





# RADIO TEST REPORT

FCC ID

: 2AYRA-08438

Equipment

: Linksys Velop Pro 7

**Brand Name** 

: LINKSYS

Model Name

: MBE7000, MBE70EC, MBE70WH, MBE70MS,

SPNMBE70, MBE70

Applicant

: Linksys USA, Inc.

121 Theory, Irvine, CA. 92617, USA

Standard

: 47 CFR FCC Part 15.247

The product was received on Dec. 01, 2022, and testing was started from Dec. 14, 2022 and completed on May 04, 2023. We, Sporton International Inc. Hsinchu Laboratory, would like to declare that the tested sample has been evaluated in accordance with the procedures given in ANSI C63.10-2013 and shown compliance with the applicable technical standards.

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

Approved by: Sam Chen

Sporton International Inc. Hsinchu Laboratory

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# History of this test report

Report No.: FR291415AC

Report No.	Version	Description	Issued Date
FR291415AC	01	Initial issue of report	Jun. 14, 2023

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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	-

### **Conformity Assessment Condition:**

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

### Disclaimer:

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

Reviewed by: Sam Chen

Report Producer: Sandy Chuang

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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
2.4G	BT-LE(1Mbps)	1	1
2.4G	BT-LE(2Mbps)	2	1

### Note:

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

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### 1.1.2 Antenna Information

		P	ort						Coin
Ant.	2.4GHz	5GHz	6GHz	Bluetooth Zigbee	Brand	Model Name	Antenna Type	Connector	Gain (dBi)
1	1	1	-	-	Galtronics	02102140-07691-1	PCB Antenna	I-PEX	
2	2	2	-	-	Galtronics	02102140-07691-2	PCB Antenna	I-PEX	
3	-	-	2	-	Galtronics	02102475-07691-2	PCB Antenna	I-PEX	Note1
4	-	-	1	-	Galtronics	02102475-07691-1	PCB Antenna	I-PEX	
5	-	-	-	1	Galtronics	02102073-07691-2	PCB Antenna	I-PEX	

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Note1:

	Antenna Gain (dBi)									
Ant.	WLAN 2.4GHz	WLAN 5GHz UNII 1	WLAN 5GHz UNII 2A	WLAN 5GHz UNII 2C	WLAN 5GHz UNII 3	WLAN 6GHz UNII 5	WLAN 6GHz UNII 6	WLAN 6GHz UNII 7	WLAN 6GHz UNII 8	Bluetooth Zigbee
1	2.626	3.600	3.535	3.323	3.333	-	-	-	-	-
2	2.626	3.600	3.535	3.323	3.333	-	-	-	-	-
3	-	-	-	-	-	3.076	3.246	3.429	3.429	-
4	-	-	-	-	-	3.076	3.246	3.429	3.429	-
5	-	ı	-	-	-	-	_	-	-	1.095

Note2: The above information was declared by manufacturer.

### <For 2.4GHz function>

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

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

Port 1 and Port 2 could transmit/receive simultaneously.

### <For 5GHz function>

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

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

Port 1 and Port 2 could transmit/receive simultaneously.

### <For 6GHz function>

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

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

Port 1 and Port 2 could transmit/receive simultaneously.

### <For Bluetooth/Zigbee function> (1TX/1RX):

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

Port 1 could transmit/receive simultaneously.

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NI ( A	D: (: )			
Note 3:	Directional	i gain i	ıntorma	tion

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

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Ex.

$$\begin{split} &\text{NSS1}(g1,1) = \ 10^{\text{G1}/20} \ ; \, \text{NSS1}(g1,2) = \ 10^{\text{G2}/20}; \\ &\text{gj,k} = &(\text{Nss1}(g1,1) \ + \ \text{Nss1}(g1,2) \ )^2 \\ &\text{DG} = &10 \ \text{log}[(\text{Nss1}(g1,1) \ + \ \text{Nss1}(g1,2) \ )^2 \ / \ N_{ANT}] => &10 \ \text{log}[(10^{\text{G1}/20} \ + \ 10^{\text{G2}/20} \ )^2 \ / \ N_{ANT}] \end{split}$$
 Where ;

2.4G G1= 2.626 dBi ;2.4G G2= 2.626 dBi ;DG= 5.636dBi

5G UNII-1 G1= 3.6 dBi ;5G UNII-1 G2= 3.6 dBi ;DG= 6.610dBi

5G UNII-2A G1= 3.535 dBi ;5G UNII-2A G2= 3.535 dBi ;DG= 6.545dBi

5G UNII-2C G1= 3.323 dBi ;5G UNII-2C G2= 3.323 dBi ;DG= 6.333dBi

5G UNII-3 G1= 3.33 dBi ;5G UNII-3 G2= 3.33 dBi ;DG= 6.343dBi

6G UNII-5 G1= 3.076 dBi ;6G UNII-5 G2= 3.076 dBi ;DG= 6.086dBi

6G UNII-6 G1= 3.246 dBi ;6G UNII-6 G2= 3.246 dBi ;DG= 6.256dBi

6G UNII-7 G1= 3.429 dBi ;6G UNII-7 G2= 3.429 dBi ;DG= 6.439dBi

6G UNII-8 G1= 3.429 dBi ;6G UNII-7 G2= 3.429 dBi ;DG= 6.439dBi

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### 1.1.3 Mode Test Duty Cycle

Note:

Mode	DC	DCF(dB)	T(s)
BT-LE(1Mbps)	1	0	n/a (DC>=0.98)
BT-LE(2Mbps)	1	0	n/a (DC>=0.98)

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# DC is Duty Cycle.DCF is Duty Cycle Factor.

### 1.1.4 EUT Operational Condition

EUT Power Type	From Power Adapter				
Function	Point-to-multipoint Deint-to-point				
<b>Test Software Version</b>	QSPR V5.0-00202				
	LE 1M PHY: 1 Mb/s				
Support Mode	LE Coded PHY (S=2): 500 Kb/s				
Support Mode	LE Coded PHY (S=8): 125 Kb/s				
	LE 2M PHY: 2 Mb/s				

Note: The above information was declared by manufacturer.

### 1.1.5 Table for Bluetooth/Zigbee Chipset Source Information

EUT	Source	Model Name	Chipset Supports NFC	EUT Supports NFC
1	Main	K32W061	V	X
2	Second	K32W041	Х	X

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

### 1.1.6 Table for Multiple Listing

The model names in the following table are all refer to the identical product.

Model Name	Description
MBE7000	
MBE70EC	
MBE70WH	All the models are identical, the difference model for difference
MBE70MS	model served as marketing strategy.
SPNMBE70	
MBE70	

Note 1: From the above models, model: MBE7000 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.

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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	23.1-24.1 / 52-63	Dec. 14, 2022~ May 04, 2023
Radiated <below 1ghz=""></below>	03CH06-CB	Roy Mai	21.3~23.2 / 61~64	Mar. 08, 2023~ May 03, 2023
Radiated <above 1ghz=""></above>	03CH03-CB	Roy Mai	21.7~22.7 / 61~63	Mar. 08, 2023~ May 03, 2023
AC Conduction	CO01-CB	Elvin Yeh	22~23 / 50~51	Feb. 23, 2023

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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)	3.4 dB	Confidence levels of 95%
Radiated Emission (9kHz ~ 30MHz)	3.4 dB	Confidence levels of 95%
Radiated Emission (30MHz ~ 1,000MHz)	5.6 dB	Confidence levels of 95%
Radiated Emission (1GHz ~ 18GHz)	5.2 dB	Confidence levels of 95%
Radiated Emission (18GHz ~ 40GHz)	4.7 dB	Confidence levels of 95%
Conducted Emission	3.2 dB	Confidence levels of 95%
Output Power Measurement	0.8 dB	Confidence levels of 95%
Power Density Measurement	3.2 dB	Confidence levels of 95%
Bandwidth Measurement	2.0 %	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	10
2440MHz	10
2480MHz	10
BT-LE(2Mbps)	-
2402MHz	10
2440MHz	10
2480MHz	10

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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(WiFi+Bluetooth) + Adapter 3 + US plug		
2	EUT 1(WiFi+Bluetooth) + Adapter 4 + US plug		
3	EUT 1(WiFi+Bluetooth) + Adapter 1		
4 EUT 1(WiFi+Bluetooth) + Adapter 2			
Mode 2 has been evaluated to be the worst case among Mode 1~4, thus measurement for Mode 5 will follow this same test mode.			
5 EUT 1(WiFi+Zigbee) + Adapter 4 + US plug			
For operating mode 5 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	Max	DTS Bandwidth Maximum Conducted Output Power Power Spectral Density Emissions in Non-restricted Frequency Bands		
Test Condition	Cor	Conducted measurement at transmit chains		
Operating Mode	1	1 EUT 1		

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Th	The Worst Case Mode for Following Conformance Tests					
Tests Item	Zimedene in received i requestoy Zanac					
Test Condition						
Operating Mode < 1GHz	стх					
	t case was found at Z axis from Radiated Emission test Above 1GHz., So the his same test configuration.					
1	EUT 1 in Z axis + WLAN 2.4GHz + Adapter 1					
2	EUT 1 in Z axis + WLAN 2.4GHz + Adapter 2					
3	EUT 1 in Z axis + WLAN 2.4GHz + Adapter 4 + US plug					
4	EUT 1 in Z axis + WLAN 2.4GHz + Adapter 3 + US plug					
Mode 2 has been evaluat follow this same test mode	ed to be the worst case among Mode $1\sim4$ , thus measurement for Mode $5\sim8$ will e.					
5	EUT 1 in Z axis + WLAN 5GHz + Adapter 2					
6	EUT 1 in Z axis + WLAN 6GHz + Adapter 2					
7	EUT 1 in Z axis + Bluetooth + Adapter 2					
8	EUT 1 in Z axis + Zigbee + Adapter 2					
For operating mode 2 is th	For operating mode 2 is the worst case and it was record in this test report.					
Operating Mode > 1GHz	СТХ					
	at case was found at Z axis from Radiated Emission test Above 1GHz., So the his same test configuration.					
1	EUT 1 in Z 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 + WLAN 6GHz + Bluetooth			
2	2 WLAN 2.4GHz + WLAN 5GHz + WLAN 6GHz + Zigbee			
Refer to Sporton Test Report No.: FA291415 for Co-location RF Exposure Evaluation.				

