



Report No.: FR232209AC



# RADIO TEST REPORT

FCC ID : UDX-600149010

Equipment : Wi-Fi 6 Access Point

Brand Name : Cisco

Model Name : MR78-HW,GR62-HW

Applicant : Cisco Systems, Inc.

170 West Tasman Drive, San Jose, CA 95134 USA

Manufacturer : Cisco Systems, Inc.

170 West Tasman Drive, San Jose, CA 95134 USA

Standard: 47 CFR FCC Part 15.247

The product was received on Mar. 22, 2022, and testing was started from Apr. 02, 2022 and completed on May 05, 2022. 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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Appendix G. Test Photos

Photographs of EUT v01

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# History of this test report

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Report No.	Version	Description	Issued Date
FR232209AC	01	Initial issue of report	Jul. 11, 2022

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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. It's means measurement values may risk exceeding the limit of regulation standards, if measurement uncertainty is include in test results.
- 2. The measurement uncertainty please refer to report "Measurement Uncertainty".

# **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: Penny Kao

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# 1 General Description

# 1.1 Information

# 1.1.1 RF General Information

Frequency Range (MHz)	uency Range (MHz) Bluetooth Mode		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.

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### 1.1.2 Antenna Information

		Port						
Ant.	WLAN 2.4GHz	WLAN 5GHz	Bluetooth	Brand	Model Name	Antenna Type	Connector	Gain (dBi)
1	1	1	-	CISCO	95XEAK15.007	Dipole	I-PEX	
2	2	2	-	CISCO	95XEAK15.006	Dipole	I-PEX	Note1
3	-	-	1	CISCO	95XEAK15.008	Dipole	I-PEX	

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Note1:

### <Antenna Gain>

	Port			Gain (dBi)			
Ant.	WLAN	WLAN D		Blacks 41 WLAN		5GHz	
Ant.	2.4GHz	5GHz	Bluetooth	2.4GHz	UNII 1	UNII 3	Bluetooth
1	1	1	-	3.27	2.14	4.47	_
2	2	2	-	3.25	3.00	3.32	_
3	-	-	1	-	-	-	2.4

### < Directional Gain>

	Directional Gain (dBi)						
Item	WLAN 2.4GHz	WLAN	5GHz				
item	WLAN 2.4GHZ	UNII 1	UNII 3				
2T1S	4.28	3.72	4.95				
2T2S	3.27	3.00	4.47				

Note2: The above information was declared by manufacturer.

Note3: WLAN 2.4GHz and WLAN 5GHz directional gain is measured which follows the procedure of KDB 662911 D03. The antenna report is provided in the operational description for this application.

Note4: The EUT has three antennas.

# <WLAN 2.4GHz function>

# For IEEE 802.11b/g/n/VHT/ax (1TX, 2TX/2RX):

### For 1TX

Only Port 1 can be use as transmitting antenna.

### For 2TX/2RX

Pot 1, Port 2 can be used as transmitting/receiving antenna.

Pot 1, Port 2 could transmit/receive simultaneously.

### <WLAN 5GHz function>

# For IEEE 802.11a/n/ac/ax mode (1TX, 2TX/2RX)

### For 1TX

Only Port 1 can be use as transmitting antenna.

### For 2TX/2RX

Pot 1, Port 2 can be used as transmitting/receiving antenna.

Pot 1, Port 2 could transmit/receive simultaneously.

# <For Bluetooth function>

### Bluetooth mode (1TX/1RX)

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

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# 1.1.3 Mode Test Duty Cycle

Mode	DC	DCF(dB)	T(s)	VBW(Hz) ≥ 1/T
BT-LE(1Mbps)	0.684	1.65	427.5u	3k
BT-LE(2Mbps)	0.39	4.09	243.75u	10k

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# Note:

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

# 1.1.4 EUT Operational Condition

EUT Power Type	Fror	From Power Adapter or PoE				
Test Software Version	Prsion DOS (ver 6.1.7601)					
	$\boxtimes$	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

Model Name	Description
MR78-HW	All the models are identical, the difference model for difference brand
GR62-HW	served as marketing strategy.

Note 1: From the above models, model: MR78-HW was selected as representative model for the test and its data was recorded in this report.

Note 2: The above information was declared by manufacturer.

# 1.1.6 Table for EUT Information

EUT	Item	Source	Brand Name	Model Name
1	LAN Chin	Main	Qualcomm	QCA8081
2	LAN Chip	Second	Qualcomm	QCA8080

Note 1: After evaluating, EUT 1 was selected to perform for all tests and EUT 2 was selected to perform Emissions in Restricted Frequency Bands below 1GHz test only.

Note 2: The above information was declared by manufacturer

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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 15.247
- 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	TH03-CB	Owen Hsu	23.6-23.9 / 58-69	May 04, 2022~ May 05, 2022
Radiated	03CH05-CB	Stim Sung	24.2-26.1 / 55-58	Apr. 02, 2022~ Apr. 12, 2022
Below 1GHz test	03CH06-CB		23.8-24.9 / 55-58	
Radiated Above 1GHz test	03CH06-CB	Stim Sung	23.5-24.6 / 55-59	Arp. 02, 2022~ Apr. 30, 2022
AC Conduction	CO01-CB	Joe Chu	20~22 / 60~62	Apr. 19, 2022

# 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)	4.2 dB	Confidence levels of 95%
Radiated Emission (30MHz ~ 1,000MHz)	5.5 dB	Confidence levels of 95%
Radiated Emission (1GHz ~ 18GHz)	4.7 dB	Confidence levels of 95%
Radiated Emission (18GHz ~ 40GHz)	4.2 dB	Confidence levels of 95%
Conducted Emission	2.5 dB	Confidence levels of 95%
Output Power Measurement	1.3 dB	Confidence levels of 95%
Power Density Measurement	2.5 dB	Confidence levels of 95%
Bandwidth Measurement	0.9%	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	200
2440MHz	200
2478MHz	200
2480MHz	130
BT-LE(2Mbps)	-
2402MHz	200
2440MHz	200
2478MHz	200
2480MHz	110

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# 2.2 The Worst Case Measurement Configuration

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 Normal Link			
1	EUT 1 + Adapter 1		
2	EUT 1 + Adapter 2		
3 EUT 1 + PoE			
For operating mode 1 is the worst case and it was record in this test report.			

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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		
1	EUT 1	

Th	The 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 + Adapter 1				
2	EUT 1 in Y axis + Adapter 1				
3	EUT 1 in X axis + Adapter 1				
Mode 2 has been evaluate follow this same test mode	ed to be the worst case among Mode 1~3, thus measurement for Mode 4~5 will e.				
4	EUT 1 in Y axis + Adapter 2				
5	EUT 1 in Y axis + PoE				
Mode 2 has been evaluated to be the worst case among Mode 1~5, thus measurement for Mode 6 will follow this same test mode.					
6	EUT 2 in Y axis + Adapter 1				
For operating mode 2 is the worst case and it was record in this test report.					

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	CTX
	The EUT was performed at X axis, Y axis and Z axis position, and the worst case as below:
1	EUT 1 in Y axis

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The Worst Case Mode for Following Conformance Tests			
Tests Item Simultaneous Transmission Analysis - Co-location RF Exposure Evaluation			
Operating Mode			
1 WLAN 2.4GHz + WLAN 5GHz + Bluetooth			
Refer to Sporton Test Report No.: FA232209 for Co-location RF Exposure Evaluation.			

Note: The PoE is for measurement only, would not be marketed.

The PoE information as below:

Support Unit	Brand	Model Name
PoE	PHIHONG	POEA33U-1ATE

# 2.3 EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

# 2.4 Accessories

	Accessories					
No.	Equipment Name	Brand Name	Model Name	Rating		
1	Adapter 1	Meraki	GA-PWR-12W-US	INPUT: 100-240V~ 50/60Hz, 0.4A MAX. OUTPUT: +12.0V, 1.0A, 12.0W MAX.		
2	2 Adapter 2 UMEC MA-PWR-30WAC INPUT: 100-240V~0.8A, 50-60Hz OUTPUT: 12.0V, 2.5A, 30.0W					
	Others					

Wall Bracket\*1

RJ-45 cable\*1: Non-shielded, 1.8m Grounding wire\*1: Non-shielded, 1m

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# 2.5 Support Equipment

# For AC Conduction:

Support Equipment						
No.	No. Equipment Brand Name Model Name FCC ID					
Α	LAN PC	DELL	T3400	N/A		
В	5G NB	DELL	E6430	N/A		
С	2.4G NB	DELL	E6430	N/A		

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For Radiated (below 1GHz):

Compart Facilities						
Support Equipment						
No.	o. Equipment Brand Name Model Name FCC ID					
Α	LAN Notebook	DELL	E4300	N/A		
В	B WiFi 2.4G Notebook DELL E4300 N/A					
С	WiFi 5G Notebook	DELL	E4300	N/A		

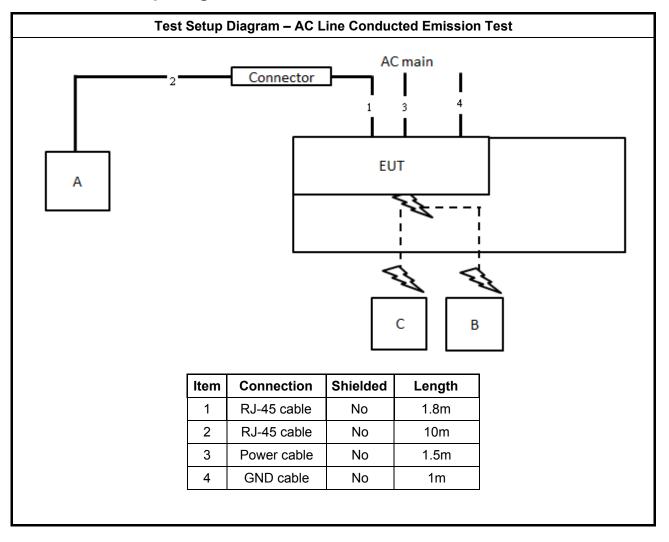
For Radiated (above 1GHz) and RF Conducted:

	Support Equipment						
No.	Equipment	Brand Name Model Name		FCC ID			
Α	Notebook	DELL	E4300	N/A			

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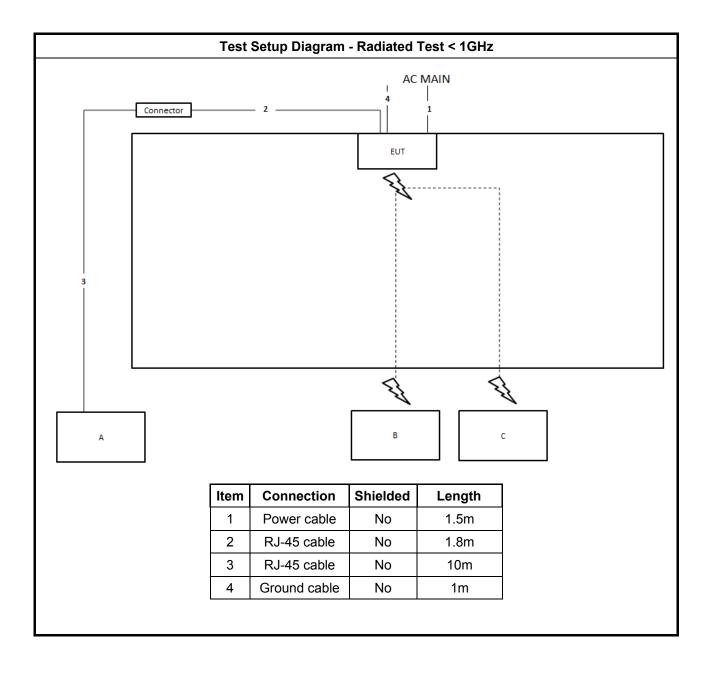
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# 2.6 Test Setup Diagram



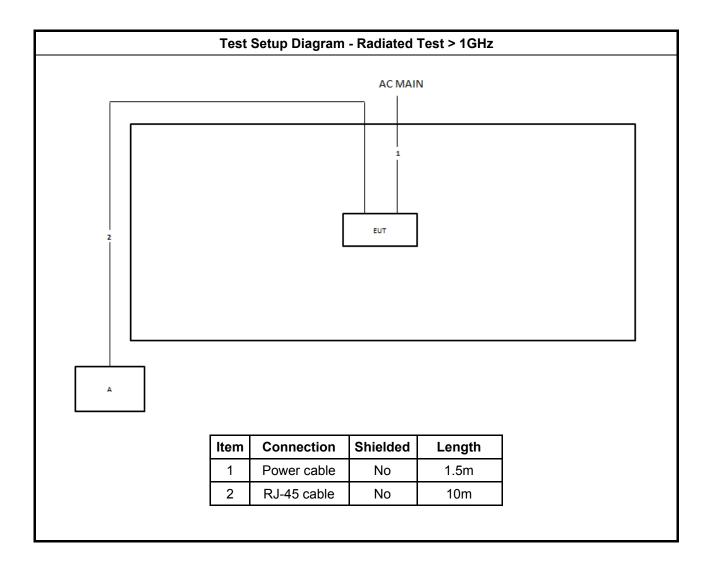
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# 3 Transmitter Test Result

# 3.1 AC Power-line Conducted Emissions

# 3.1.1 AC Power-line Conducted Emissions Limit

AC Power-line Conducted Emissions Limit					
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 the frequency.					

