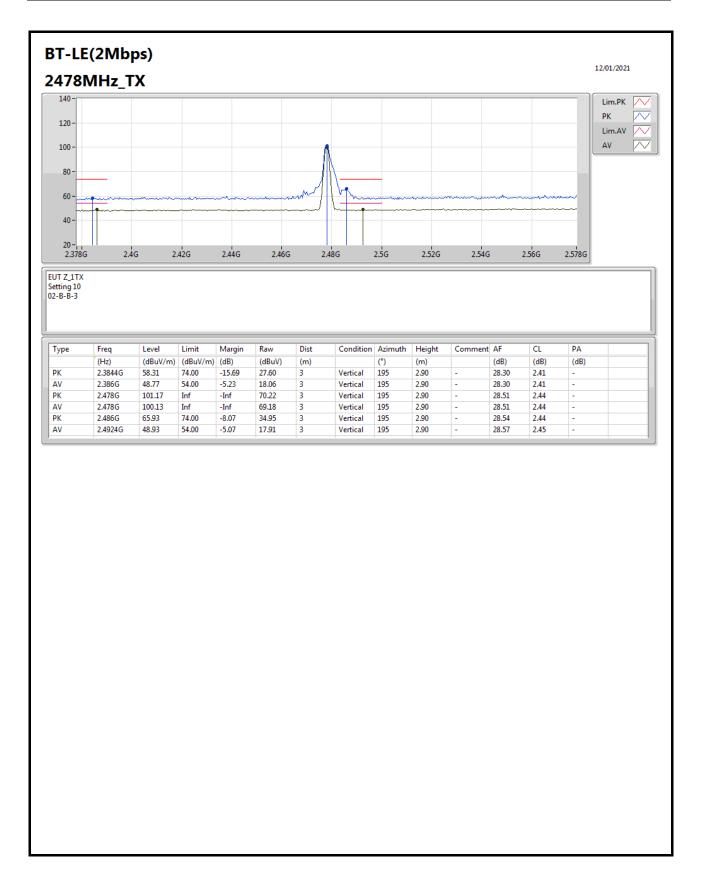




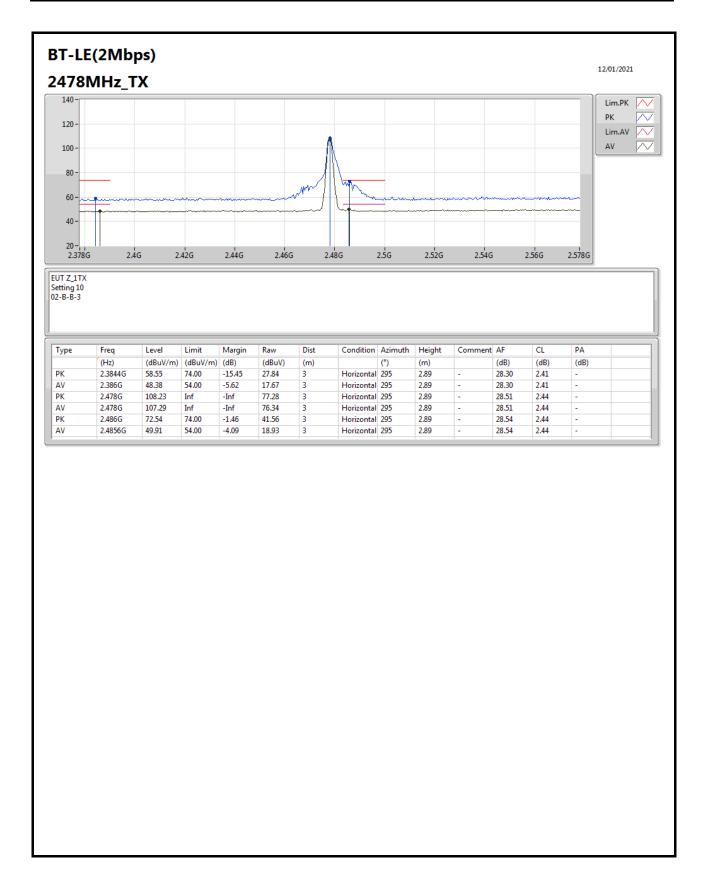




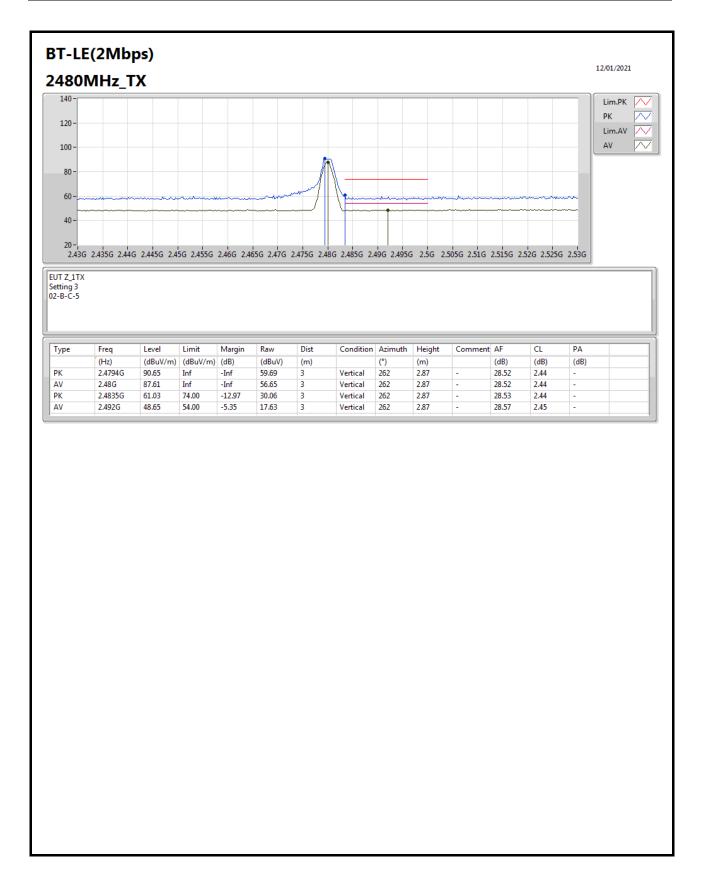




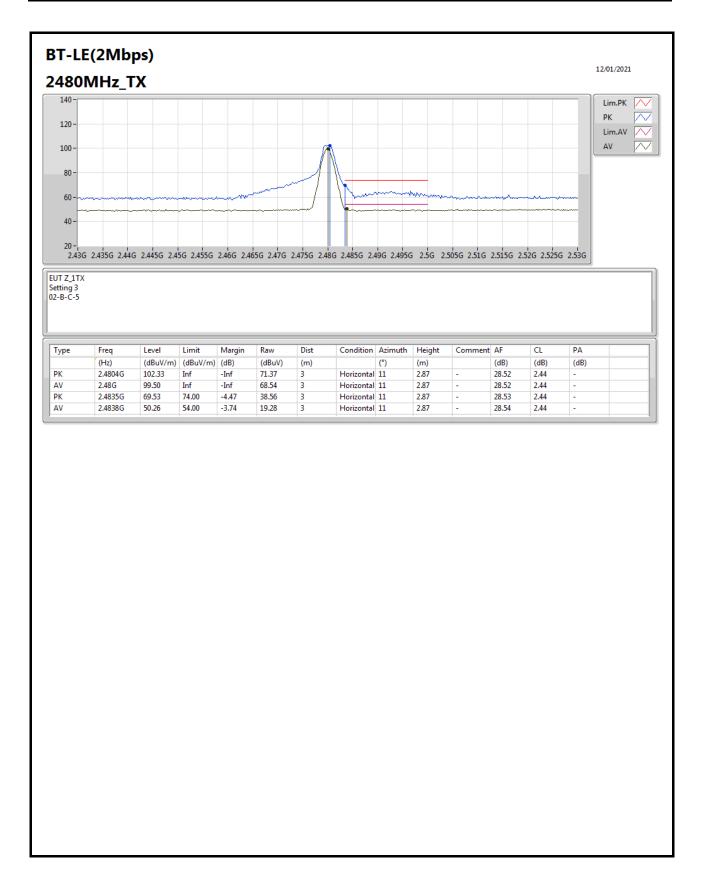




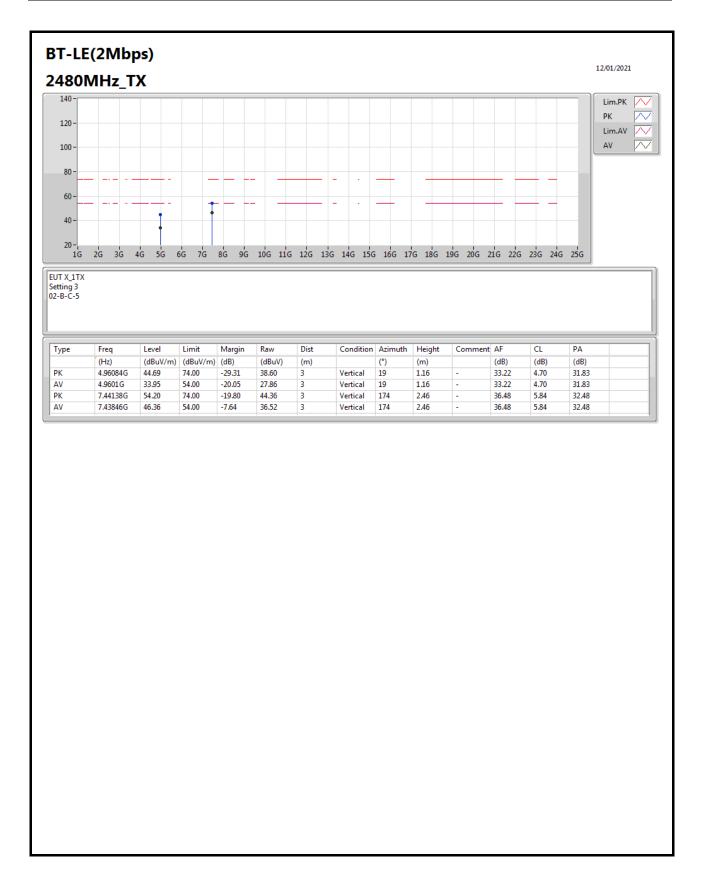