# 2.3 EUT Operation during Test

### For CTX Mode:

The EUT was programmed to be in continuously transmitting mode.

### For Normal Link Mode:

During the test, the EUT operation to normal function.

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### 2.4 Accessories

Accessories					
Equipment Name	Brand Name	Model Name	Rating		
Adapter 1	Ktec	KSA-30W-120250VU	Input: 100-240V~50/60Hz, 1.0A Output: 12.0V, 2.5A		
Adapter 2	APD	WA-30P12FU	Input: 100-240V~, 50-60Hz, 0.9A Max. Output: 12.0V, 2.5A		
Adapter 3	Ktec	KSA-30W-120250D5	Input: 100-240V~50/60Hz, 1.0A Output: 12.0V, 2.5A, 30.0W		
Adapter 4	APD	WA-30P12R	Input: 100-240V~, 50-60Hz, 0.9A Max. Output: 12.0V, 2.5A, 30.0W		
Others					
RJ-45 cable*1, non-shielded, 0.9m					
Plug*1 (Equip with Adapter 3 use only)					

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# 2.5 Support Equipment

Plug\*1 (Equip with Adapter 4 use only)

### For AC Conduction:

. 0. 7	of AC Conduction.					
	Support Equipment					
No.	Equipment	Brand Name	Model Name	FCC ID		
Α	LAN NB	DELL	E6430	N/A		
В	WAN NB	DELL	E6430	N/A		
С	2.4G NB	DELL	E6430	N/A		
D	5G NB	DELL	E6430	N/A		
Е	6G NB	DELL	E6430	N/A		
F	Client	Linksys	MX6000	N/A		
G	Client NB	DELL	E6430	N/A		
Н	AX210	Intel	AX210NGW	N/A		

### For Radiated:

	Support Equipment				
No.	No. Equipment Brand Name Model Name FCC ID				
Α	NB	Lenovo	L440	N/A	

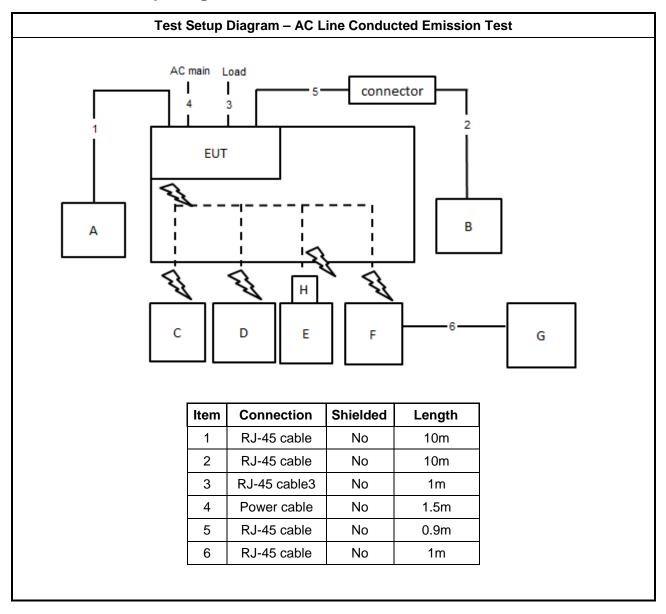
### For RF Conducted:

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

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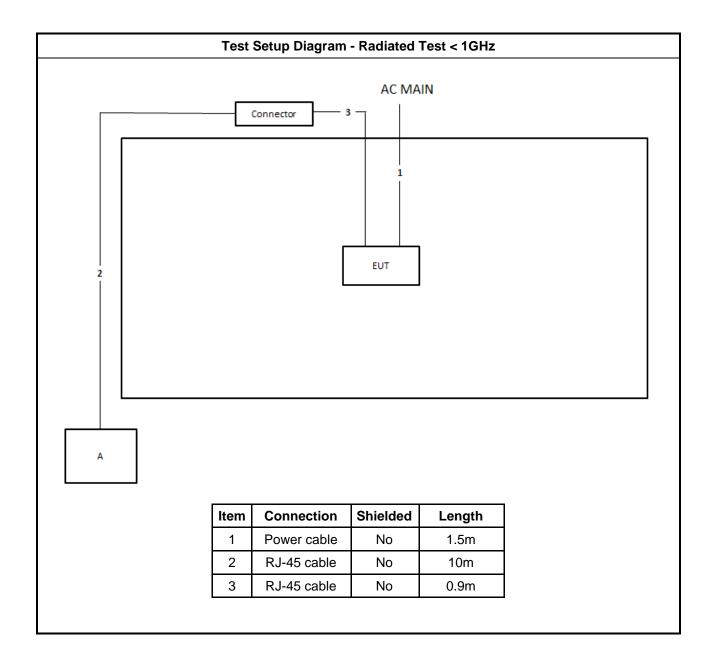
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# 2.6 Test Setup Diagram



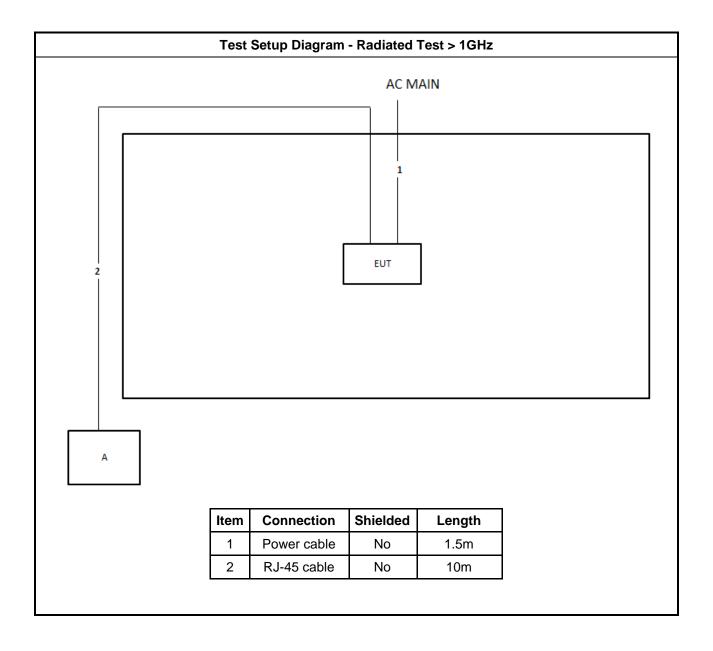
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# 3 Transmitter Test Result

### 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

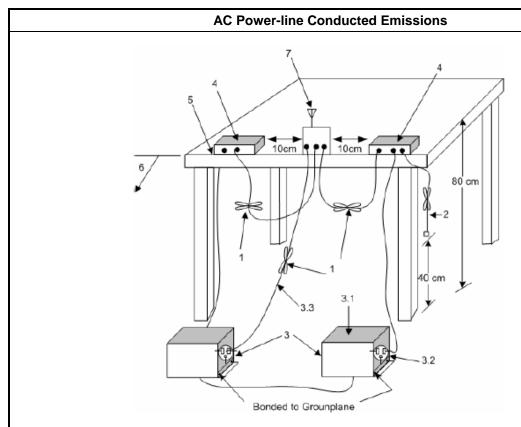
Refer a test equipment and calibration data table in this test report.

### 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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- 2—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 peripheráls, 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
- 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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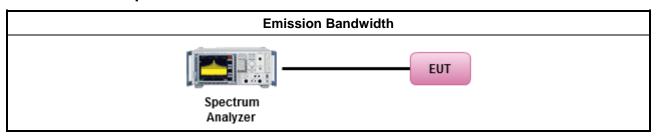
### 3.2.2 Measuring Instruments

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:								
		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<sub>TX</sub> > 6 dBi, then P<sub>Out</sub> = 30 (G<sub>TX</sub> 6)/3 + 8dB dBm

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

### 3.3.2 Measuring Instruments

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

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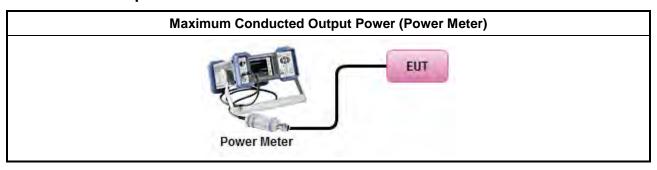
### 3.3.3 Test Procedures

		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).					
		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

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

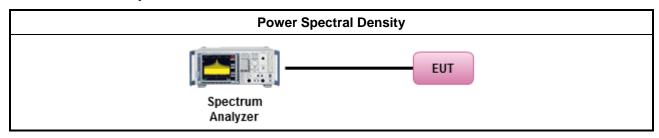
Refer a test equipment and calibration data table in this test report.