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# 3.1.2 Measuring Instruments

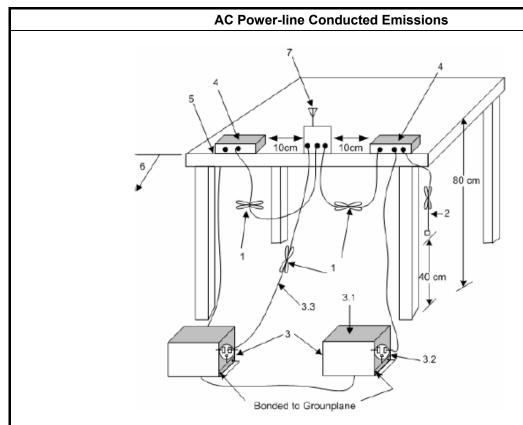
Refer a test equipment and calibration data table in this test report.

# 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  $\Omega$  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.
- 6—Edge of tabletop shall be 40 cm removed from a vertical conducting plane that is bonded to the ground
- —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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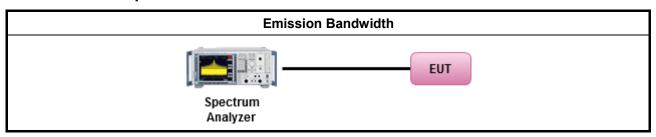
# 3.2.2 Measuring Instruments

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<sub>TX</sub> ≤ 6 dBi, then P<sub>Out</sub> ≤ 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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 $\mathbf{P}_{\text{Out}}$  = maximum peak conducted output power or maximum conducted output power in dBm,  $\mathbf{G}_{\text{TX}}$  = 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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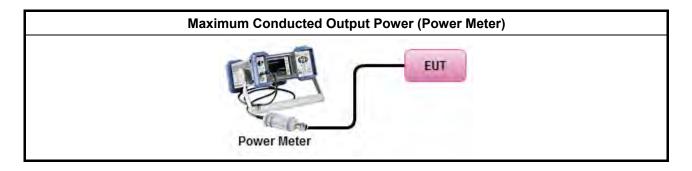
# 3.3.3 Test Procedures

	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)					
	Measurement 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).						
		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 <sub>total</sub> = $P_{total} + DG$					

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# 3.3.4 Test Setup



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# 3.3.5 Test Result of Maximum Conducted Output Power

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

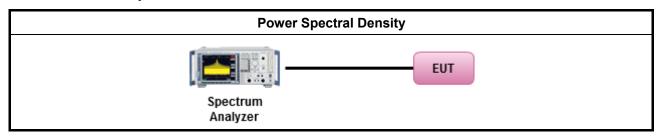
Refer a test equipment and calibration data table in this test report.

# 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).					
	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 conducted measurement.					
	If 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.

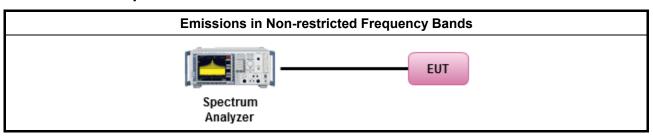
# 3.5.2 Measuring Instruments

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

# 3.5.3 Test Procedures

Test Method	
<ul> <li>Refer as FCC KDB 558074, clause 8.5 for unwanted emissions into non-restricted bands.</li> </ul>	

# 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

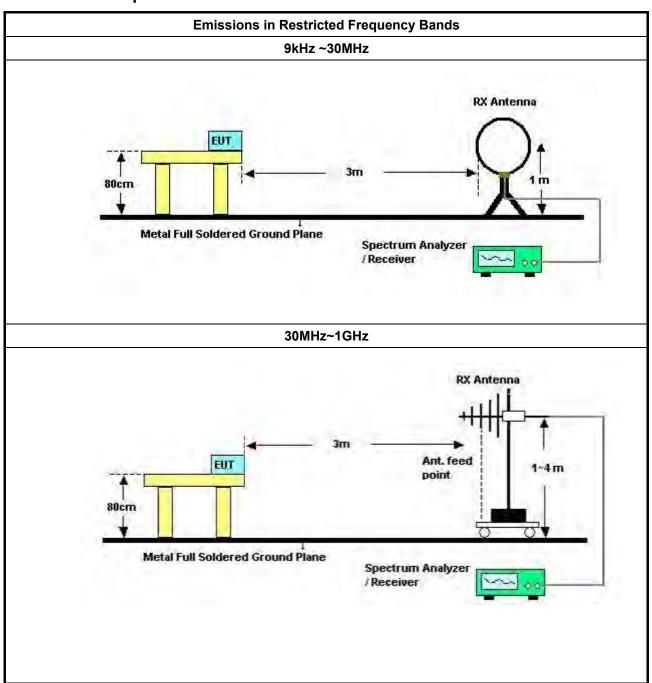
	Test Method					
•	The	average emission levels shall be measured in [duty cycle ≥ 98 or duty factor].				
•		er as ANSI C63.10, clause 6.10.3 band-edge testing shall be performed at the lowest frequency and highest frequency channel within the allowed operating band.				
	For	the transmitter unwanted 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 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.				
<ul> <li>Refer as FCC KDB 558074, clause 8.7 (ANSI C63.10, clause 6.10.6) for marker-delta metro band-edge measurements.</li> </ul>						
	•	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. 22, 2022	Feb. 21, 2023	Conduction (CO01-CB)
LISN	F.C.C.	FCC-LISN-50- 16-2	04083	150kHz ~ 100MHz	Feb. 09, 2022	Feb. 08, 2023	Conduction (CO01-CB)
LISN	Schwarzbeck	NSLK 8127	8127647	9kHz ~ 30MHz	Apr. 12, 2022	Apr. 11, 2023	Conduction (CO01-CB)
Pulse Limiter	Rohde&Schwa rz	ESH3-Z2	100430	9kHz ~ 30MHz	Feb. 10, 2022	Feb. 09, 2023	Conduction (CO01-CB)
COND Cable	Woken	Cable	Low cable-CO01	9kHz ~ 30MHz	May 19, 2021	May 18, 2022	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. 14, 2021	Apr. 13, 2022	Radiation (03CH05-CB)
3m Semi Anechoic Chamber NSA	TDK	SAC-3M	03CH05-CB	30 MHz ~ 1 GHz	Aug. 09, 2021	Aug. 08, 2022	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. 27, 2021	Apr. 26, 2022	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. 21, 2021	Jun. 20, 2022	Radiation (03CH05-CB)
RF Cable-low	Woken	RG402	Low Cable-04+23	30MHz~1GHz	Oct. 13, 2021	Oct. 12, 2022	Radiation (03CH05-CB)
Test Software	SPORTON	SENSE	V5.10	-	N.C.R.	N.C.R.	Radiation (03CH05-CB)
Loop Antenna	Teseq	HLA 6120	24155	9kHz - 30 MHz	Apr. 14, 2021	Apr. 13, 2022	Radiation (03CH06-CB)
3m Semi Anechoic Chamber NSA	TDK	SAC-3M	03CH06-CB	30 MHz ~ 1 GHz	Aug. 09, 2021	Aug. 08. 2022	Radiation (03CH06-CB)
3m Semi Anechoic Chamber VSWR	TDK	SAC-3M	03CH06-CB	1GHz ~18GHz 3m	Oct. 01, 2021	Sep. 30, 2022	Radiation (03CH06-CB)
Bilog Antenna with 6 dB attenuator	TESEQ & EMCI	CBL6112D & N-6-06	37878 & AT-N0606	20MHz ~ 2GHz	Jul. 31, 2021	Jul. 30, 2022	Radiation (03CH06-CB)
Horn Antenna	SCHWARZBE CK	BBHA9120D	BBHA 9120D-1292	1GHz~18GHz	Aug. 04, 2021	Aug. 03, 2022	Radiation (03CH06-CB)
Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170252	15GHz ~ 40GHz	Aug. 05, 2021	Aug. 04, 2022	Radiation (03CH06-CB)

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Instrument	Brand	Brand Model No. Serial No. Characteristics Calibration Calibration			Remark		
Instrument	Brand	Model No.	Seriai No.	Characteristics	Date	Due Date	
Pre-Amplifier	Agilent	310N	187290	0.1MHz ~ 1GHz	Nov. 04, 2021	Nov. 03, 2022	Radiation (03CH06-CB)
Pre-Amplifier	Agilent	83017A	MY53270064	0.5GHz ~ 26.5GHz	May 06, 2021	May 05, 2022	Radiation (03CH06-CB)
Pre-Amplifier	MITEQ	TTA1840-35-H G	1864479	18GHz ~ 40GHz	Jul. 13, 2021	Jul. 12, 2022	Radiation (03CH06-CB)
Spectrum analyzer	R&S	FSP40	100080	9kHz~40GHz	Dec. 24, 2021	Dec. 23, 2022	Radiation (03CH06-CB)
EMI Test Receiver	R&S	ESCS	826547/017	9kHz ~ 2.75GHz	Jun. 21, 2021	Jun. 20, 2022	Radiation (03CH06-CB)
RF Cable-low	Woken	RG402	Low Cable-05+24	30MHz~1GHz	Oct. 04, 2021	Oct. 03, 2022	Radiation (03CH06-CB)
RF Cable-high	Woken	RG402	High Cable-67	1GHz~18GHz	Feb. 24, 2022	Feb. 23, 2023	Radiation (03CH06-CB)
RF Cable-high	Woken	RG402	High Cable-05+67	1GHz~18GHz	Feb. 24, 2022	Feb. 23, 2023	Radiation (03CH06-CB)
High Cable	Woken	WCA0929M	40G#5+7	1GHz ~ 40 GHz	Dec. 14, 2021	Dec. 13, 2022	Radiation (03CH06-CB)
High Cable	Woken	WCA0929M	40G#5	1GHz ~ 40 GHz	Dec. 08, 2021	Dec. 07, 2022	Radiation (03CH06-CB)
High Cable	Woken	WCA0929M	40G#7	1GHz ~ 40 GHz	Dec. 14, 2021	Dec. 13, 2022	Radiation (03CH06-CB)
Test Software	SPORTON	SENSE	V5.10	-	N.C.R.	N.C.R.	Radiation (03CH06-CB)
Spectrum analyzer	R&S	FSV40	101028	9kHz~40GHz	Jan. 07, 2022	Jan. 06, 2023	Conducted (TH03-CB)
Power Sensor	Anritsu	MA2411B	1726195	300MHz~40GHz	Aug. 22, 2021	Aug. 21, 2022	Conducted (TH03-CB)
Power Meter	Anritsu	ML2495A	1035008	300MHz~40GHz	Aug. 22, 2021	Aug. 21, 2022	Conducted (TH03-CB)
RF Cable-high	Woken	RG402	High Cable-11	1 GHz –18 GHz	Oct. 04, 2021	Oct. 03, 2022	Conducted (TH03-CB)
RF Cable-high	Woken	RG402	High Cable-12	1 GHz –18 GHz	Oct. 04, 2021	Oct. 03, 2022	Conducted (TH03-CB)
RF Cable-high	Woken	RG402	High Cable-13	1 GHz –18 GHz	Oct. 04, 2021	Oct. 03, 2022	Conducted (TH03-CB)
RF Cable-high	Woken	RG402	High Cable-14	1 GHz –18 GHz	Oct. 04, 2021	Oct. 03, 2022	Conducted (TH03-CB)
RF Cable-high	Woken	RG402	High Cable-15	1 GHz –18 GHz	Oct. 04, 2021	Oct. 03, 2022	Conducted (TH03-CB)
Switch	SPTCB	SP-SWI	SWI-03	1 GHz –26.5 GHz	Dec. 13, 2021	Dec. 12, 2022	Conducted (TH03-CB)
RF Cable-high	Woken	RG402	SWI-03-P1	1 GHz –26.5 GHz	Dec. 13, 2021	Dec. 12, 2022	Conducted (TH03-CB)
RF Cable-high	Woken	RG402	SWI-03-P2	1 GHz –26.5 GHz	Dec. 13, 2021	Dec. 12, 2022	Conducted (TH03-CB)
RF Cable-high	Woken	RG402	SWI-03-P3	1 GHz –26.5 GHz	Dec. 13, 2021	Dec. 12, 2022	Conducted (TH03-CB)

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Instrument	Brand	Model No.	Serial No.	Characteristics	Calibration Date	Calibration Due Date	Remark
RF Cable-high	Woken	RG402	SWI-03-P4	1 GHz –26.5 GHz	Dec. 13, 2021	Dec. 12, 2022	Conducted (TH03-CB)
RF Cable-high	Woken	RG402	SWI-03-P5	1 GHz –26.5 GHz	Dec. 13, 2021	Dec. 12, 2022	Conducted (TH03-CB)
Test Software	SPORTON	SENSE	V5.10	-	N.C.R.	N.C.R.	Conducted (TH03-CB)

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

NCR means Non-Calibration required.