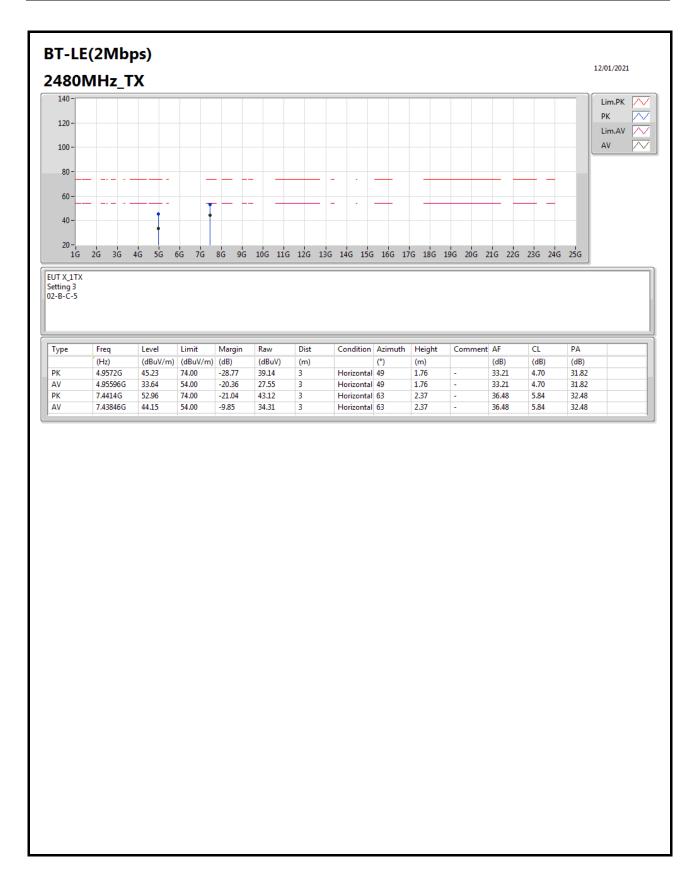














RSE TX above 1GHz_Ant.2

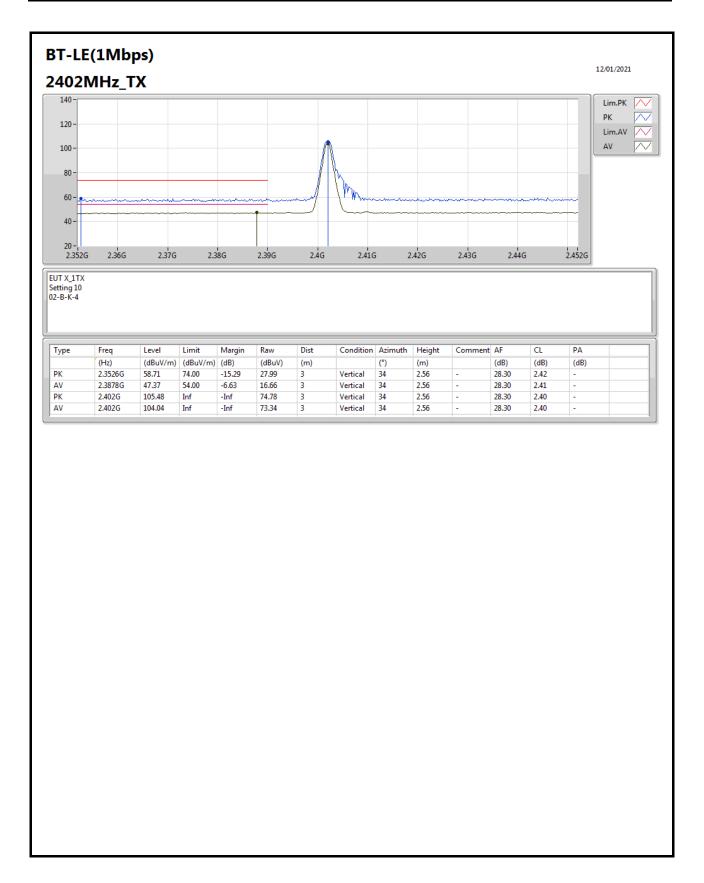
Appendix F.3

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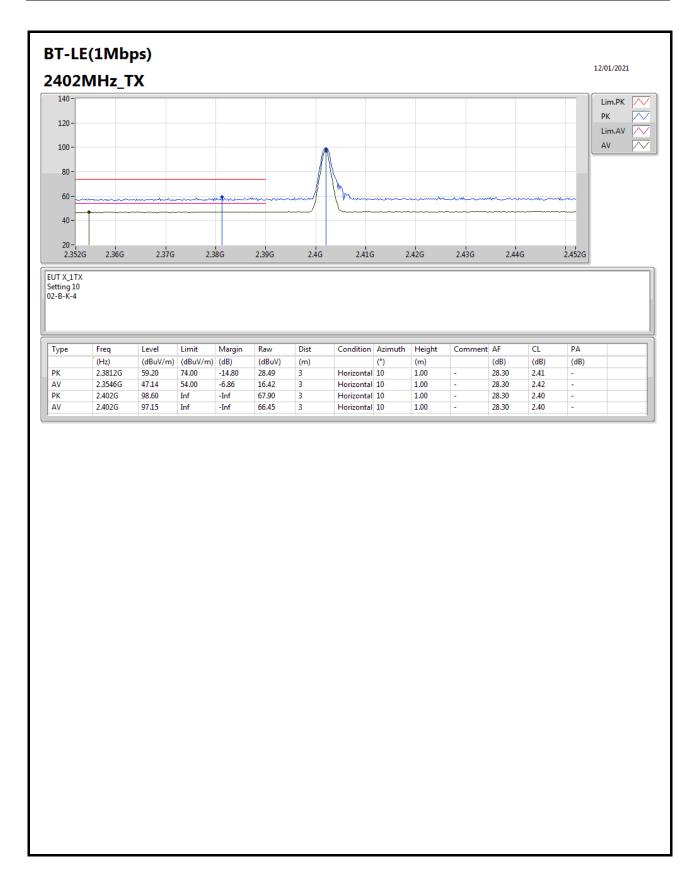
Summary

Mode	Result	Туре	Freq	Level	Limit	Margin	Dist	Condition	Azimuth	Height	Comments
			(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(m)		(°)	(m)	
2.4-2.4835GHz	-	-	•	-	-	-	-	-	-	-	-
BT-LE(1Mbps)	Pass	AV	2.4838G	49.57	54.00	-4.43	3	Vertical	44	2.75	-