### 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 6629 In-band power spectral density (PSD). Sample all transmit ports simultaneously using spectrum analyzer for each transmit port. Where the trace bin-by-bin of each transmit p summing can be performed. (i.e., in the first spectral bin of output 1 is summed with that in t first spectral bin of output 2 and that from the first spectral bin of output 3, and so on up to t NTX output to obtain the value for the first frequency bin of the summed spectrum.). Add the amplitude (power) values for the different transmit chains and use this as the new dataset.	ort he he up						
	Option 2: Measure and sum spectral maxima across the outputs. With this technique, spec are measured at each output of the device at the required resolution bandwidth. T maximum value (peak) of each spectrum is determined. These maximum values are th summed mathematically in linear power units across the outputs. These operations shall performed separately over frequency spans that have different out-of-band or spurio emission limits,	he en be						
	Option 3: Measure and add 10 log(N) dB, where N is the number of transmit chains. Refer FCC KDB 662911, In-band power spectral density (PSD). Performed at 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.	ins						

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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.

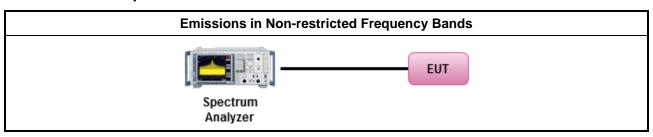
### 3.5.2 Measuring Instruments

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				
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 FLIT
- 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

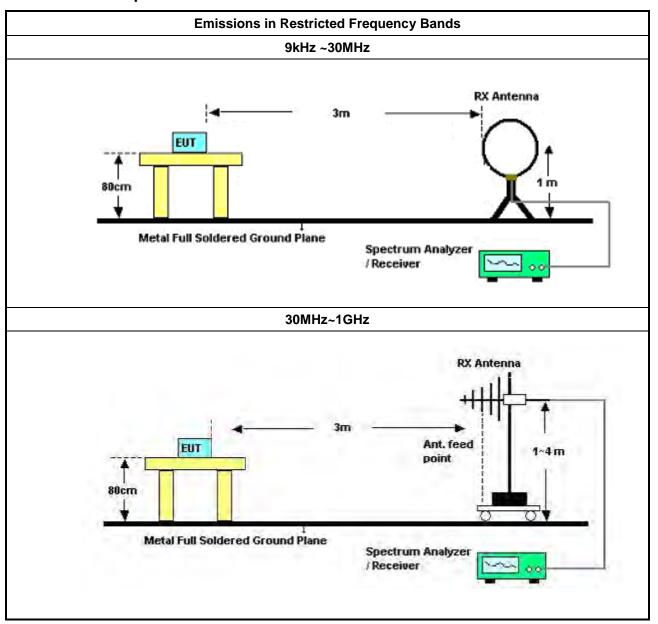
		Test Method						
•	The average emission levels shall be measured in [duty cycle ≥ 98 or duty factor].							
•	Refer as ANSI C63.10, clause 6.10.3 band-edge testing shall be performed at the lowest frequency channel and highest frequency channel within the allowed operating band.							
•	For	For the 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 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:						
	<ul> <li>Refer as FCC KDB 558074 clause 8.7 &amp; c63.10 clause 11.13.1, When the performing peak average radiated measurements, emissions within 2 MHz of the authorized band edge may measured using the marker-delta method described below.</li> </ul>							
	•	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						
	<ul> <li>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.</li> </ul>							

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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	MY52260140	9kHz ~ 8.4GHz	May 06, 2022	May 05, 2023	Conduction (CO01-CB)
LISN	F.C.C.	FCC-LISN-50- 16-2	04083	150kHz ~ 100MHz	Feb. 16, 2023	Feb. 15, 2024	Conduction (CO01-CB)
LISN	Schwarzbeck	NSLK 8127	8127647	9kHz ~ 30MHz	Apr. 12, 2022	Apr. 11, 2023	Conduction (CO01-CB)
Pulse Limiter	Rohde&Schwa rz	ESH3-Z2	100430	9kHz ~ 30MHz	Feb. 09, 2023	Feb. 08, 2024	Conduction (CO01-CB)
COND Cable	Woken	Cable	Low cable-CO01	9kHz ~ 30MHz	Oct. 18, 2022	Oct. 17, 2023	Conduction (CO01-CB)
Software	SPORTON	SENSE	V5.10	-	N.C.R.	N.C.R.	Conduction (CO01-CB)
Loop Antenna	Teseq	HLA 6120	24155	9kHz - 30 MHz	May 14, 2022	May 13, 2023	Radiation (03CH06-CB)
3m Semi Anechoic Chamber NSA	TDK	SAC-3M	03CH06-CB	30 MHz ~ 1 GHz	Aug. 04, 2022	Aug. 03. 2023	Radiation (03CH06-CB)
Bilog Antenna with 6 dB attenuator	TESEQ & EMCI	CBL6112D & N-6-06	37878 & AT-N0606	20MHz ~ 2GHz	Jul. 31, 2022	Jul. 30, 2023	Radiation (03CH06-CB)
Pre-Amplifier	Agilent	310N	187290	0.1MHz ~ 1GHz	Nov. 04, 2022	Nov. 03, 2023	Radiation (03CH06-CB)
Signal Analyzer	R&S	FSV40	101904	9kHz ~ 40GHz	Apr. 26, 2022	Apr. 25, 2023	Radiation (03CH06-CB)
EMI Test Receiver	R&S	ESCS	826547/017	9kHz ~ 2.75GHz	Jun. 17, 2022	Jun. 16, 2023	Radiation (03CH06-CB)
RF Cable-low	Woken	RG402	Low Cable-24+68	30MHz~1GHz	Oct. 03, 2022	Oct. 02, 2023	Radiation (03CH06-CB)
Test Software	SPORTON	SENSE	V5.10	-	N.C.R.	N.C.R.	Radiation (03CH06-CB)
3m Semi Anechoic Chamber VSWR	TDK	SAC-3M	03CH03-CB	1GHz ~18GHz 3m	May 05, 2022	May 04, 2023	Radiation (03CH03-CB)
Horn Antenna	ETS · Lindgren	3115	6821	750MHz~18GHz	Feb. 03, 2023	Feb. 02, 2024	Radiation (03CH03-CB)
Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170252	15GHz ~ 40GHz	Aug. 22, 2022	Aug. 21, 2023	Radiation (03CH03-CB)
Pre-Amplifier	Agilent	8449B	3008A02097	1GHz ~ 26.5GHz	Jul. 01, 2022	Jun. 30, 2023	Radiation (03CH03-CB)
Pre-Amplifier	SGH	SGH184	20221107-3	18GHz ~ 40GHz	Nov. 16, 2022	Nov. 15, 2023	Radiation (03CH03-CB)
Spectrum Analyzer	R&S	FSP40	100019	9kHz ~ 40GHz	Jun. 10, 2022	Jun. 09, 2023	Radiation (03CH03-CB)

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Instrument	Brand	Model No.	Serial No.	Characteristics	Calibration Date	Calibration Due Date	Remark
RF Cable-high	Woken	RG402	High Cable-20+29	1GHz ~ 18GHz	Oct. 03, 2022	Oct. 02, 2023	Radiation (03CH03-CB)
RF Cable-high	Woken	RG402	High Cable-29	1GHz ~ 18GHz	Oct. 03, 2022	Oct. 02, 2023	Radiation (03CH03-CB)
High Cable	Woken	WCA0929M	40G#5+6	1GHz ~ 40 GHz	Dec. 07, 2022	Dec. 06, 2023	Radiation (03CH03-CB)
High Cable	Woken	WCA0929M	40G#5	1GHz ~ 40 GHz	Dec. 07, 2022	Dec. 06, 2023	Radiation (03CH03-CB)
High Cable	Woken	WCA0929M	40G#6	1GHz ~ 40 GHz	Dec. 07, 2022	Dec. 06, 2023	Radiation (03CH03-CB)
Test Software	SPORTON	SENSE	V5.10	-	N.C.R.	N.C.R.	Radiation (03CH03-CB)
Signal Analyzer	R&S	FSV40	101903	9kHz ~ 40GHz	May 27, 2022	May 26, 2023	Conducted (TH03-CB)
Power Sensor	Anritsu	MA2411B	1726195	300MHz~40GHz	Sep. 04, 2022	Sep. 03, 2023	Conducted (TH03-CB)
Power Meter	Anritsu	ML2495A	1035008	300MHz~40GHz	Sep. 04, 2022	Sep. 03, 2023	Conducted (TH03-CB)
RF Cable-high	Woken	RG402	High Cable-11	1 GHz –18 GHz	Oct. 03, 2022	Oct. 02, 2023	Conducted (TH03-CB)
RF Cable-high	Woken	RG402	High Cable-12	1 GHz –18 GHz	Oct. 03, 2022	Oct. 02, 2023	Conducted (TH03-CB)
RF Cable-high	Woken	RG402	High Cable-13	1 GHz –18 GHz	Oct. 03, 2022	Oct. 02, 2023	Conducted (TH03-CB)
RF Cable-high	Woken	RG402	High Cable-14	1 GHz –18 GHz	Oct. 03, 2022	Oct. 02, 2023	Conducted (TH03-CB)
RF Cable-high	Woken	RG402	High Cable-15	1 GHz –18 GHz	Oct. 03, 2022	Oct. 02, 2023	Conducted (TH03-CB)
Switch	SPTCB	SP-SWI	SWI-03	1 GHz –26.5 GHz	Oct. 04, 2022	Oct. 03, 2023	Conducted (TH03-CB)
		İ					

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Conducted

(TH03-CB)

N.C.R.