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# **Conducted Emissions at Powerline**

Appendix A

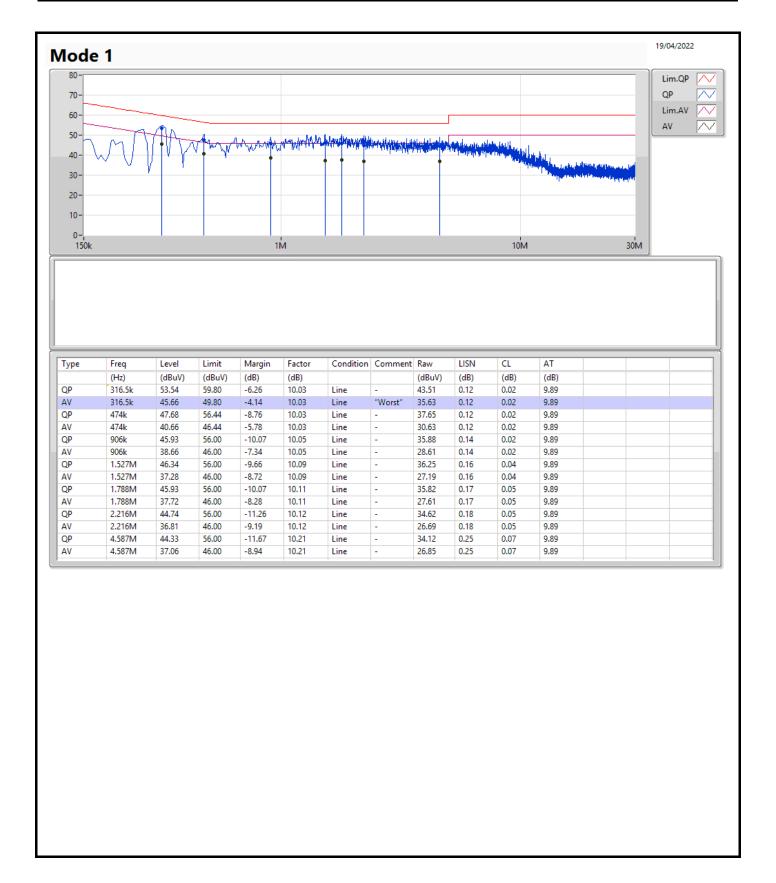
Summary

Mode	Result	Туре	Freq (Hz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Condition
Mode 1	Pass	AV	316.5k	45.66	49.80	-4.14	Line

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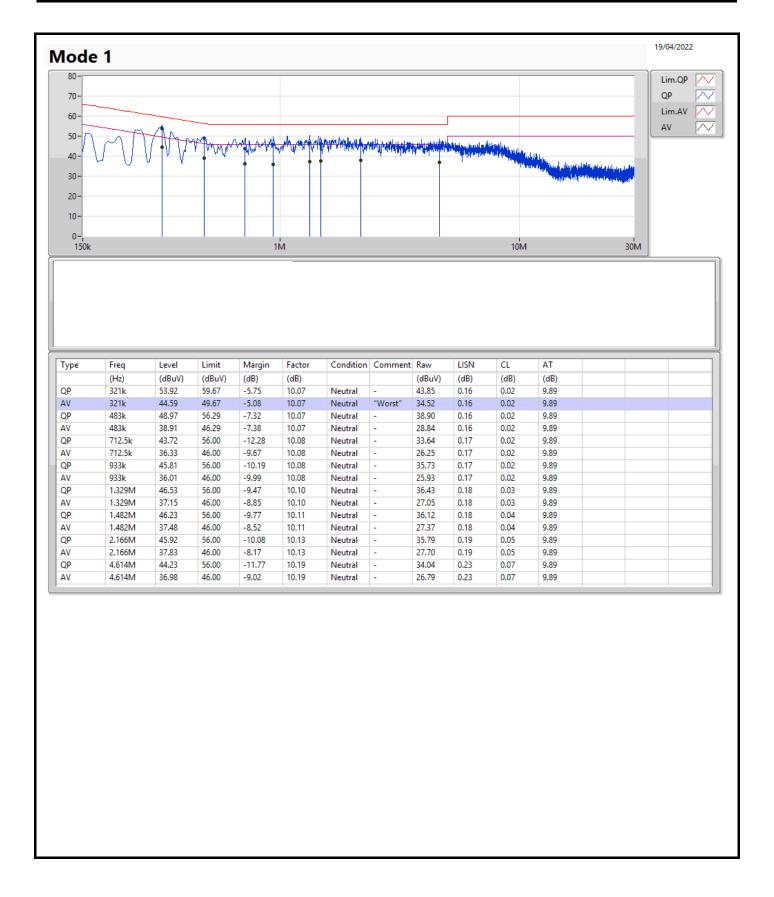
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EBW-DTS Appendix B

# Summary

Mode	Max-N dB	Max-OBW	ITU-Code	Min-N dB	Min-OBW
	(Hz)	(Hz)		(Hz)	(Hz)
2.4-2.4835GHz	-	-	-	-	-
BT-LE(1Mbps)	635k	1.029M	1M03F1D	632.5k	1.022M
BT-LE(2Mbps)	1.09M	2.059M	2M06F1D	1.085M	2.046M

 $Max\text{-N }dB = Maximum \ 6dB \ down \ bandwidth; \ Max\text{-OBW} = Maximum \ 99\% \ occupied \ bandwidth; \ Min\text{-OBW} = Minimum \ 99\% \ occu$ 

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EBW-DTS Appendix B

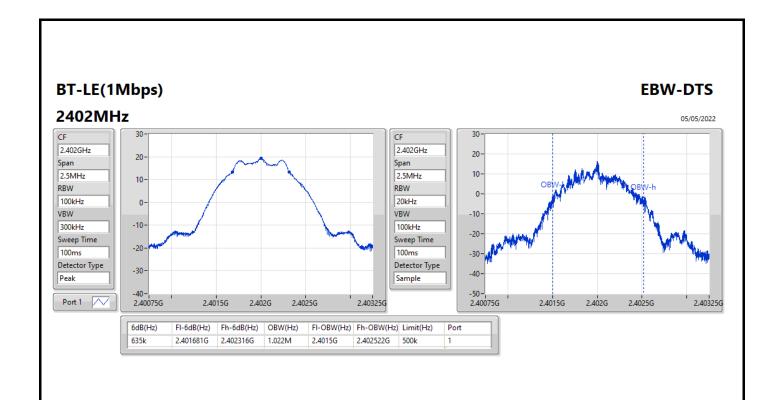
# Result

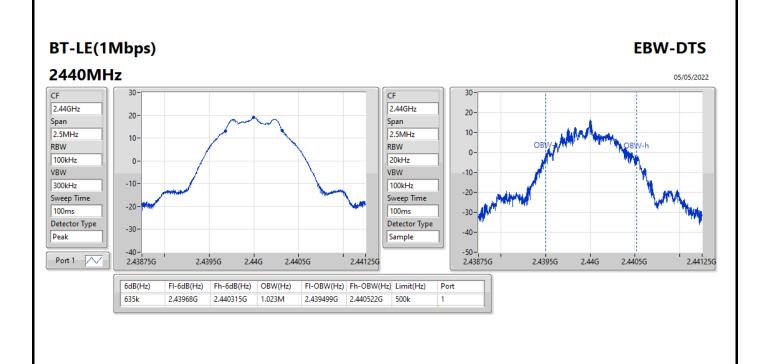
Mode	Result	Limit	Port 1-N dB	Port 1-OBW
		(Hz)	(Hz)	(Hz)
BT-LE(1Mbps)	-	-	-	-
2402MHz	Pass	500k	635k	1.022M
2440MHz	Pass	500k	635k	1.023M
2478MHz	Pass	500k	632.5k	1.029M
2480MHz	Pass	500k	633.75k	1.024M
BT-LE(2Mbps)	•	•	-	-
2402MHz	Pass	500k	1.09M	2.054M
2440MHz	Pass	500k	1.088M	2.049M
2478MHz	Pass	500k	1.085M	2.046M
2480MHz	Pass	500k	1.085M	2.059M

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

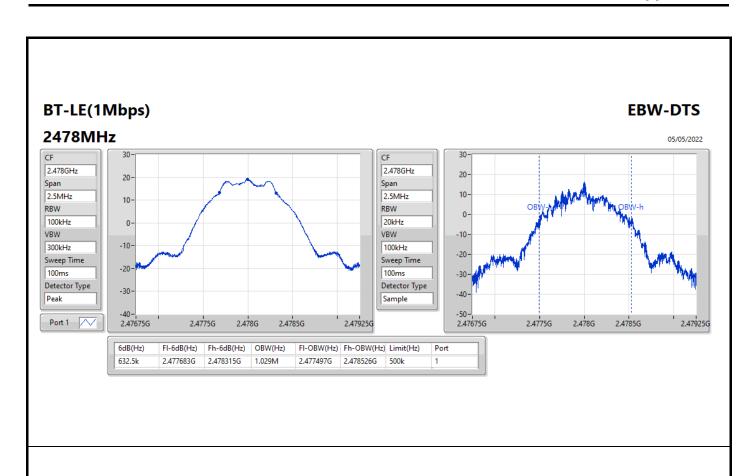
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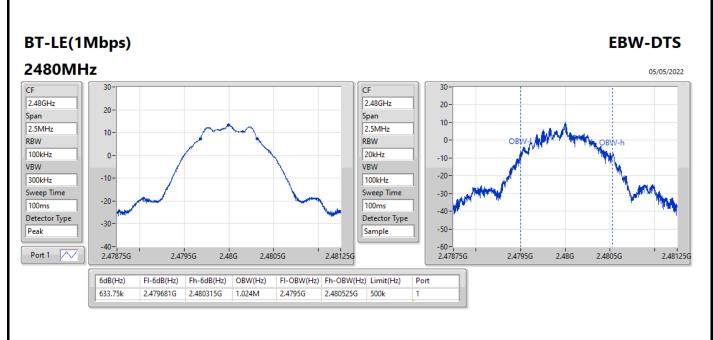
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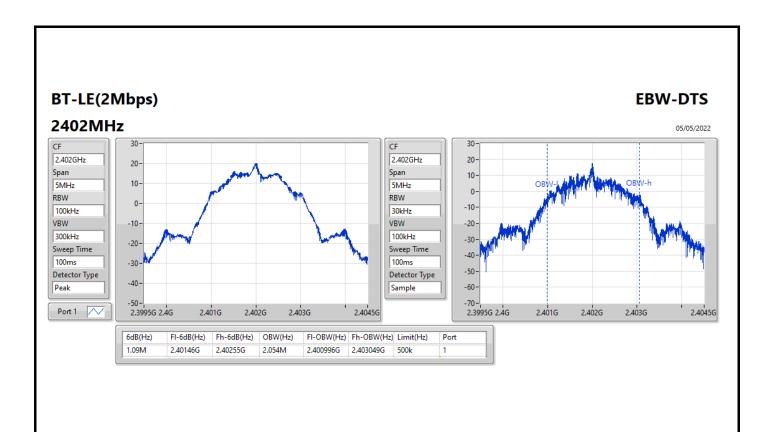