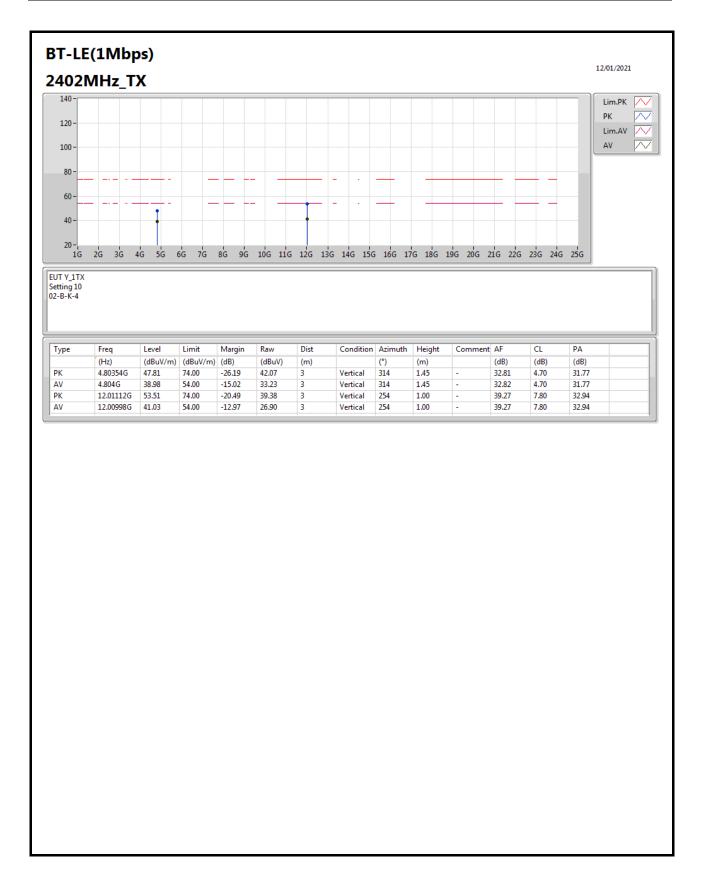




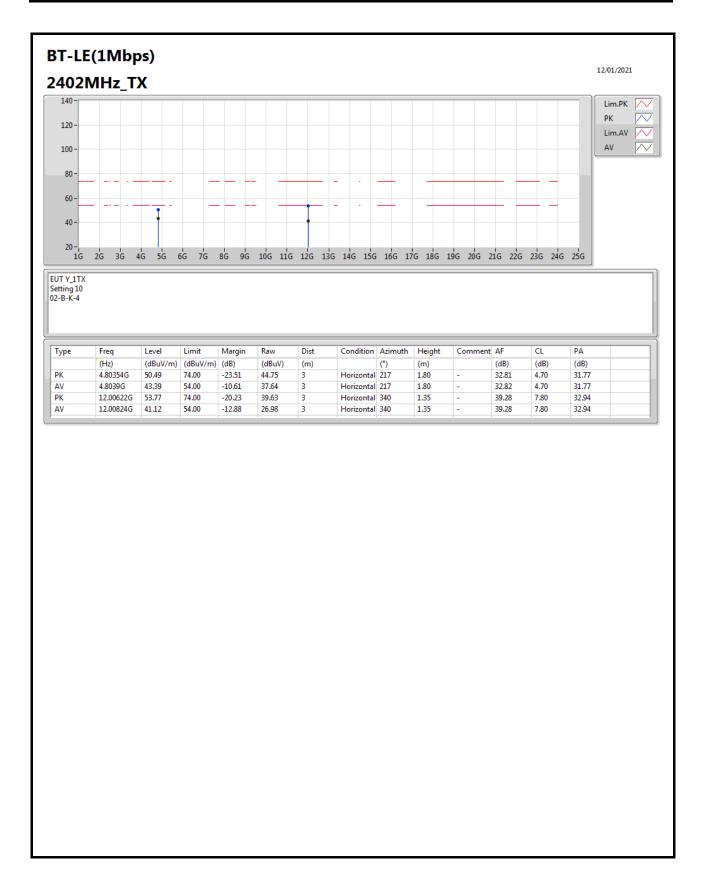




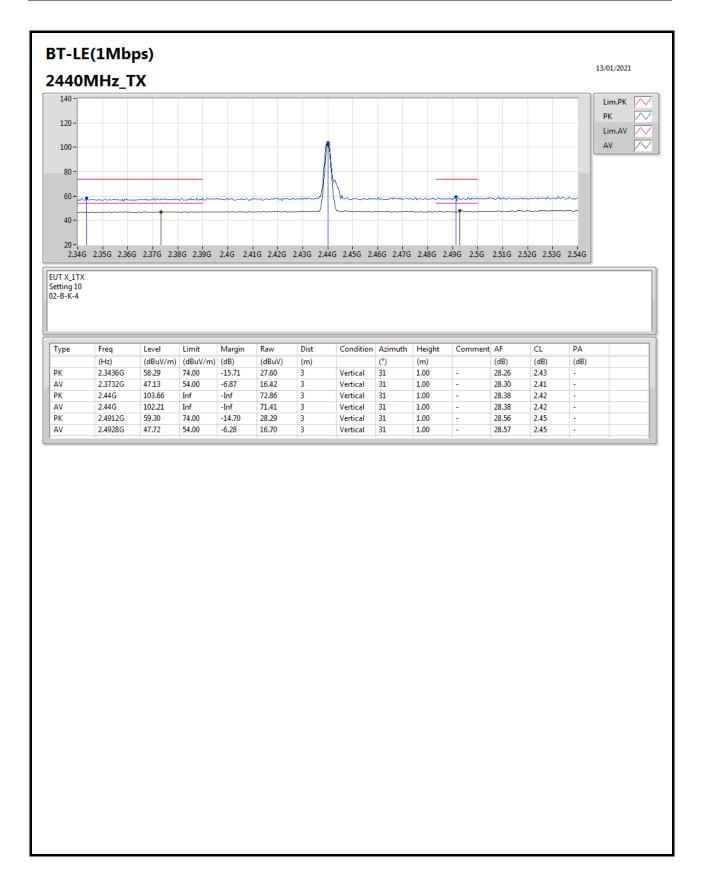