N.C.R.

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

SENSE

NCR means Non-Calibration required.

SPORTON

Test Software

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V5.10



### **Conducted Emissions at Powerline**

Appendix A

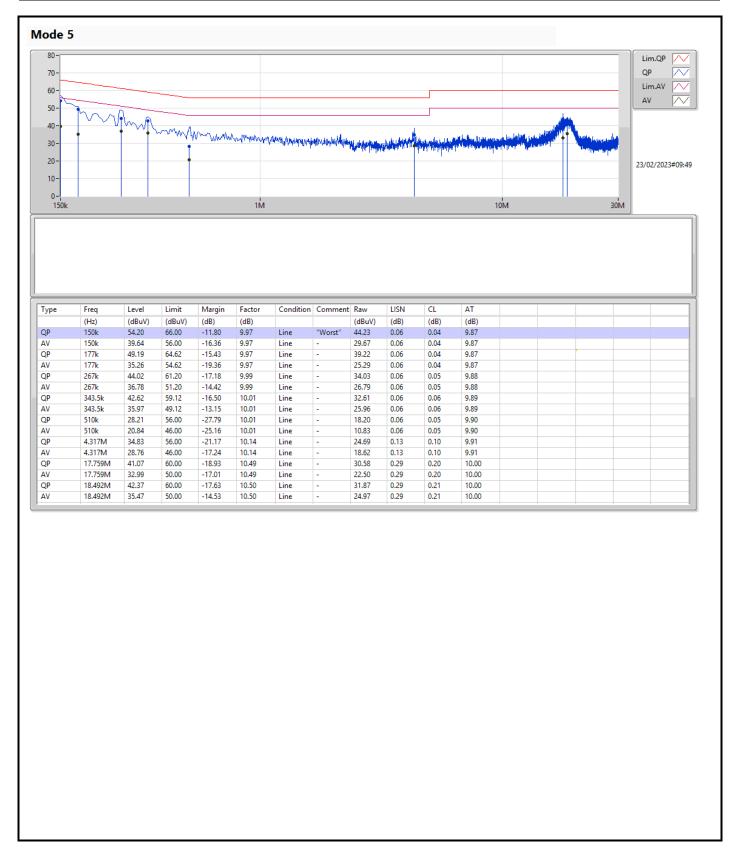
Summary

Mode	Result	Туре	Freq (Hz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Condition
Mode 5	Pass	QP	150k	54.20	66.00	-11.80	Line

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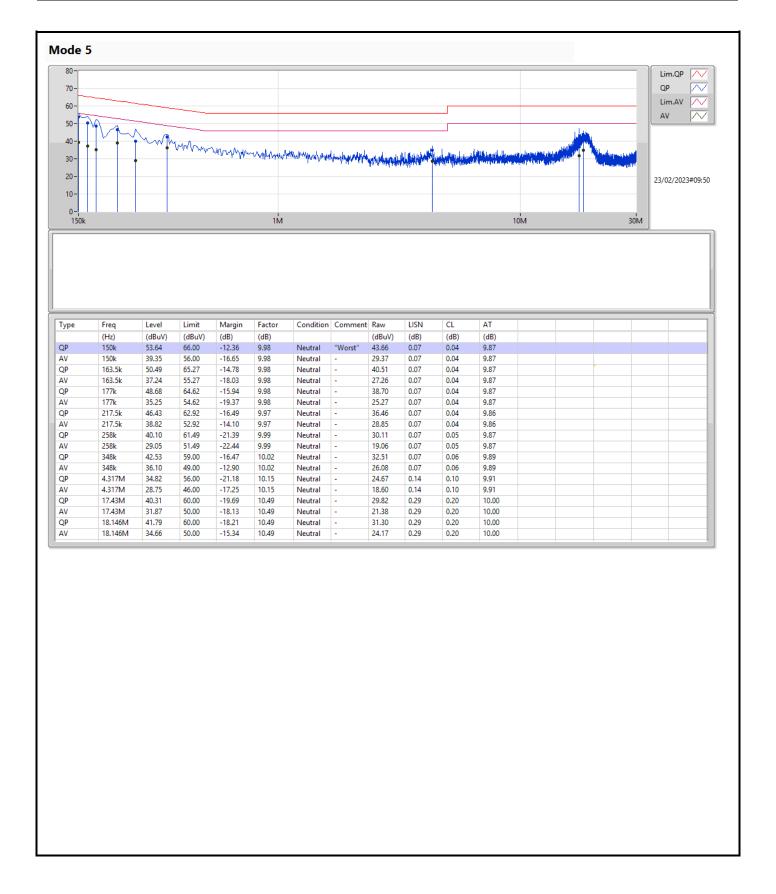




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EBW-DTS Appendix B

### 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)	711.25k	1.03M	1M03F1D	705k	1.024M
BT-LE(2Mbps)	1.38M	2.047M	2M05F1D	1.368M	2.034M

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

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#### Result

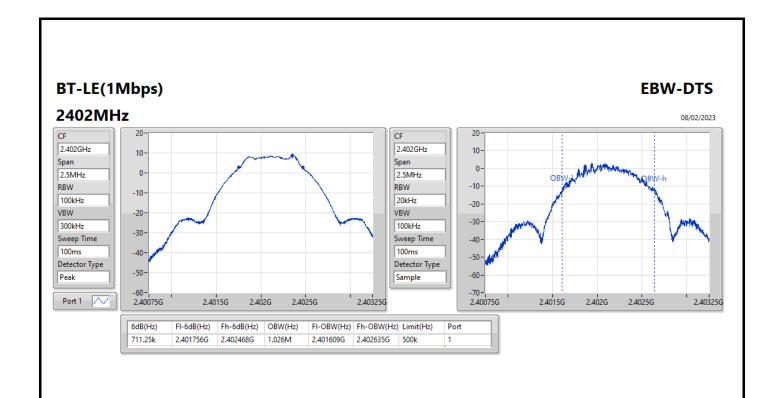
Mode	Result	Limit	Port 1-N dB	Port 1-OBW
		(Hz)	(Hz)	(Hz)
BT-LE(1Mbps)	-	-	-	-
2402MHz	Pass	500k	711.25k	1.026M
2440MHz	Pass	500k	705k	1.024M
2480MHz	Pass	500k	710k	1.03M
BT-LE(2Mbps)	-	•	-	-
2402MHz	Pass	500k	1.368M	2.034M
2440MHz	Pass	500k	1.38M	2.034M
2480MHz	Pass	500k	1.38M	2.047M

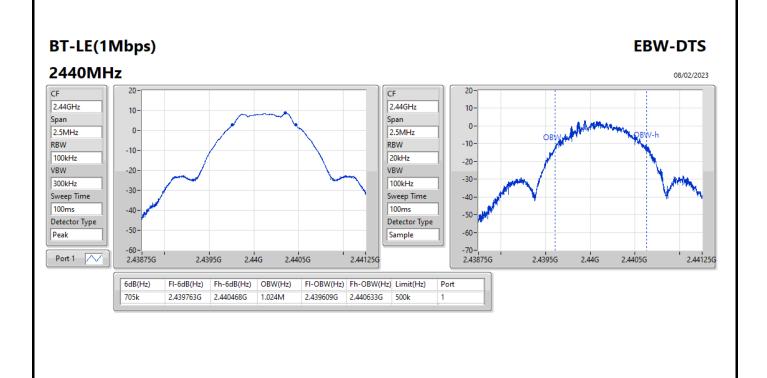
Port X-N dB = Port X 6dB down bandwidth; Port X-OBW = Port X 99% occupied bandwidth