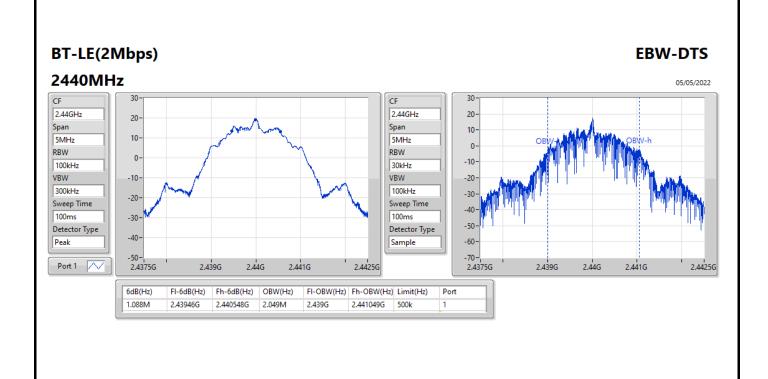
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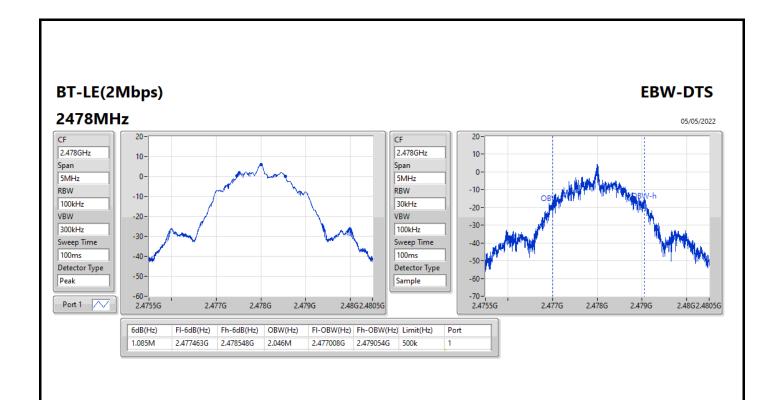
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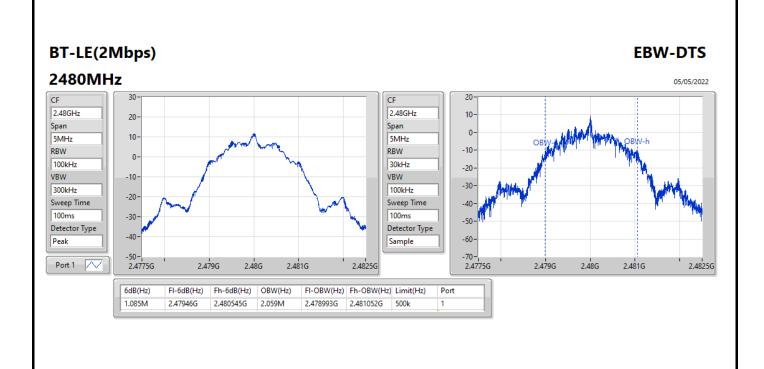




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## Average Power-DTS

Appendix C

Summary

Mode	Power	Power
	(dBm)	(W)
2.4-2.4835GHz	-	-
BT-LE(1Mbps)	18.53	0.07129
BT-LE(2Mbps)	18.44	0.06982

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Appendix C



#### Result

Mode	Result	Gain	Power	Power Limit
		(dBi)	(dBm)	(dBm)
BT-LE(1Mbps)	-	-	-	-
2402MHz	Pass	2.40	18.46	30.00
2440MHz	Pass	2.40	18.53	30.00
2478MHz	Pass	2.40	18.47	30.00
2480MHz	Pass	2.40	12.36	30.00
BT-LE(2Mbps)	-	•	-	-
2402MHz	Pass	2.40	18.44	30.00
2440MHz	Pass	2.40	18.43	30.00
2478MHz	Pass	2.40	5.24	30.00
2480MHz	Pass	2.40	10.14	30.00

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

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PSD-DTS Appendix D

Summary

Mode	PD (dBm/RBW)
2.4-2.4835GHz	
BT-LE(1Mbps)	4.07
BT-LE(2Mbps)	3.86

RBW = 3kHz;

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Appendix D **PSD-DTS** 

#### Result

Mode	Result	Gain	PD	PD Limit
		(dBi)	(dBm/RBW)	(dBm/RBW)
BT-LE(1Mbps)	-	-	-	-
2402MHz	Pass	2.40	4.07	8.00
2440MHz	Pass	2.40	4.02	8.00
2478MHz	Pass	2.40	4.06	8.00
2480MHz	Pass	2.40	-1.85	8.00
BT-LE(2Mbps)	-	•	-	-
2402MHz	Pass	2.40	3.86	8.00
2440MHz	Pass	2.40	3.79	8.00
2478MHz	Pass	2.40	-9.32	8.00
2480MHz	Pass	2.40	-4.60	8.00

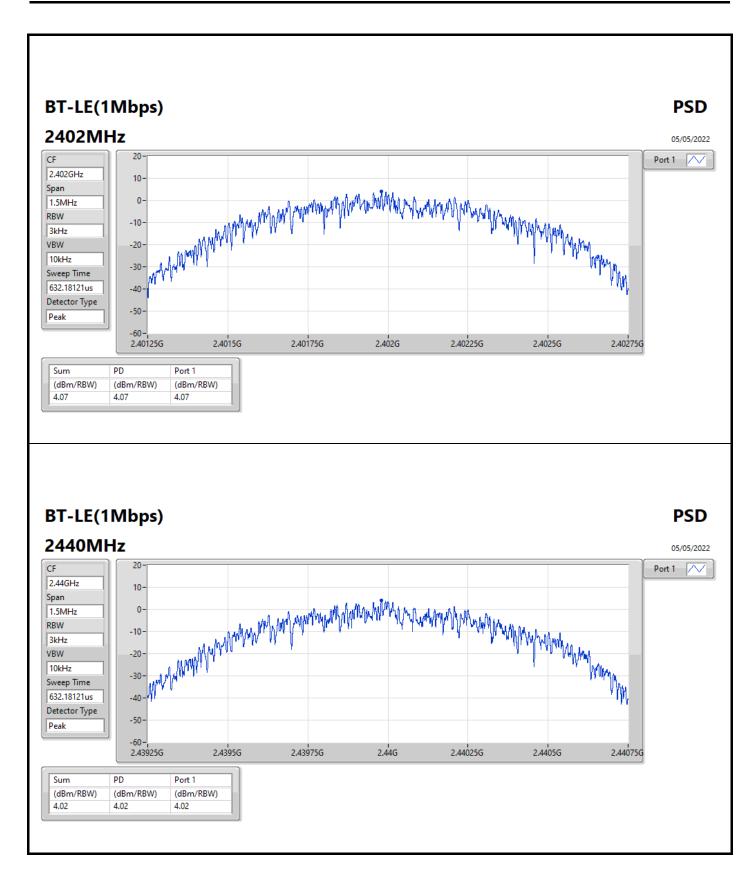
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DG = Directional Gain; RBW = 3kHz; PD = trace bin-by-bin of each transmits port summing can be performed maximum power density; Port X = Port X Power Density;

Appendix D

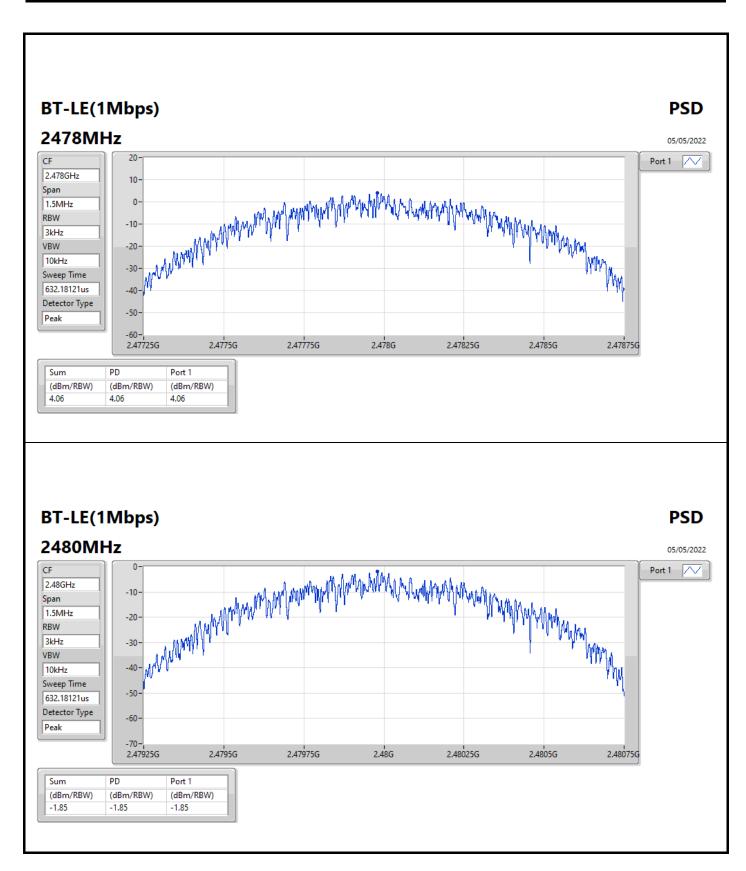




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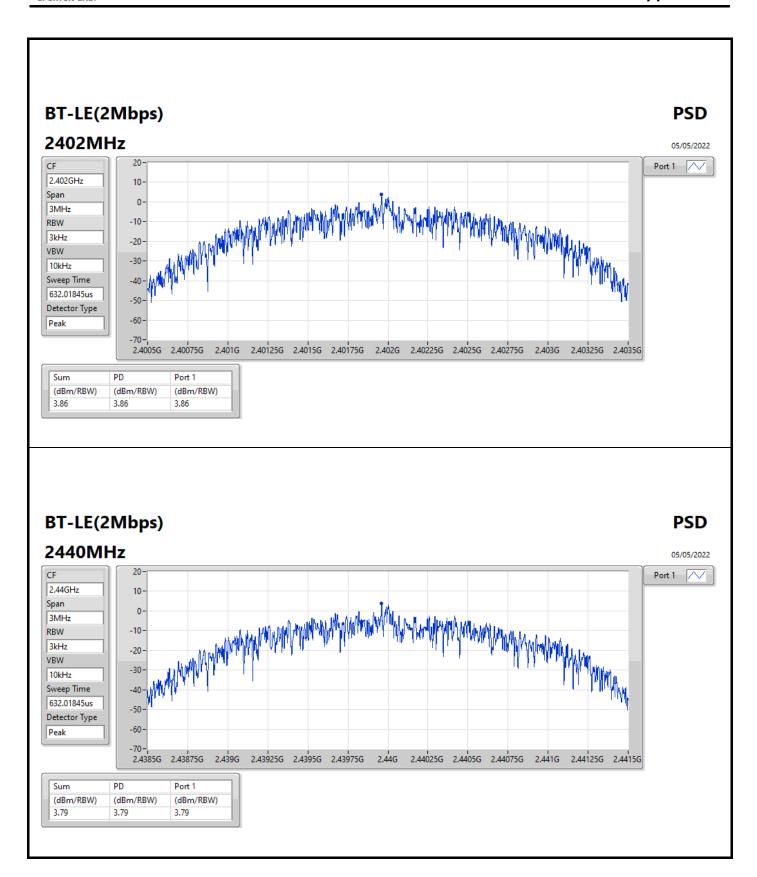
Appendix D





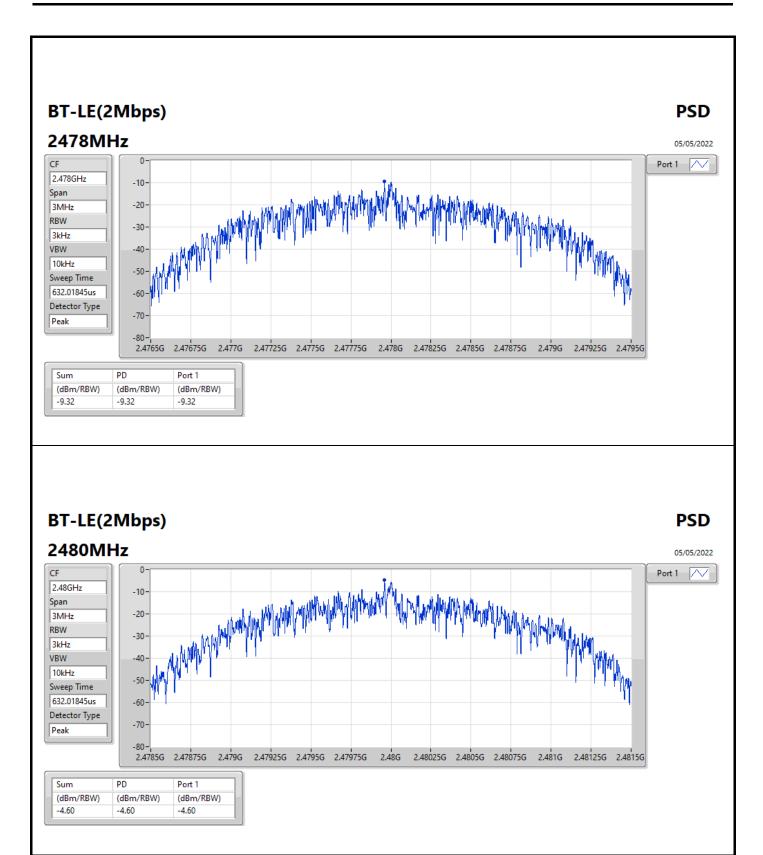
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PSD-DTS Appendix D