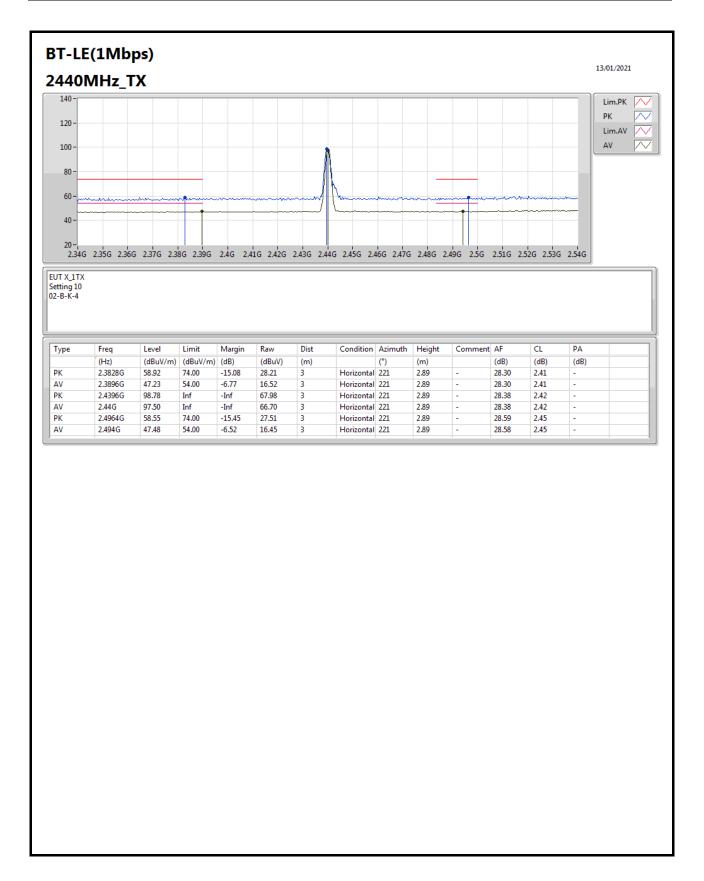




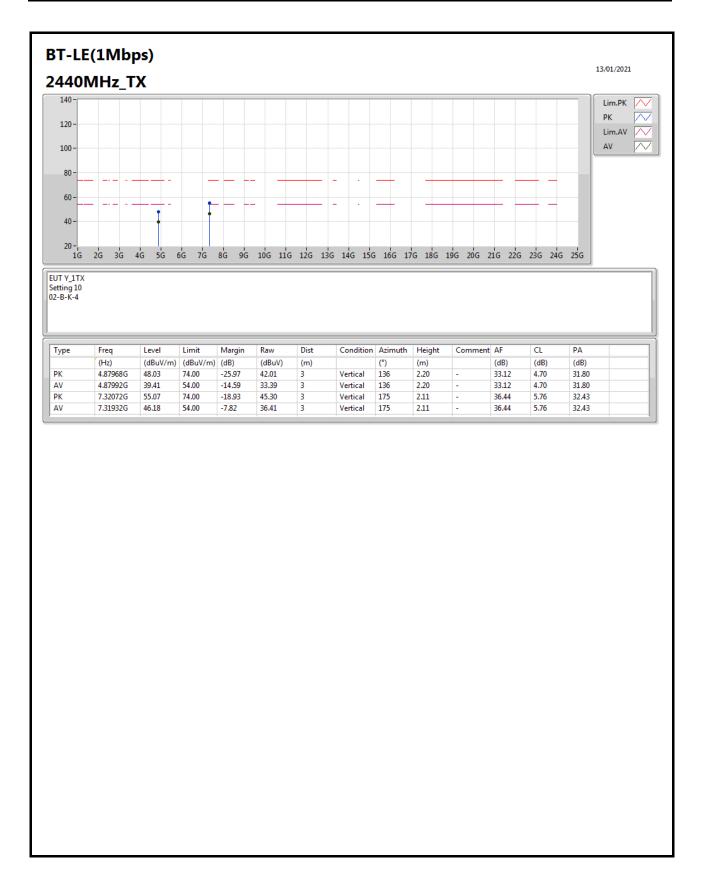




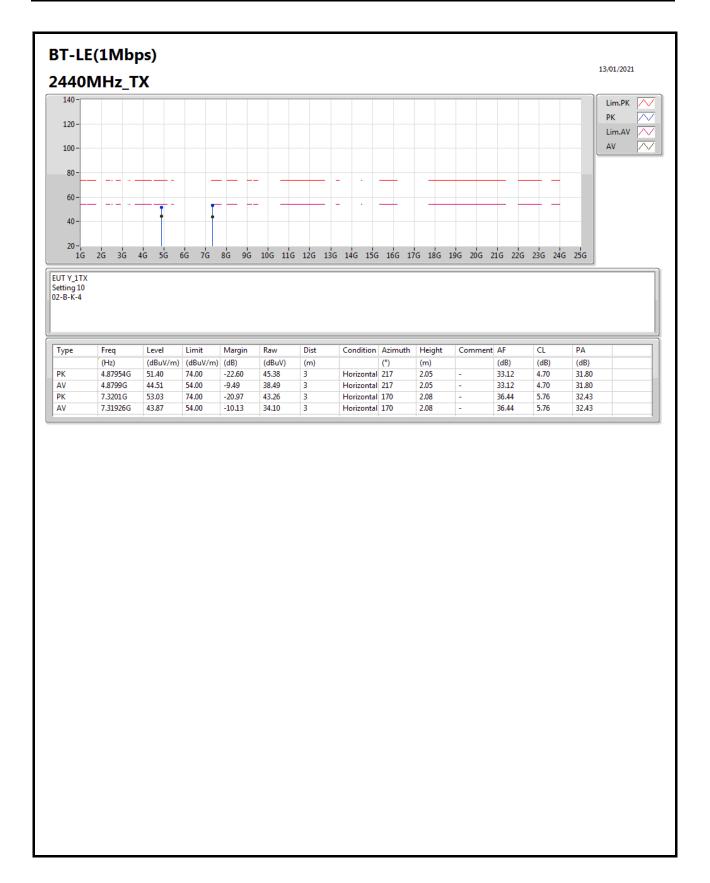