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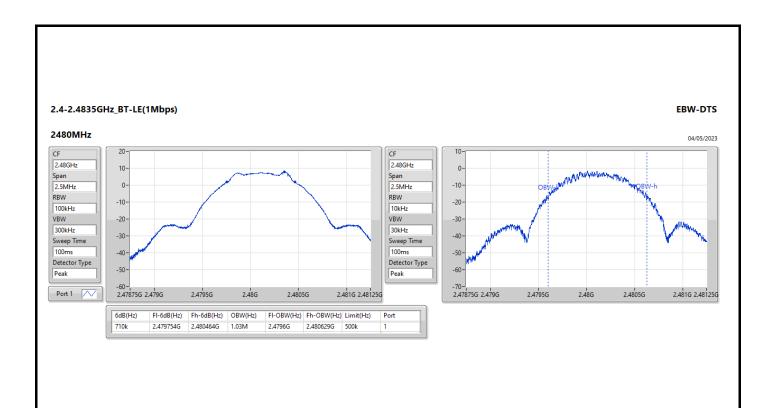
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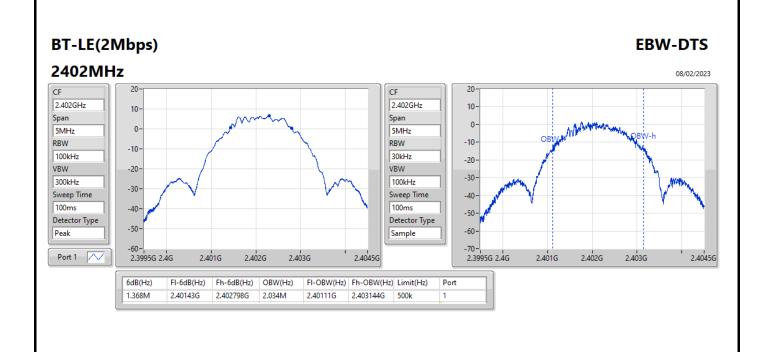




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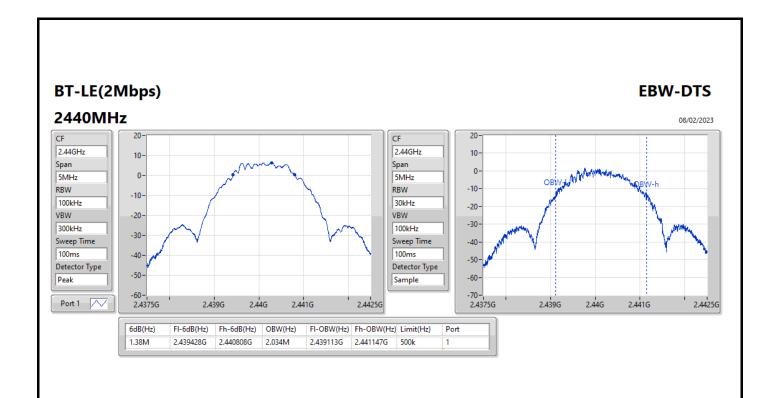
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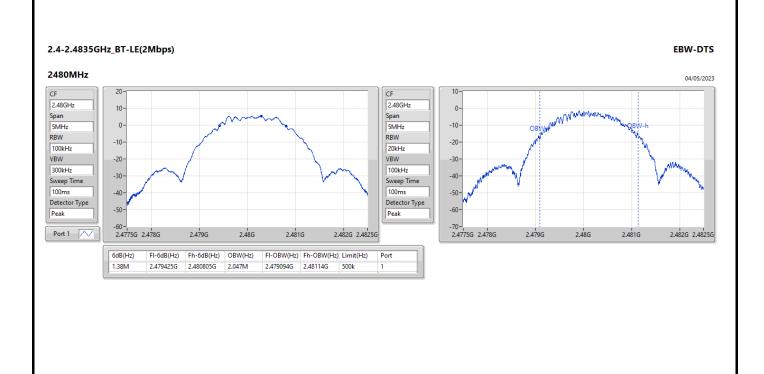




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# Average Power-DTS

Appendix C

Summary

Mode	Total Power (dBm)	Power (W)
2.4-2.4835GHz	-	-
BT-LE(1Mbps)	9.34	0.00859
BT-LE(2Mbps)	9.32	0.00855

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Appendix C

## Result

Mode	Result	DG	Total Power	Power Limit
		(dBi)	(dBm)	(dBm)
BT-LE(1Mbps)	-	-	-	-
2402MHz	Pass	1.095	9.34	30.00
2440MHz	Pass	1.095	9.33	30.00
2480MHz	Pass	1.095	9.22	30.00
BT-LE(2Mbps)	-	-	-	-
2402MHz	Pass	1.095	9.32	30.00
2440MHz	Pass	1.095	9.27	30.00
2480MHz	Pass	1.095	9.23	30.00

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

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### Summary

Mode	PD (dBm/RBW)
2.4-2.4835GHz	-
BT-LE(1Mbps)	-7.87
BT-LE(2Mbps)	-13.11

RBW = 3kHz;

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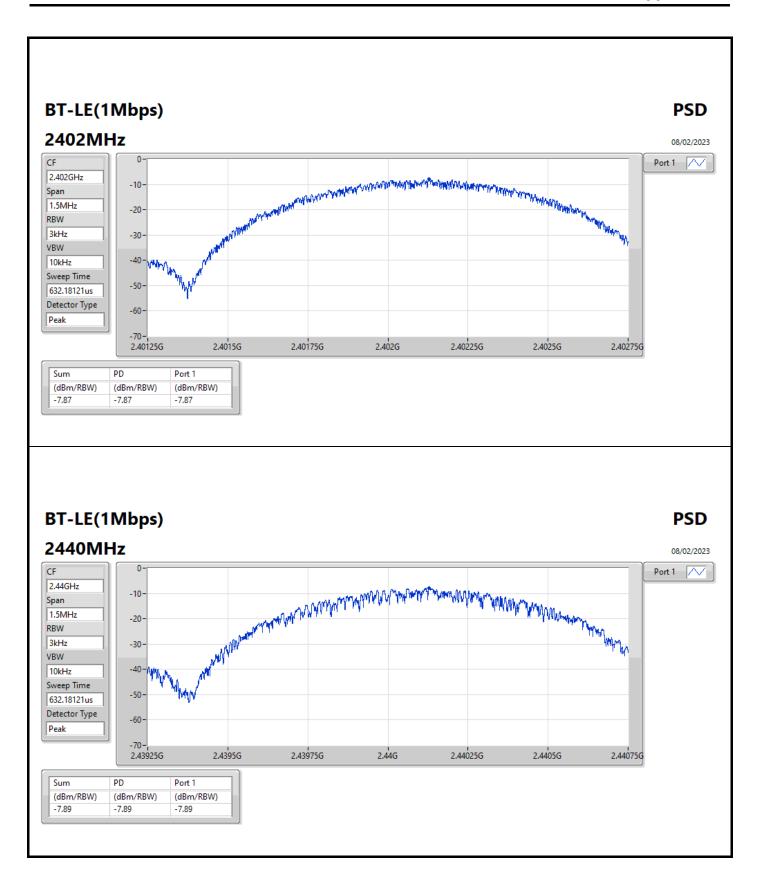
#### Result

Mode	Result	DG	PD	PD Limit
		(dBi)	(dBm/RBW)	(dBm/RBW)
BT-LE(1Mbps)	-	-	-	-
2402MHz	Pass	1.095	-7.87	8.00
2440MHz	Pass	1.095	-7.89	8.00
2480MHz	Pass	1.095	-8.86	8.00
BT-LE(2Mbps)	•	•	-	-
2402MHz	Pass	1.095	-13.11	8.00
2440MHz	Pass	1.095	-13.21	8.00
2480MHz	Pass	1.095	-13.93	8.00

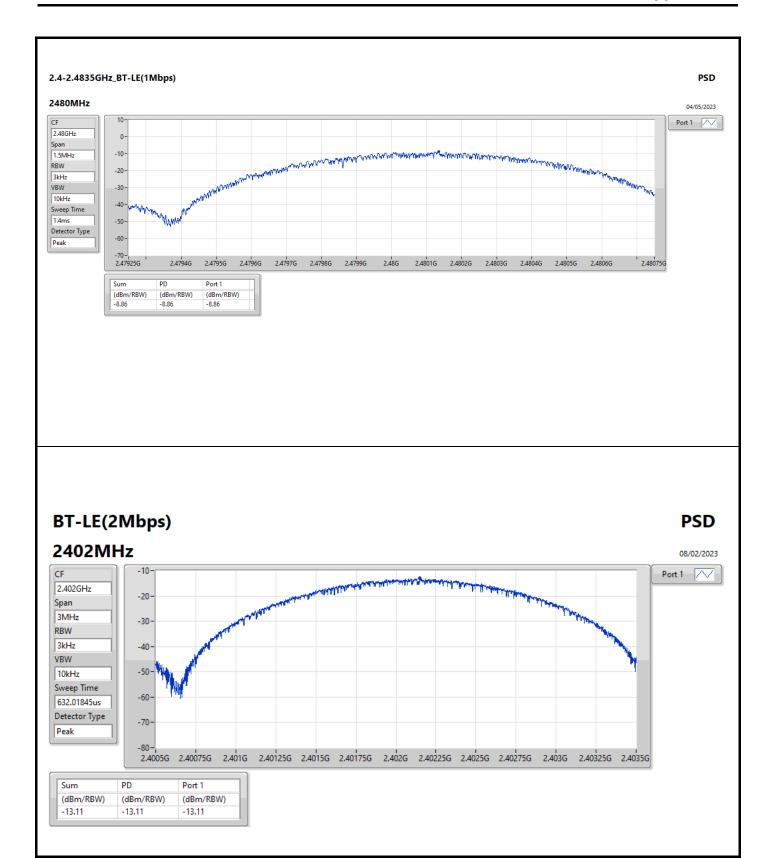
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DG = Directional Gain; RBW = 3kHz; PD = trace bin-by-bin of each transmits port summing can be performed maximum power density; Port X = Port X Power Density;