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PSD-DTS Appendix D



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## CSE (Non-restricted Band)-DTS

Appendix E

Summary

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	2.44G	19.07	-10.93	2.12767G	-51.99	2.39986G	-31.97	2.4G	-34.19	2.48998G	-51.33	17.66895G	-46.71	1
BT-LE(2Mbps)	Pass	2.44004G	18.84	-11.16	828.71M	-51.88	2.39999G	-13.06	2.4G	-13.44	2.49795G	-50.86	5.90891G	-46.89	1

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## CSE (Non-restricted Band)-DTS

# Appendix E

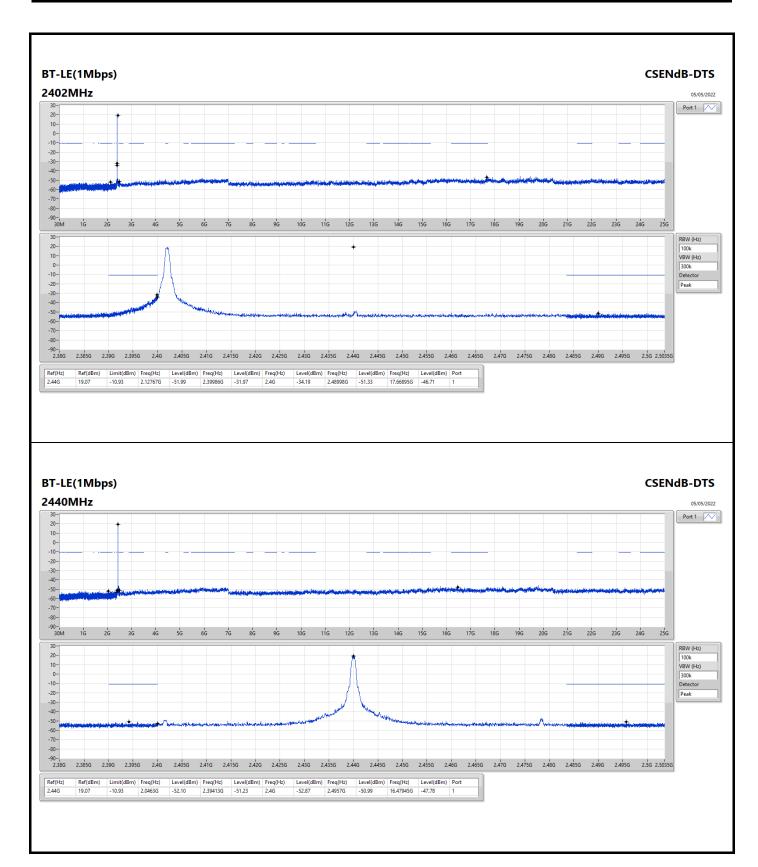
#### Result

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	2.44G	19.07	-10.93	2.12767G	-51.99	2.39986G	-31.97	2.4G	-34.19	2.48998G	-51.33	17.66895G	-46.71	1
2440MHz	Pass	2.44G	19.07	-10.93	2.0463G	-52.10	2.39413G	-51.23	2.4G	-52.87	2.4957G	-50.99	16.47945G	-47.78	1
2478MHz	Pass	2.44G	19.07	-10.93	640.41M	-51.26	2.39461G	-51.69	2.4835G	-44.51	2.484G	-42.15	16.34728G	-47.63	1
2480MHz	Pass	2.44G	19.07	-10.93	1.81718G	-52.51	2.39035G	-51.75	2.4835G	-46.65	2.48373G	-44.98	5.82173G	-46.94	1
BT-LE(2Mbps)	-	-	-		-		-			-	-			-	-
2402MHz	Pass	2.44004G	18.84	-11.16	828.71M	-51.88	2.39999G	-13.06	2.4G	-13.44	2.49795G	-50.86	5.90891G	-46.89	1
2440MHz	Pass	2.44004G	18.84	-11.16	902.14M	-51.91	2.39205G	-50.94	2.4G	-54.16	2.49108G	-51.28	6.42633G	-46.76	1
2478MHz	Pass	2.44004G	18.84	-11.16	929.46M	-52.51	2.39761G	-51.98	2.4835G	-53.09	2.48849G	-50.76	17.68864G	-47.49	1
2480MHz	Pass	2.44004G	18.84	-11.16	820.48M	-51.74	2.39848G	-50.93	2.4835G	-44.77	2.48354G	-43.58	16.27698G	-47.09	1

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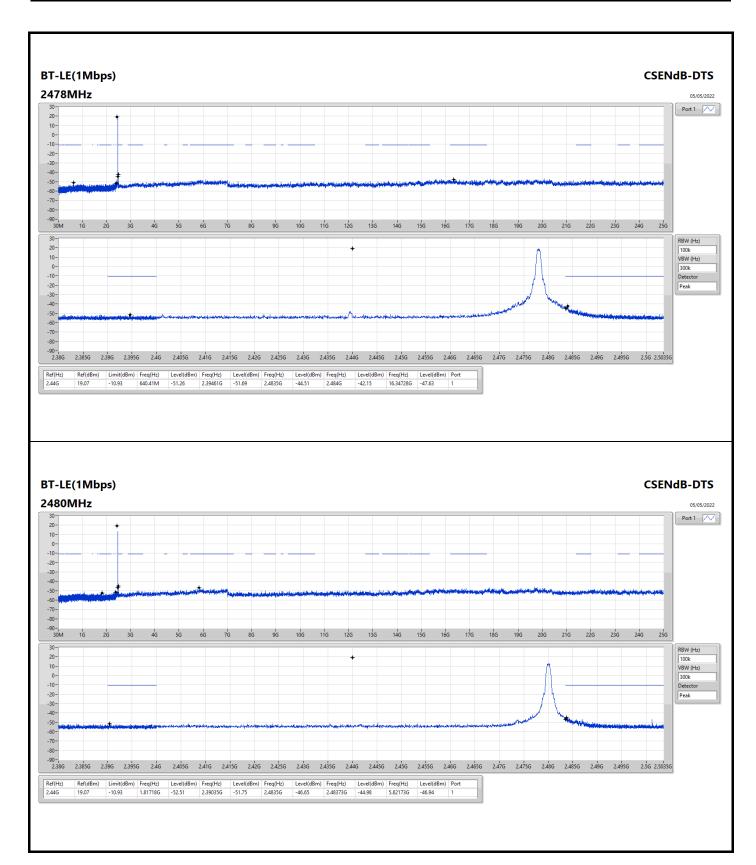
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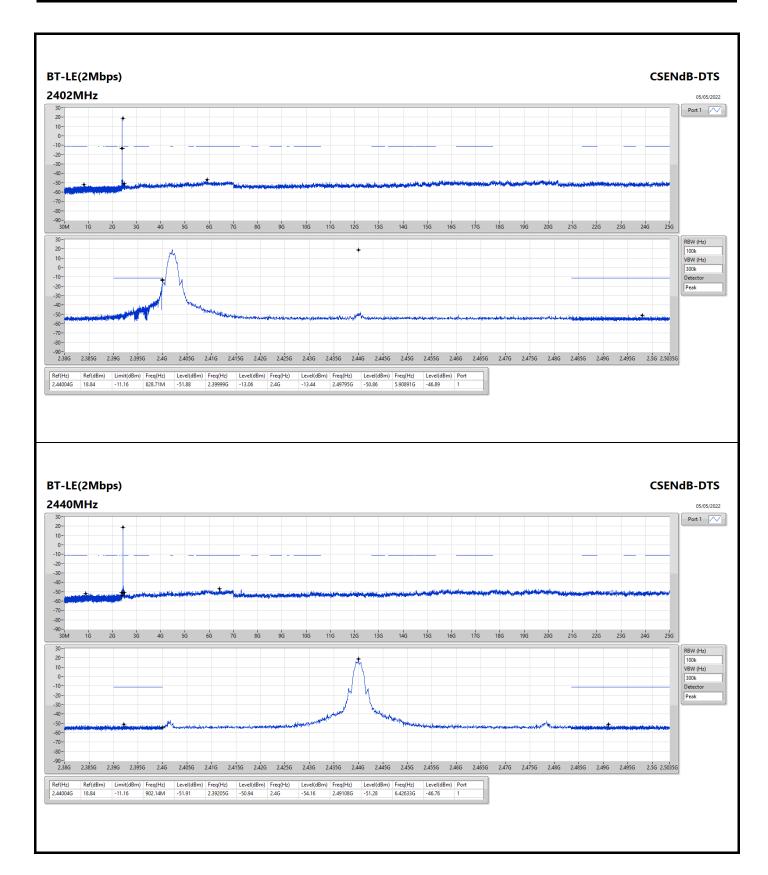
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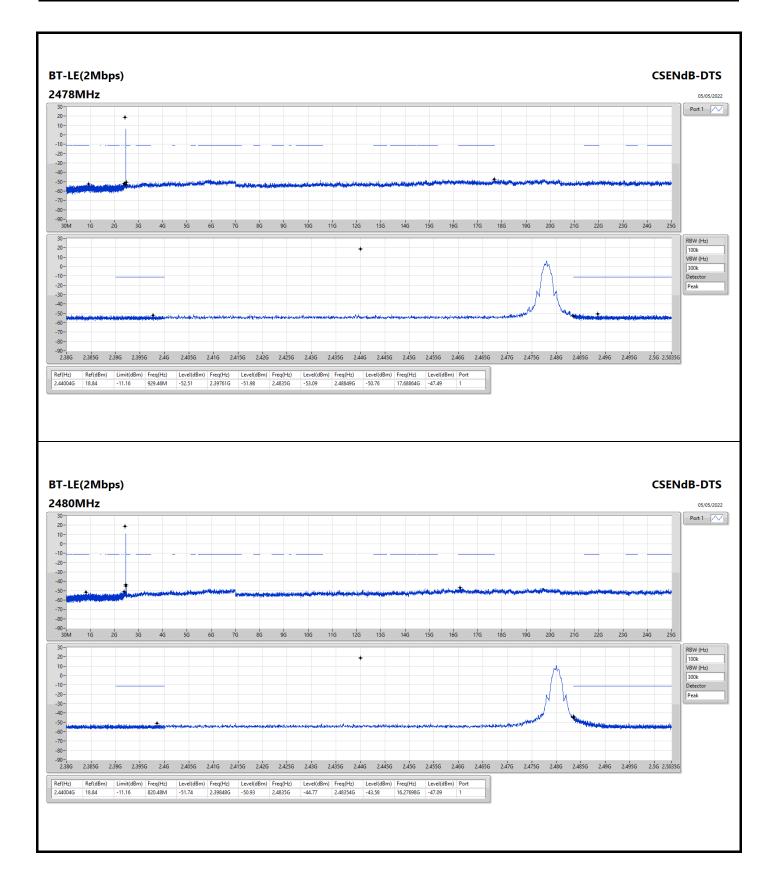




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### Radiated Emissions below 1GHz

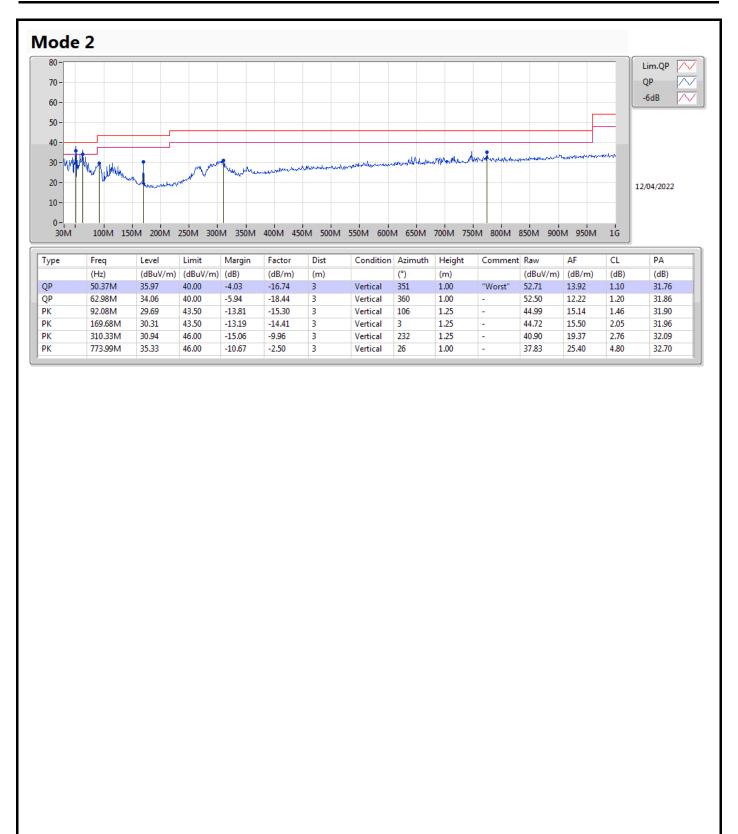
Appendix F.1

Summary

Mode	Result	Туре	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Condition
Mode 2	Pass	QP	50.37M	35.97	40.00	-4.03	Vertical