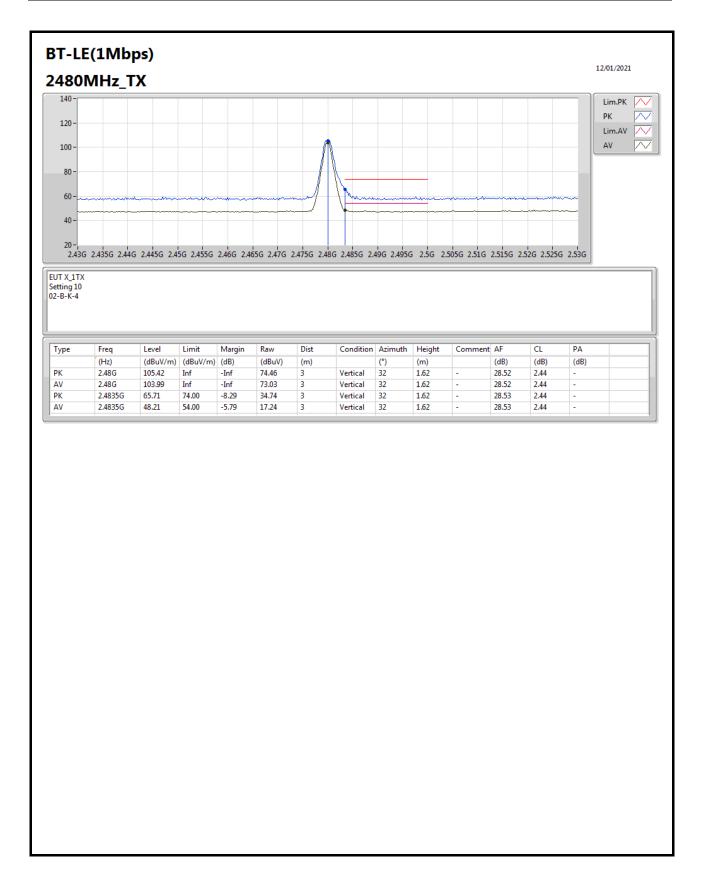




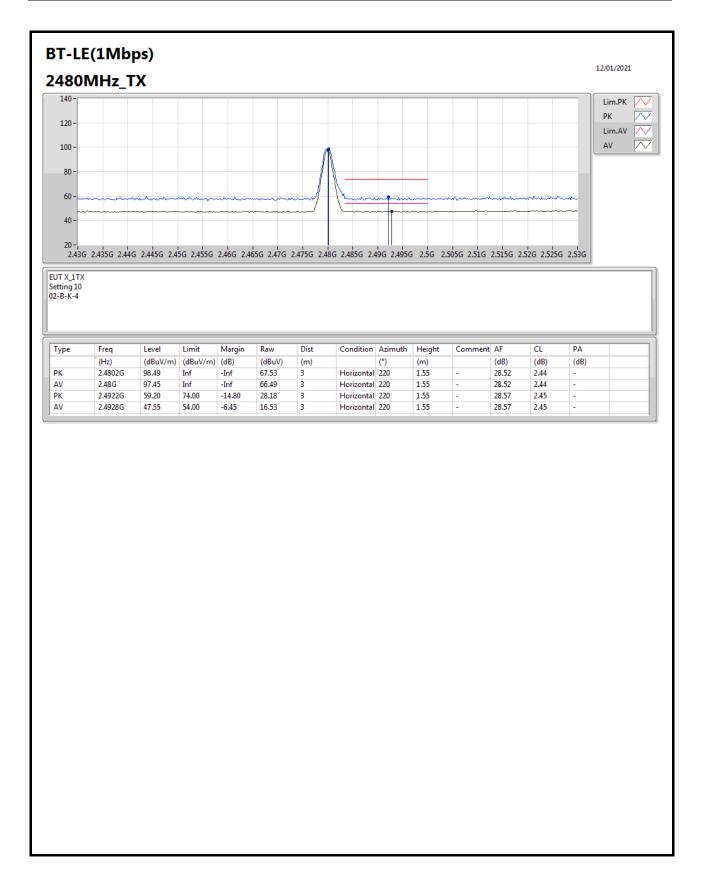




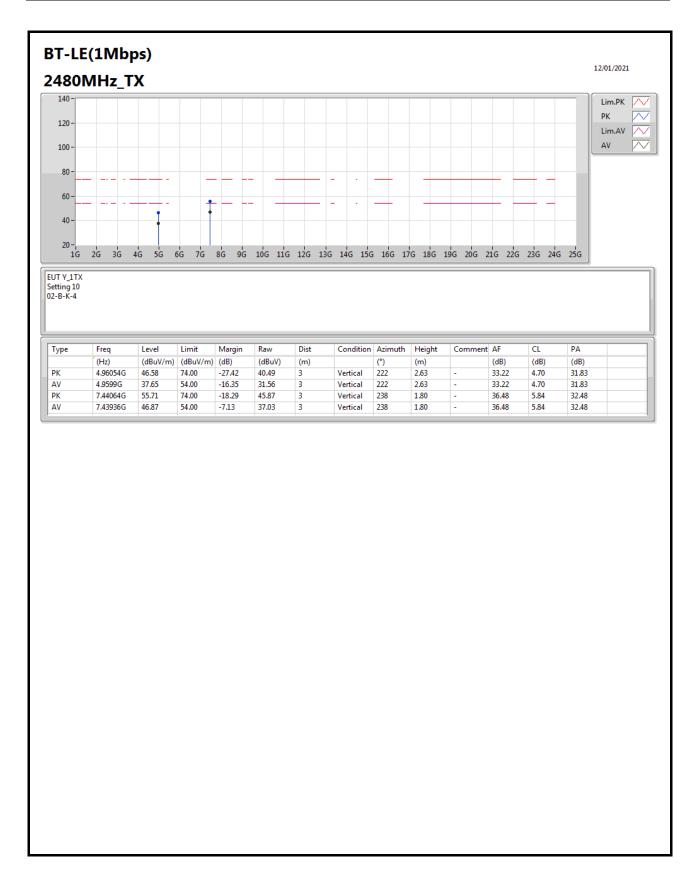