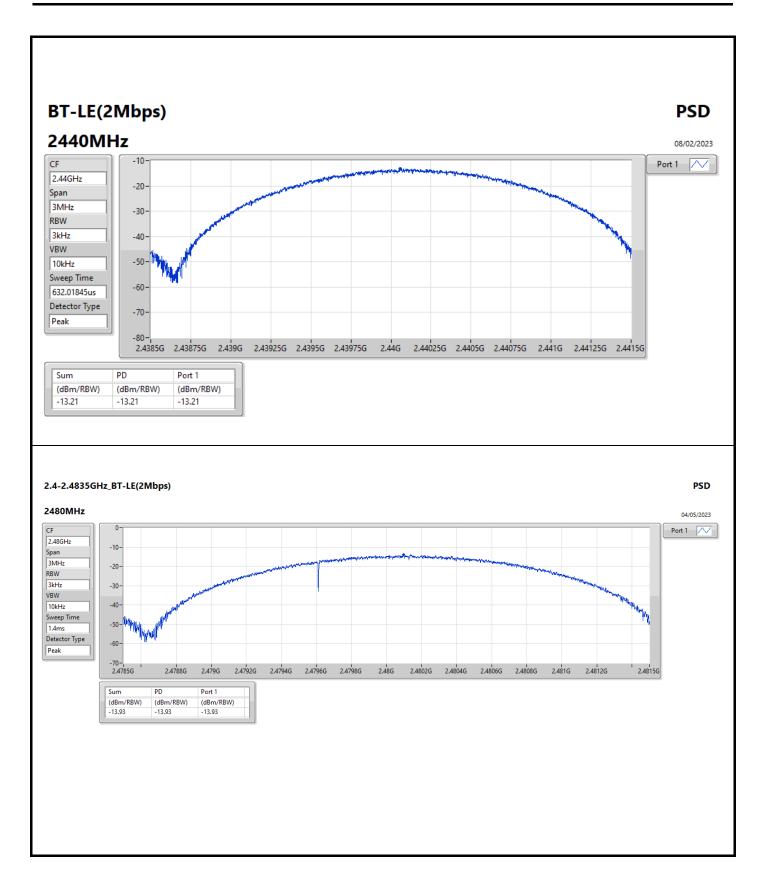


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## Summary

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	2.40234G	8.93	-21.07	803.15M	-52.18	2.4G	-47.53	2.4G	-47.74	2.50254G	-51.88	17.64083G	-46.10	1
BT-LE(2Mbps)	Pass	2.40217G	6.69	-23.31	1.97698G	-52.34	2.4G	-29.24	2.4G	-26.25	2.50018G	-51.79	6.99155G	-46.73	1

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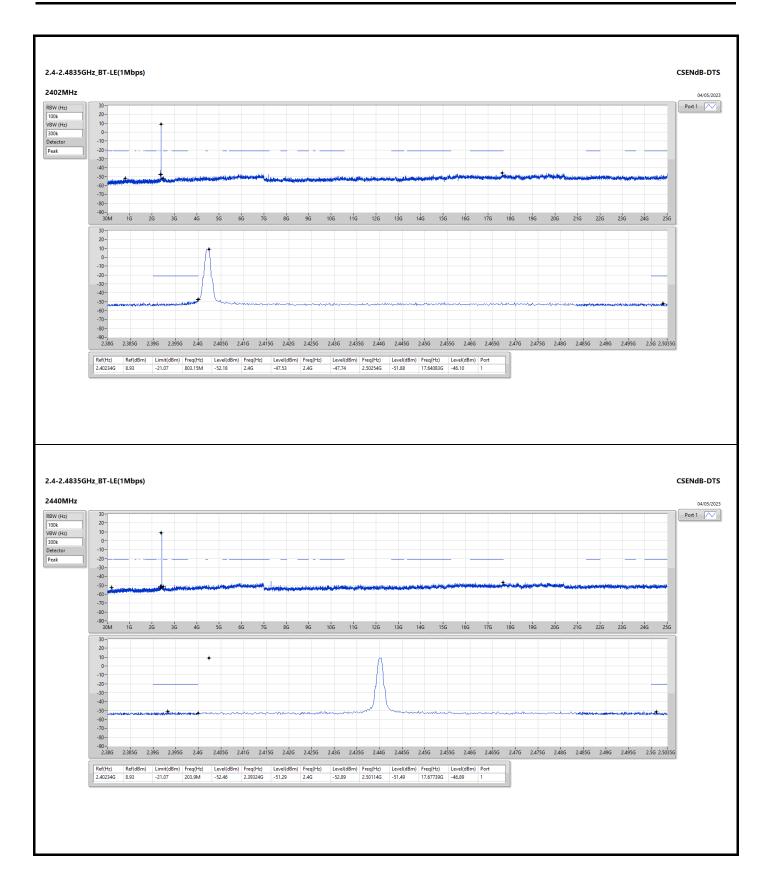


## Result

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	2.40234G	8.93	-21.07	803.15M	-52.18	2.4G	-47.53	2.4G	-47.74	2.50254G	-51.88	17.64083G	-46.10	1
2440MHz	Pass	2.40234G	8.93	-21.07	203.9M	-52.46	2.39324G	-51.29	2.4G	-52.89	2.50114G	-51.49	17.67739G	-46.89	1
2480MHz	Pass	2.40234G	8.93	-21.07	66.43M	-52.98	2.39508G	-51.71	2.4G	-57.05	2.50158G	-51.60	21.53273G	-47.29	1
BT-LE(2Mbps)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2402MHz	Pass	2.40217G	6.69	-23.31	1.97698G	-52.34	2.4G	-29.24	2.4G	-26.25	2.50018G	-51.79	6.99155G	-46.73	1
2440MHz	Pass	2.40217G	6.69	-23.31	2.192G	-51.06	2.39404G	-50.99	2.4G	-53.00	2.50038G	-50.78	6.78908G	-46.68	1
2480MHz	Pass	2.40217G	6.69	-23.31	1.63858G	-53.87	2.39596G	-51.65	2.4G	-56.52	2.5027G	-51.76	21.51304G	-47.44	1

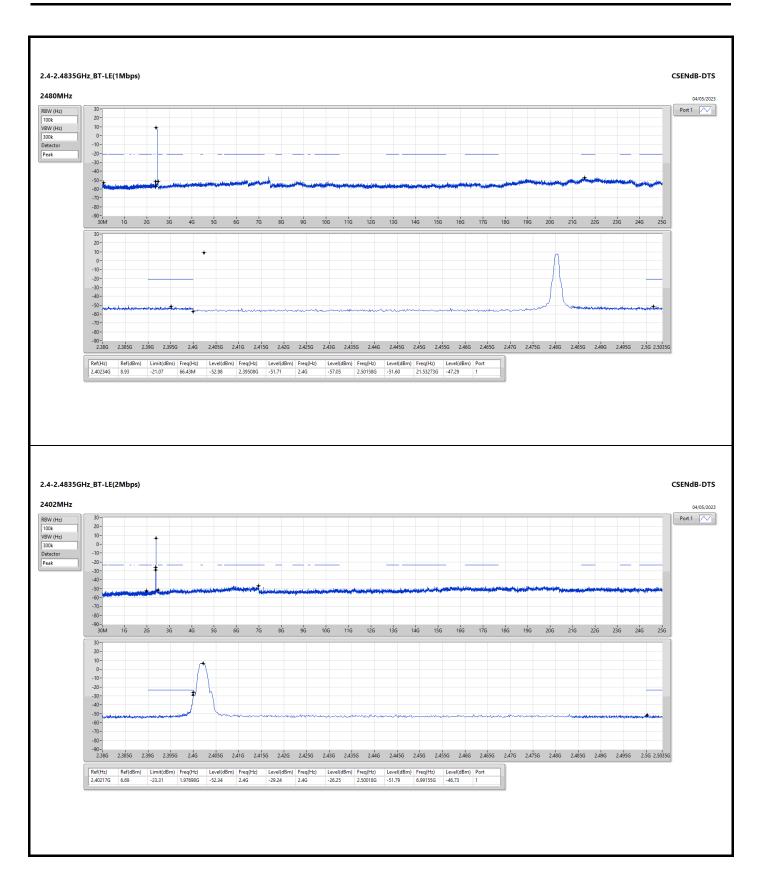
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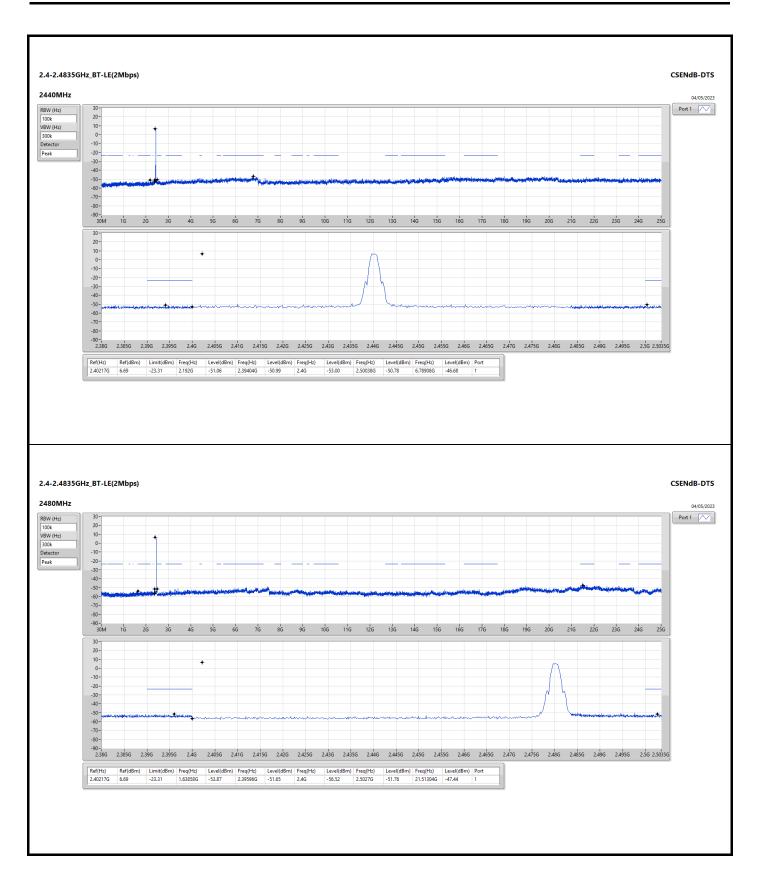