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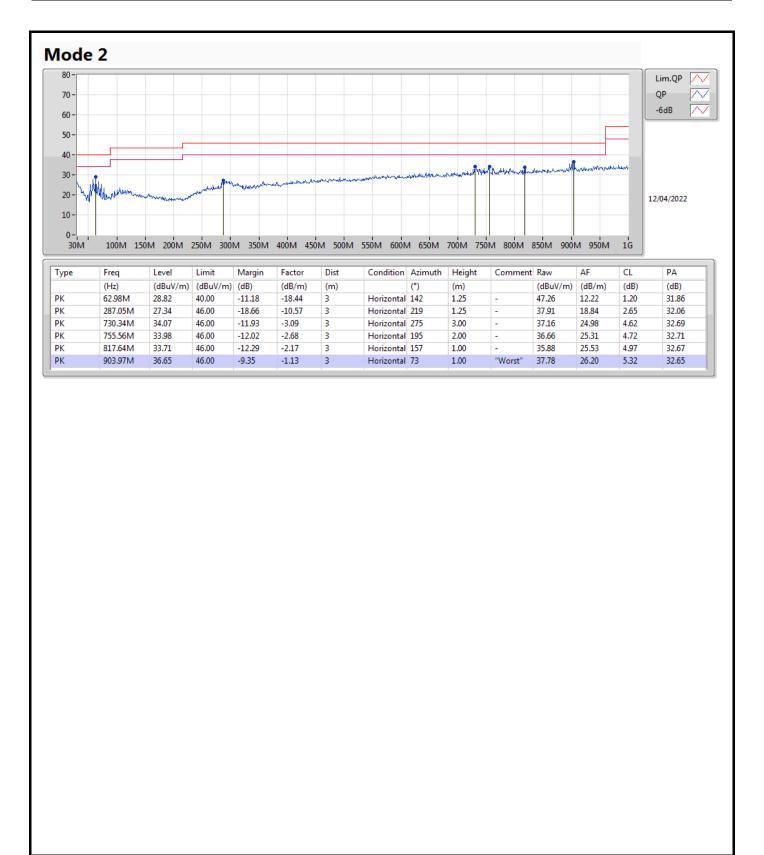
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### RSE TX above 1GHz

Appendix F.2

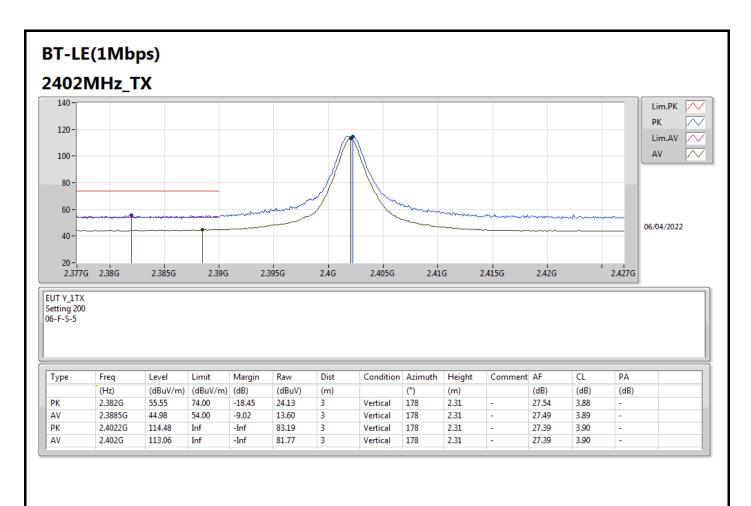
Summary

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	2.4835G	53.86	54.00	-0.14	3	Vertical	162	1.09	-

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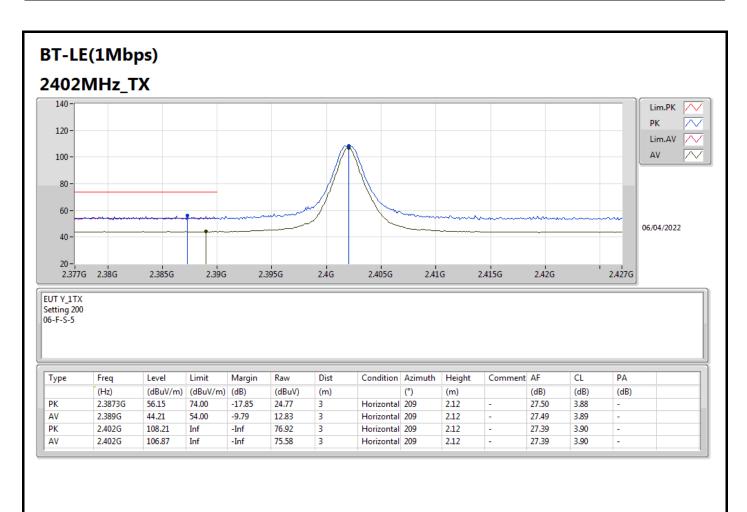




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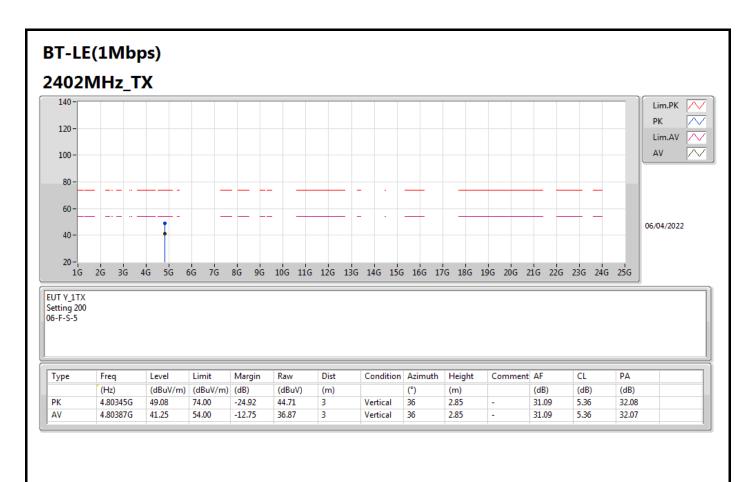




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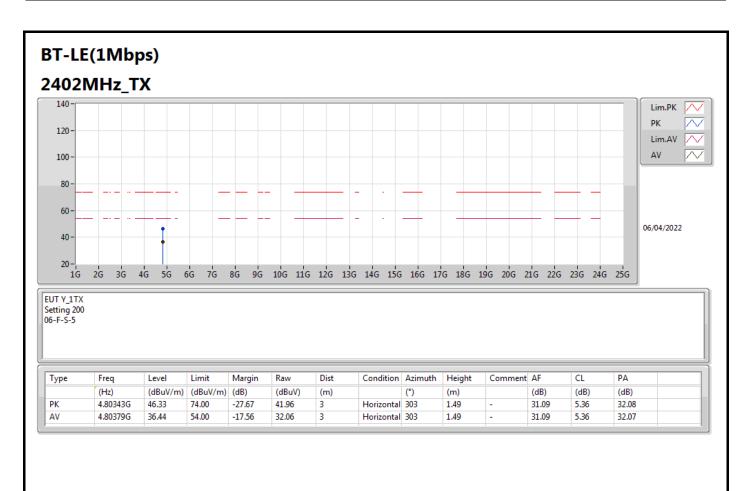




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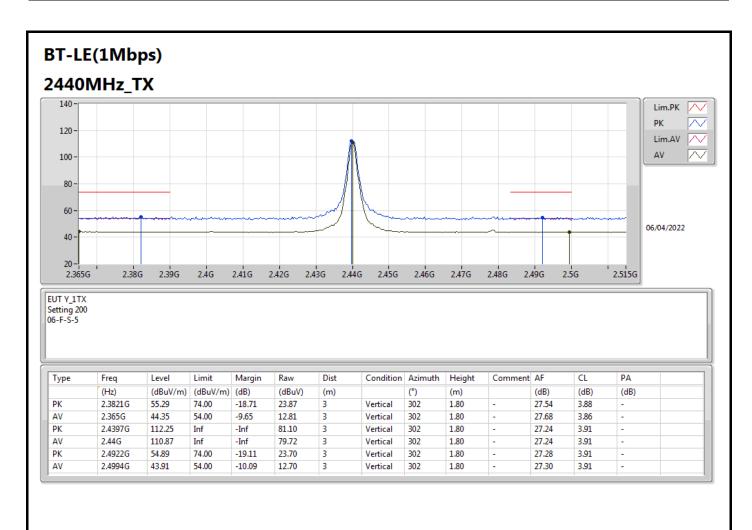




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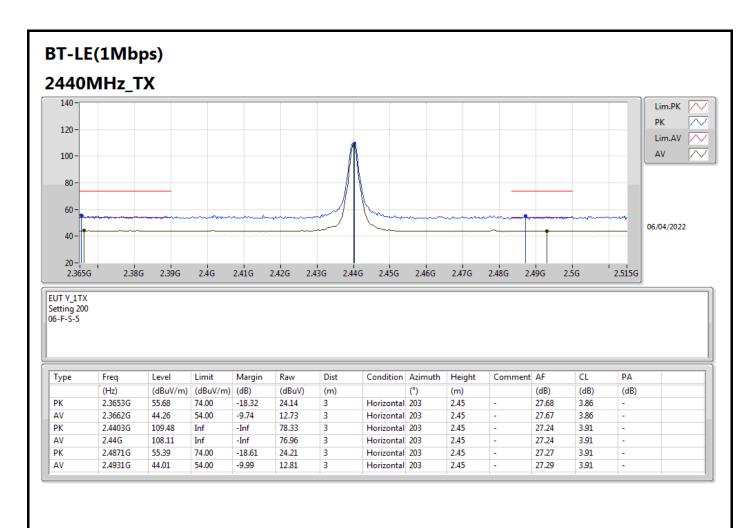




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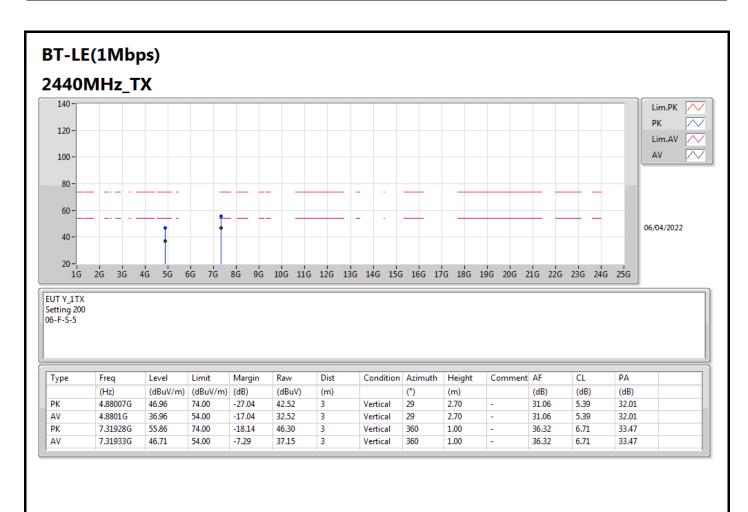