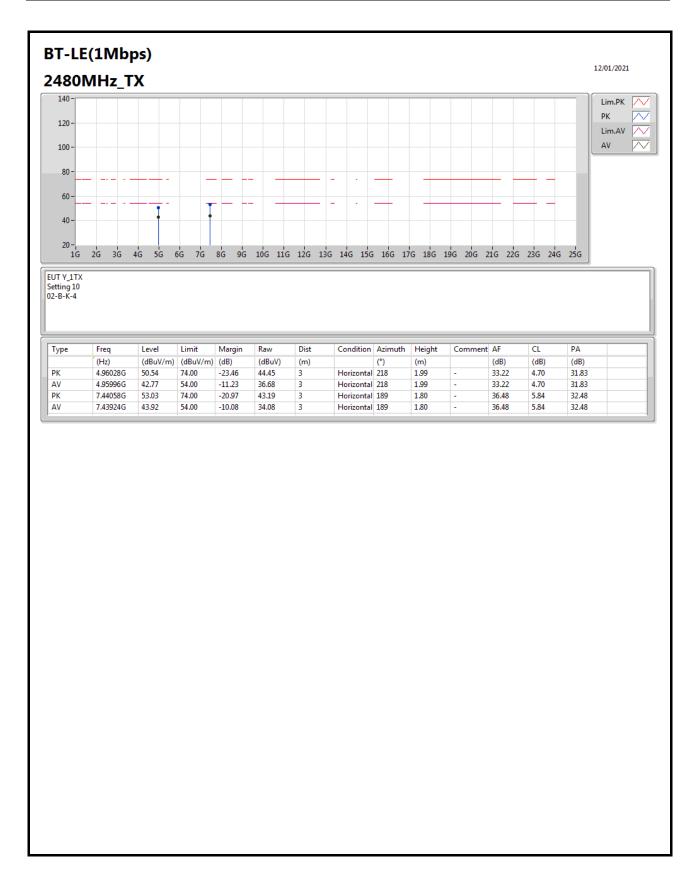




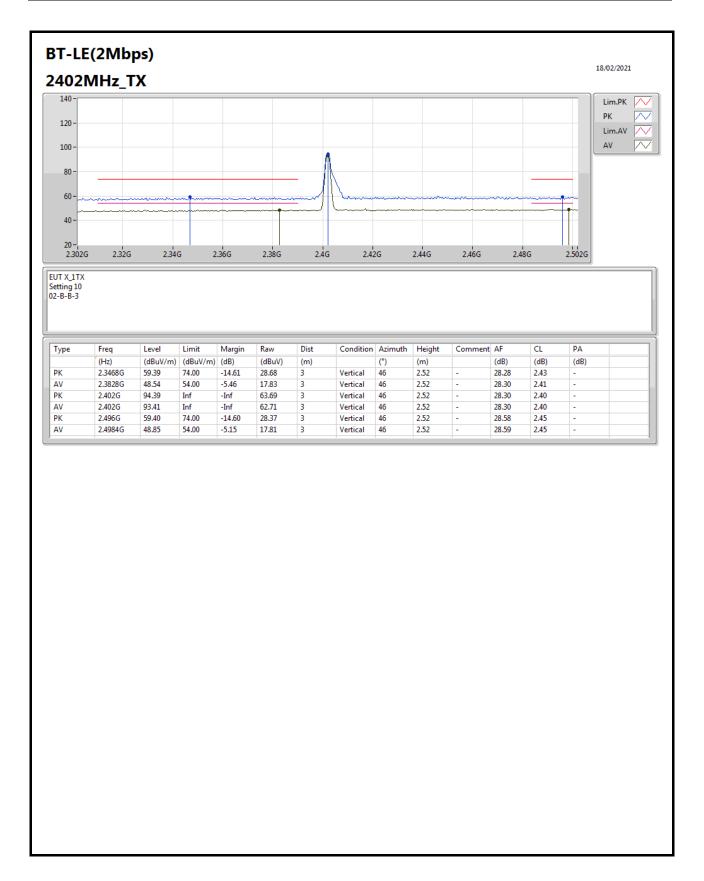




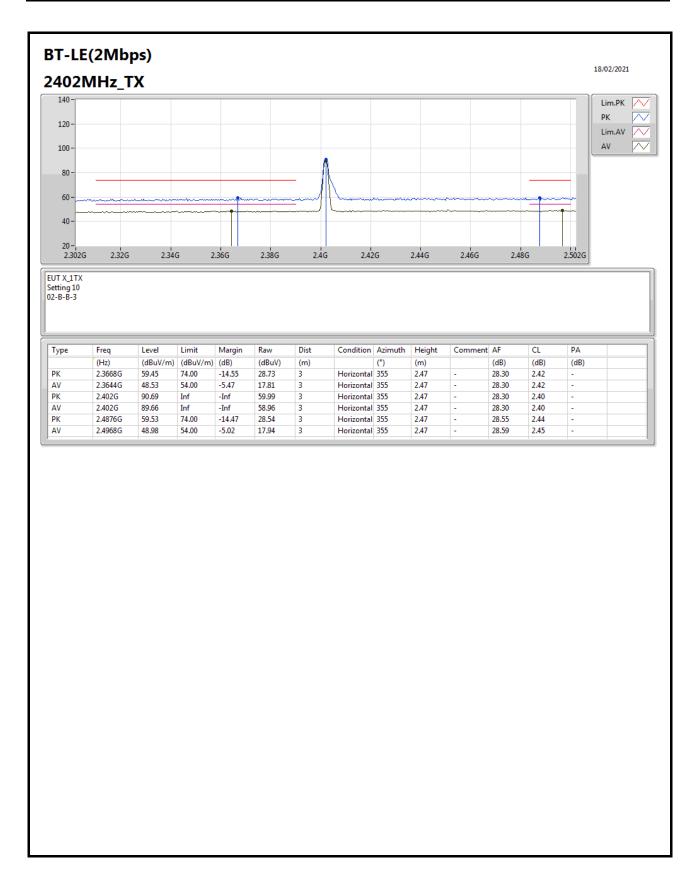