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# Radiated Emissions below 1GHz

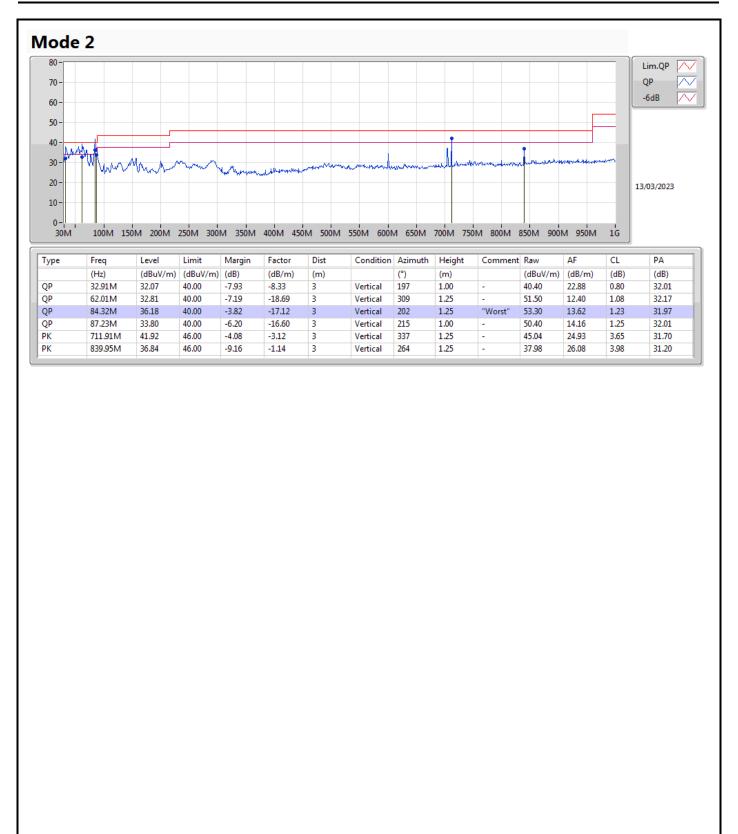
Appendix F.1

Summary

Mode	Result	Туре	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Condition
Mode 2	Pass	PK	84.32M	36.75	40.00	-3.25	Horizontal

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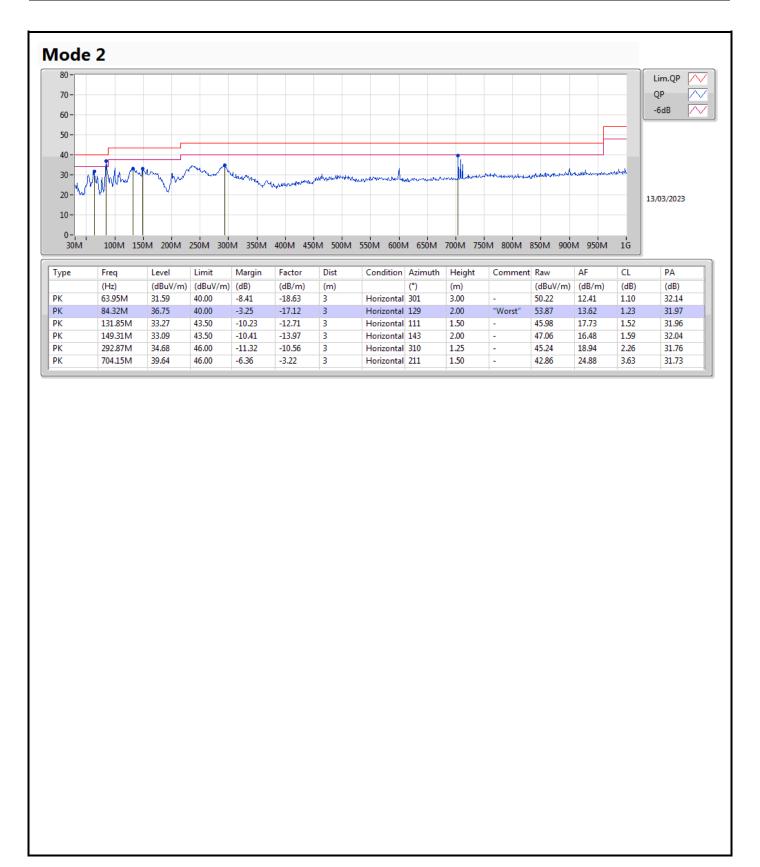
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# RSE TX above 1GHz

Appendix F.2

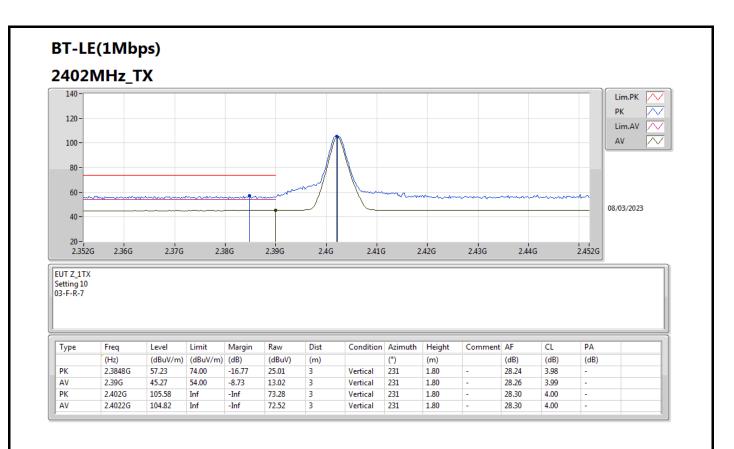
Summary

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(2Mbps)	Pass	AV	2.4835G	52.01	54.00	-1.99	3	Vertical	147	1.84	-

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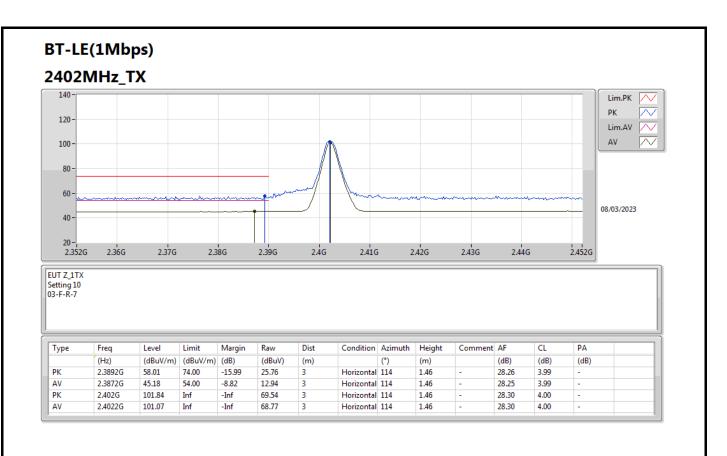




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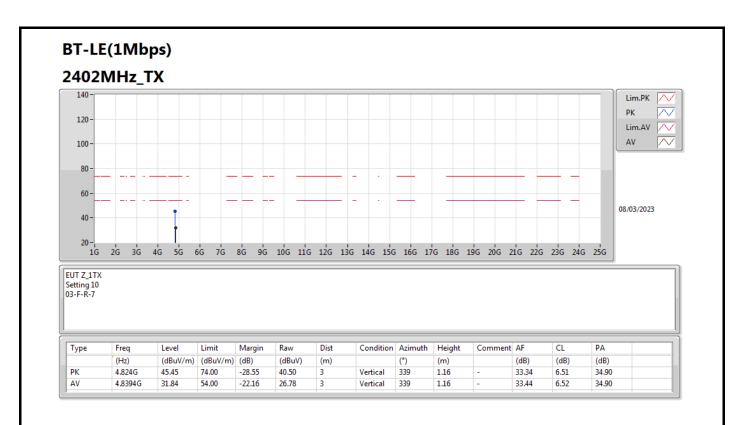