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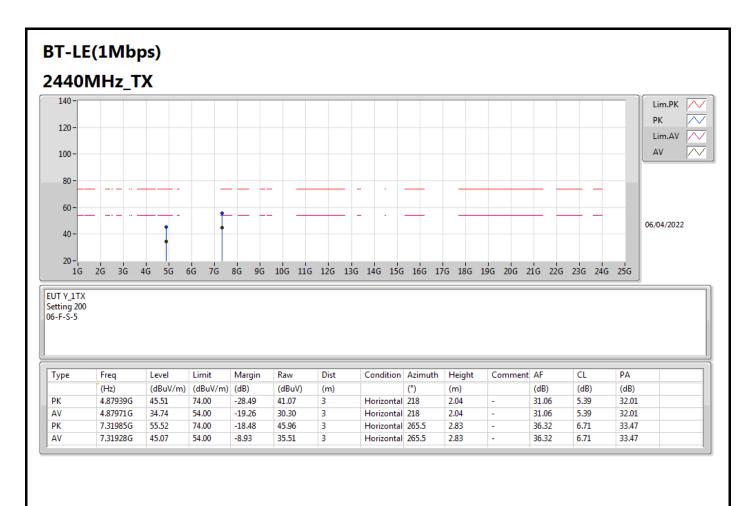




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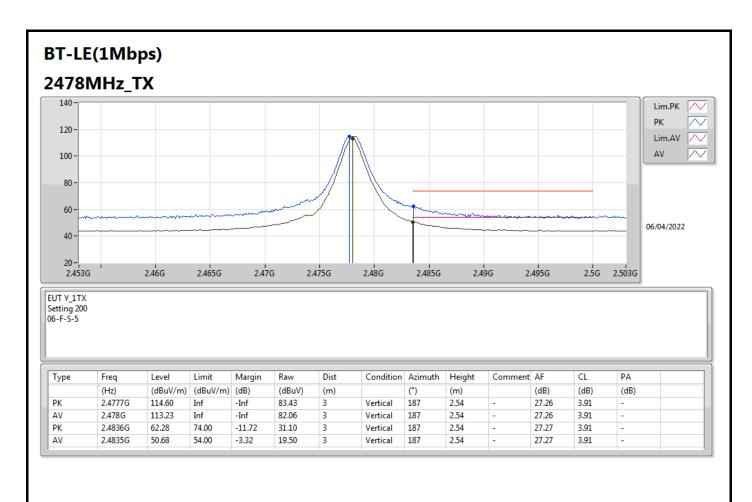




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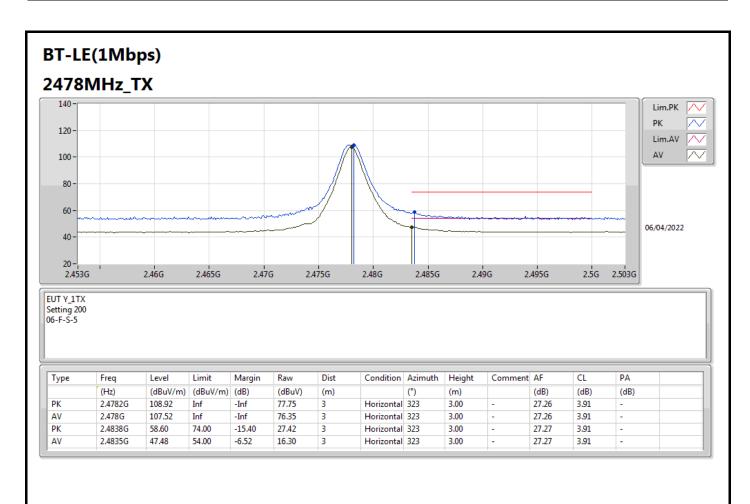




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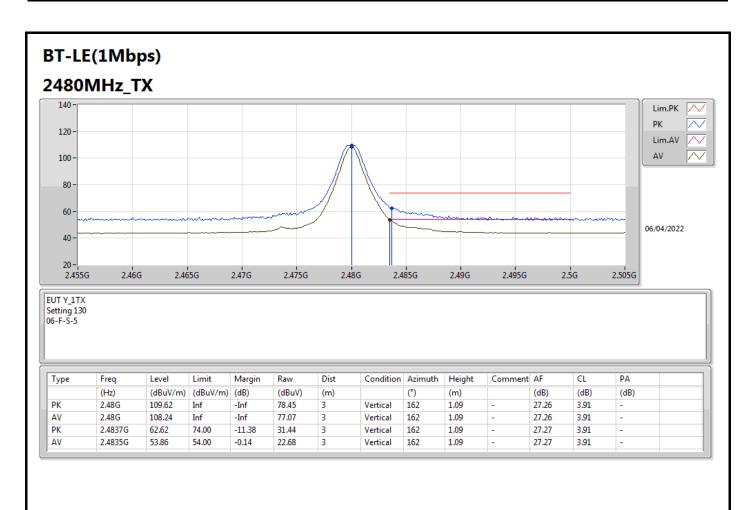
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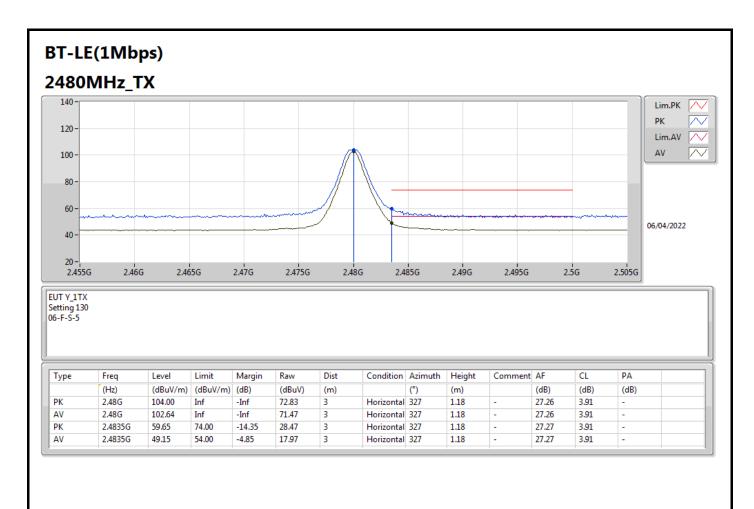




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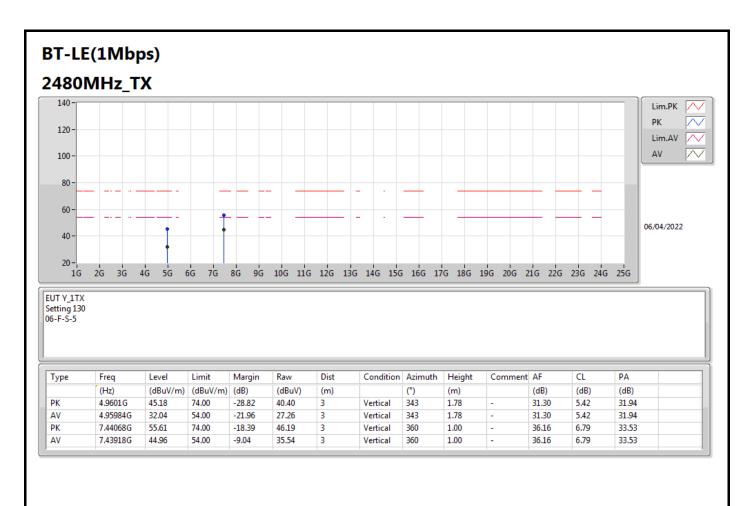




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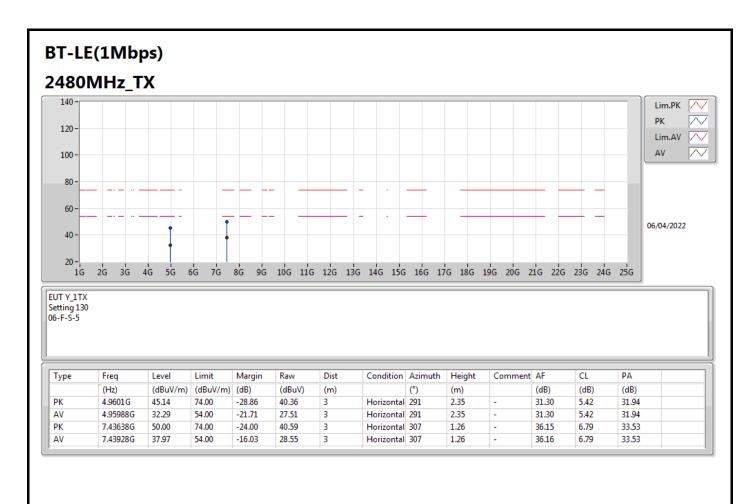




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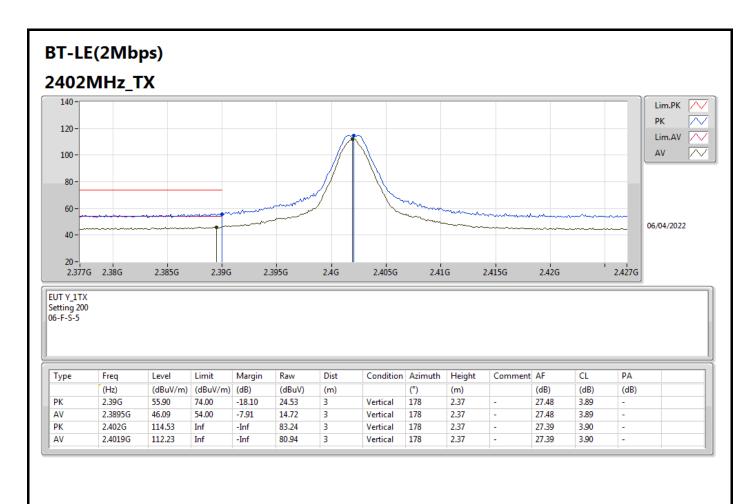




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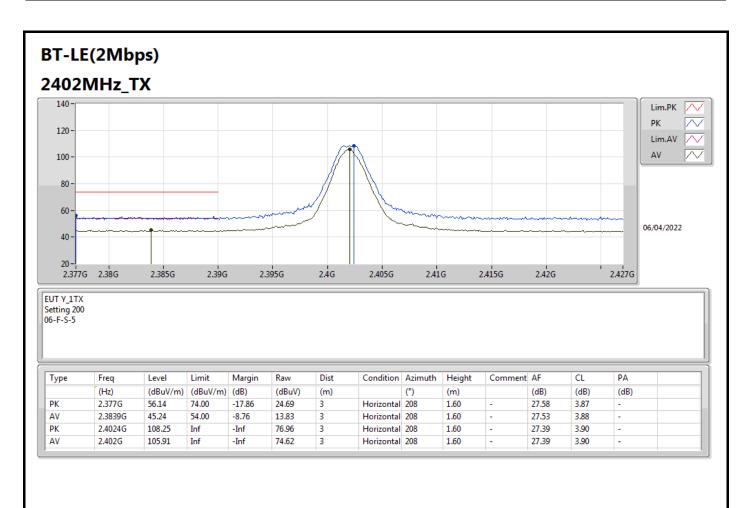




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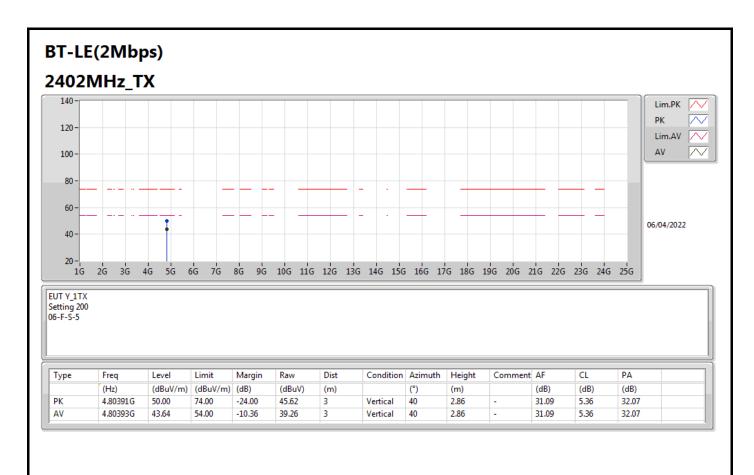




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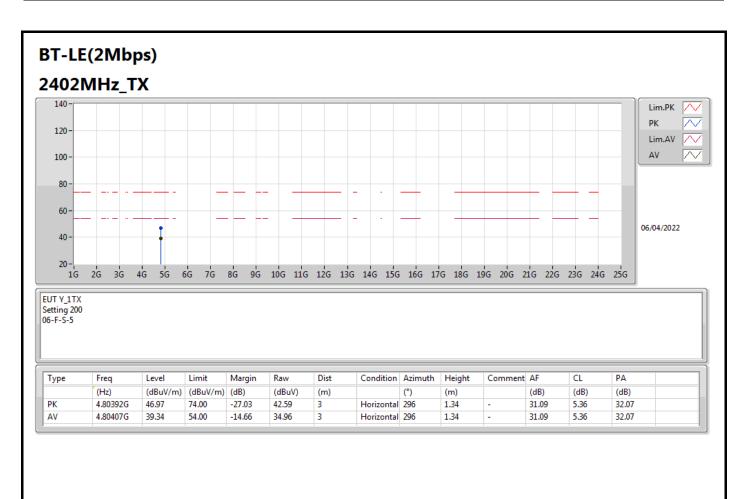