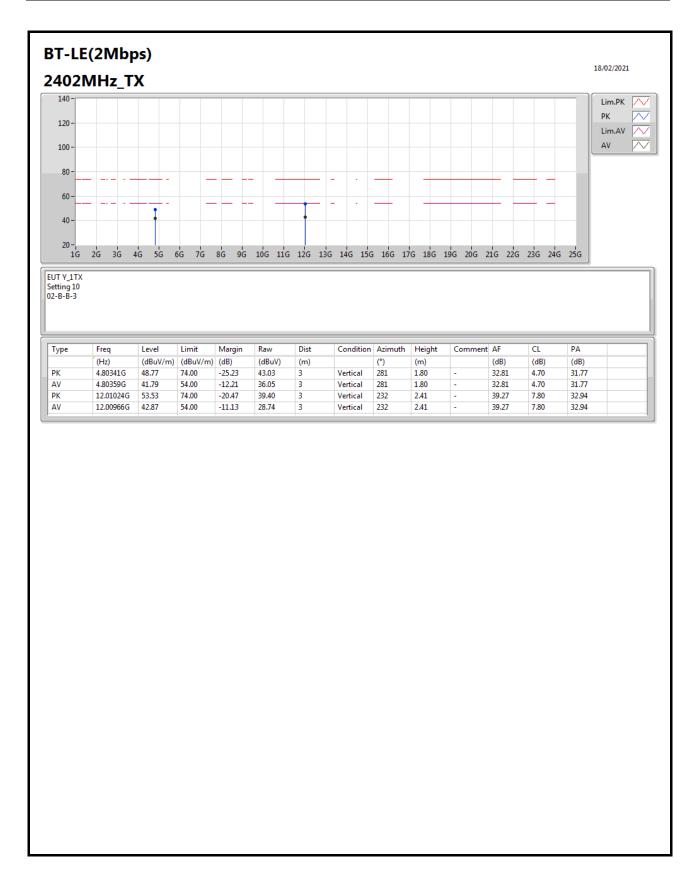




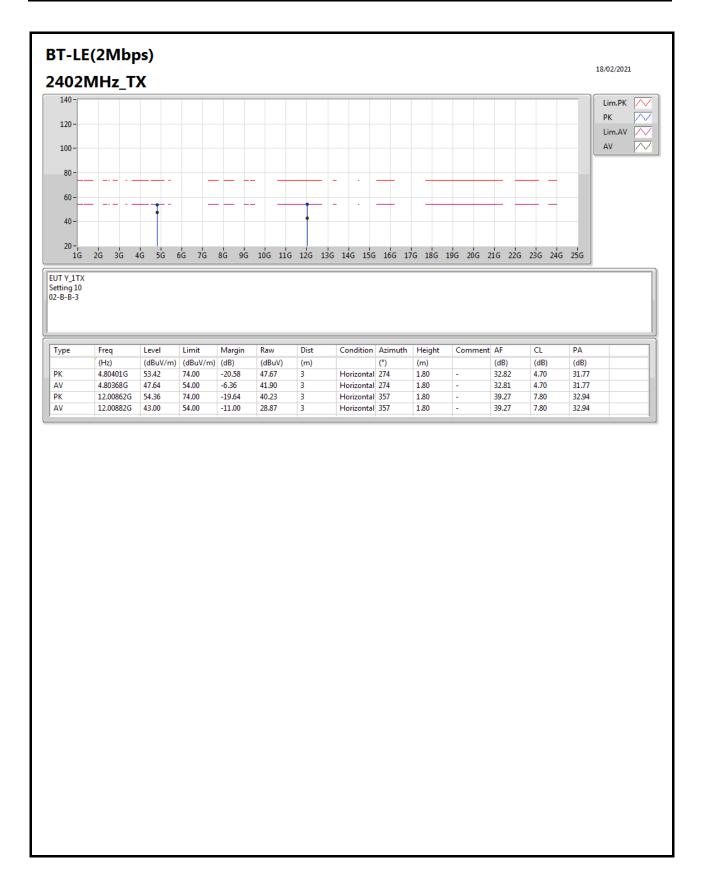












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