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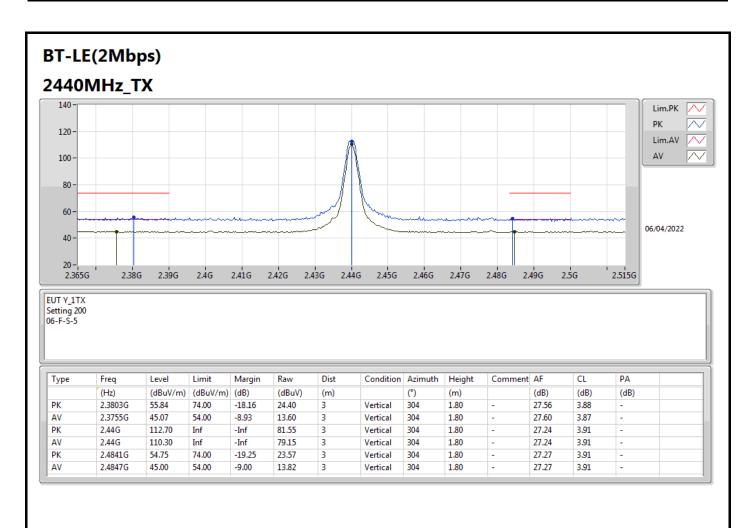




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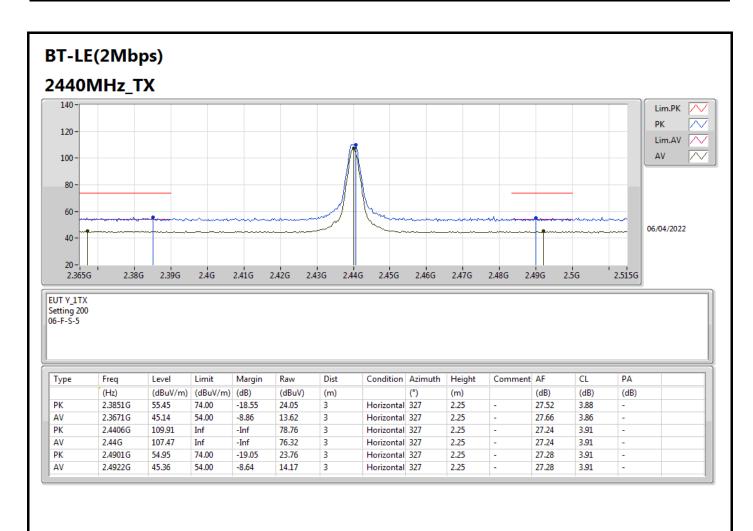




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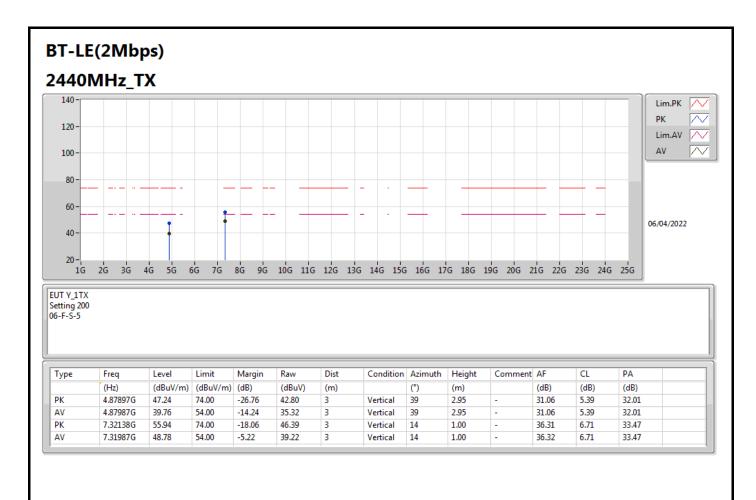




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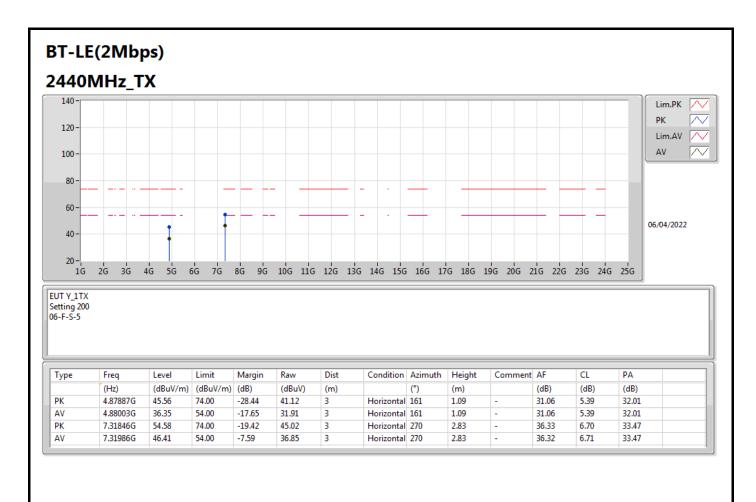




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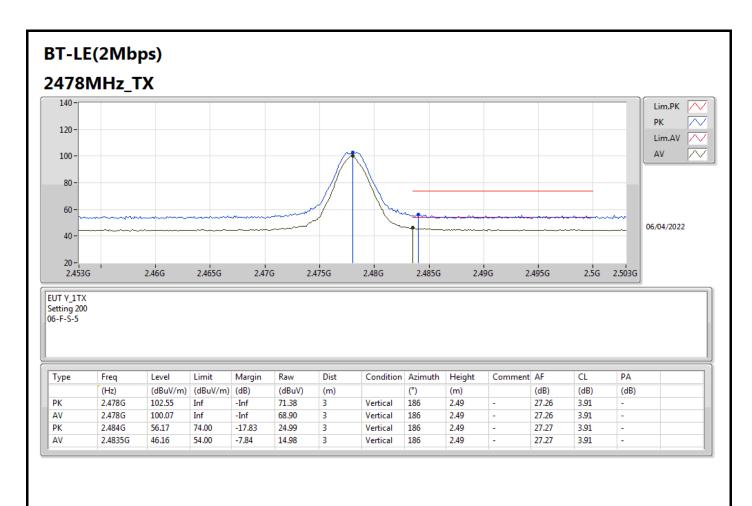




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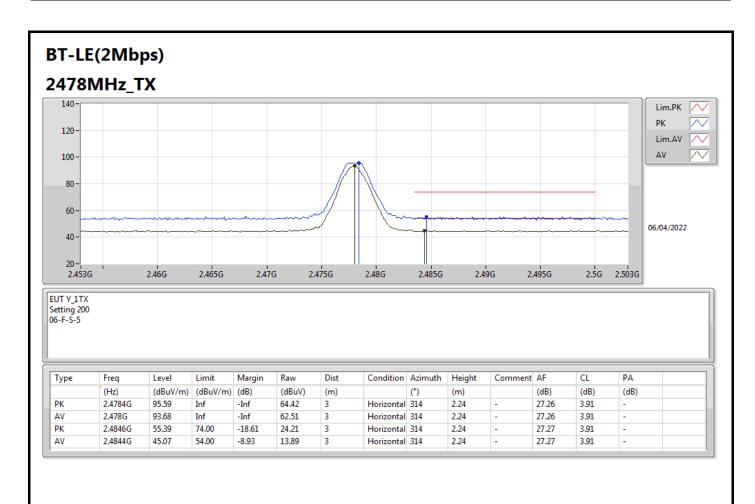




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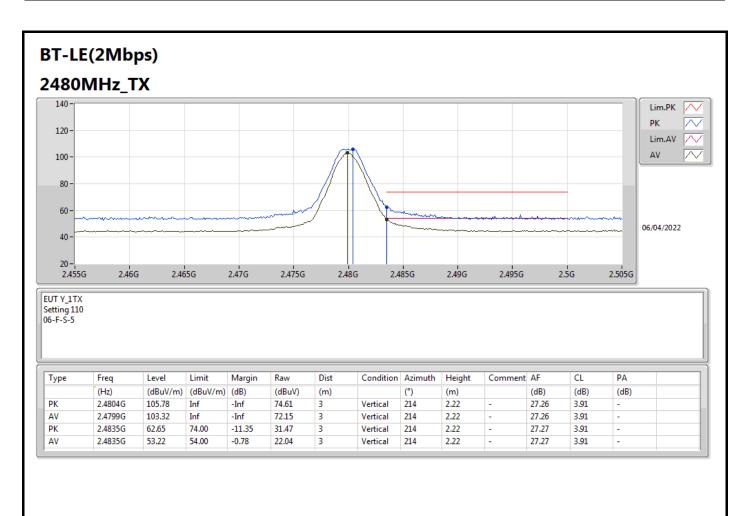




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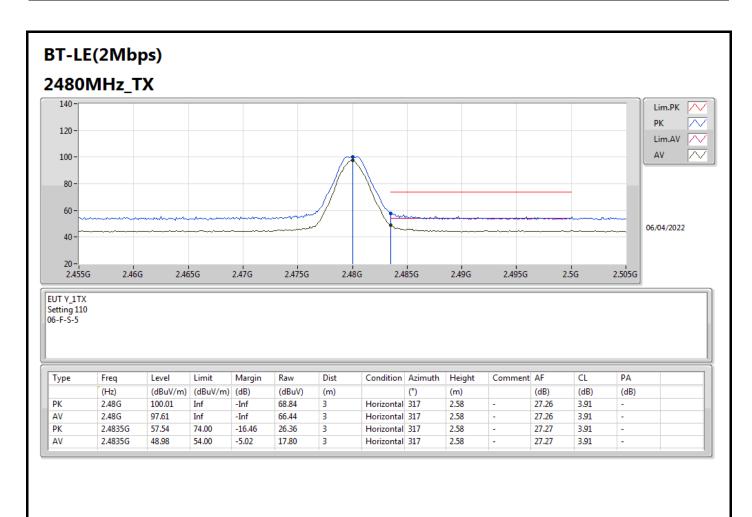




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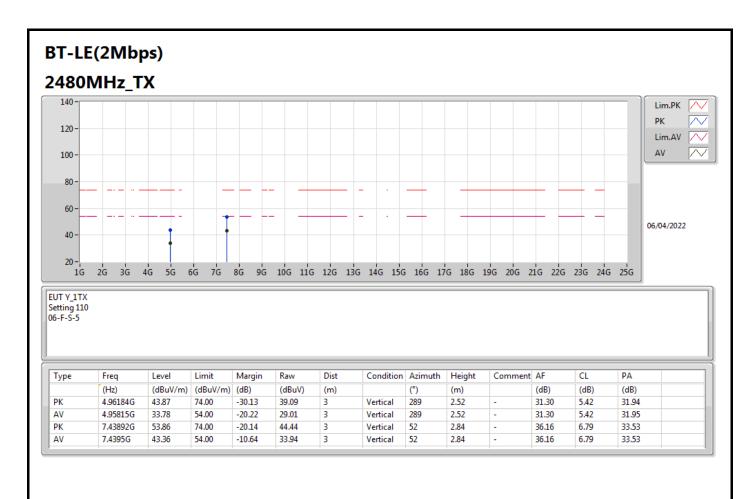




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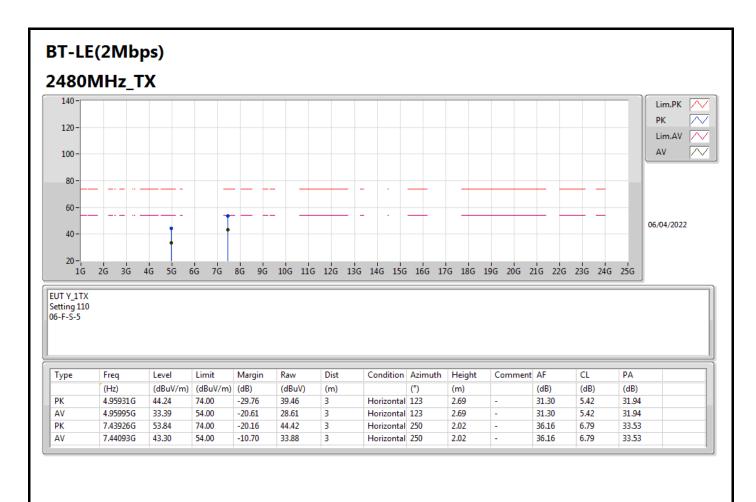




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