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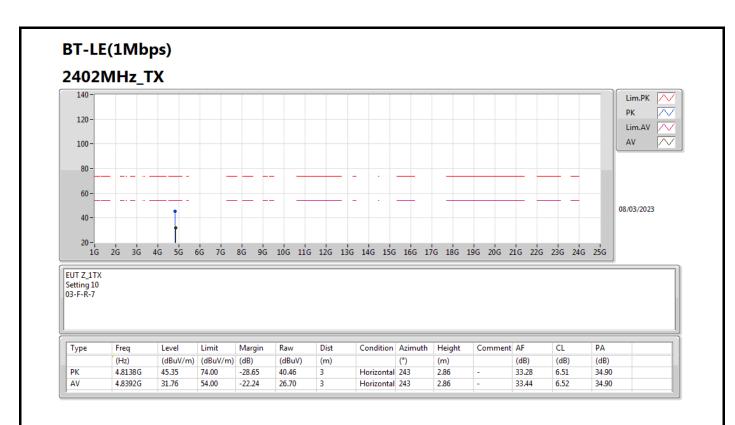




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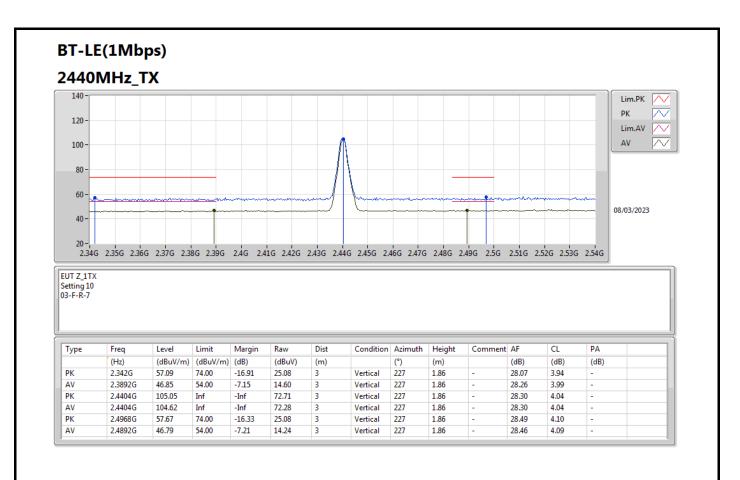




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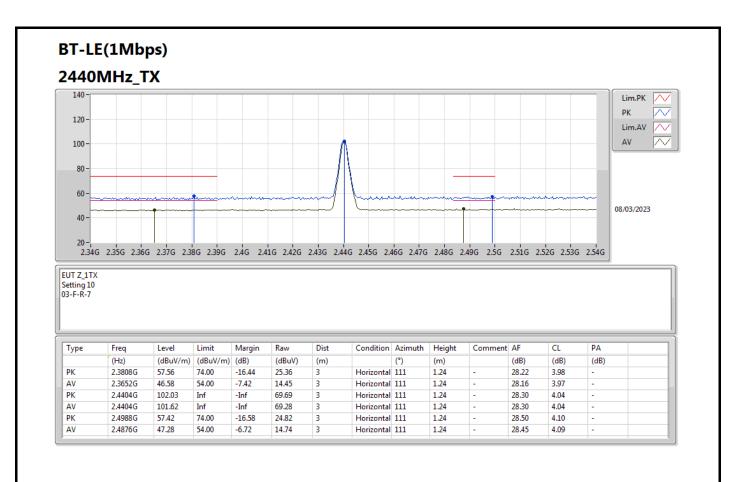




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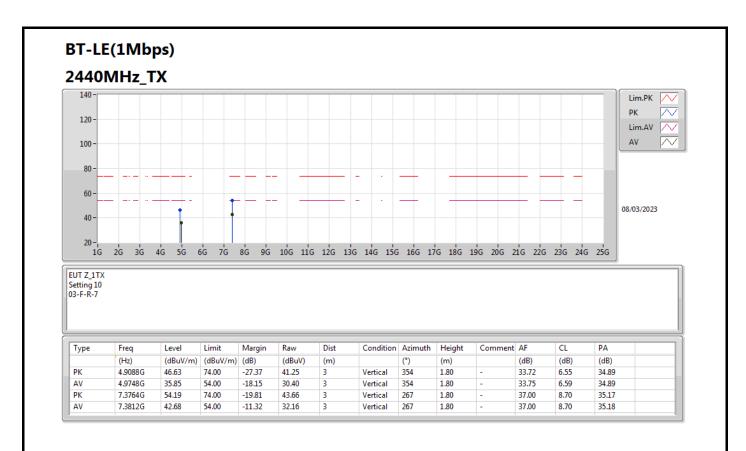




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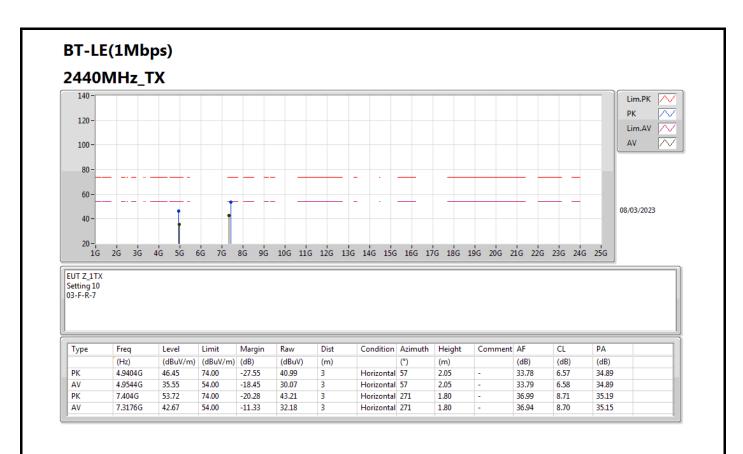




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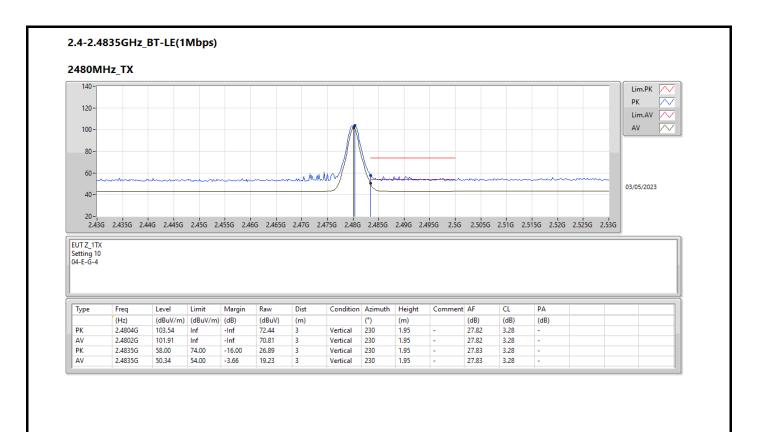




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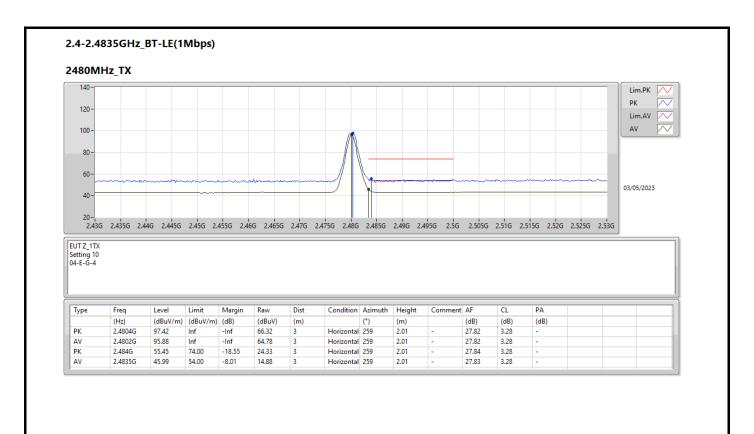




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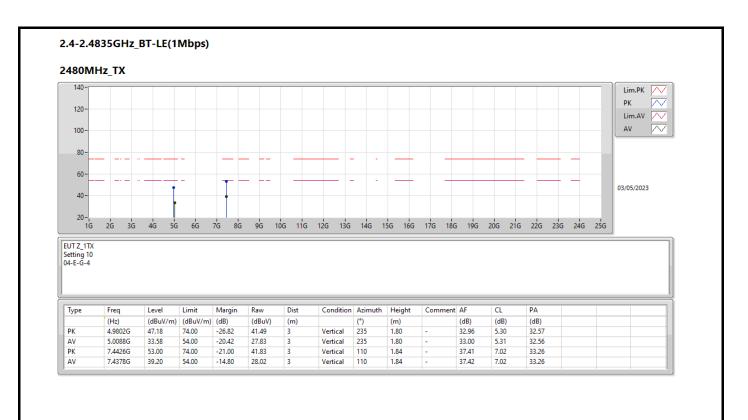




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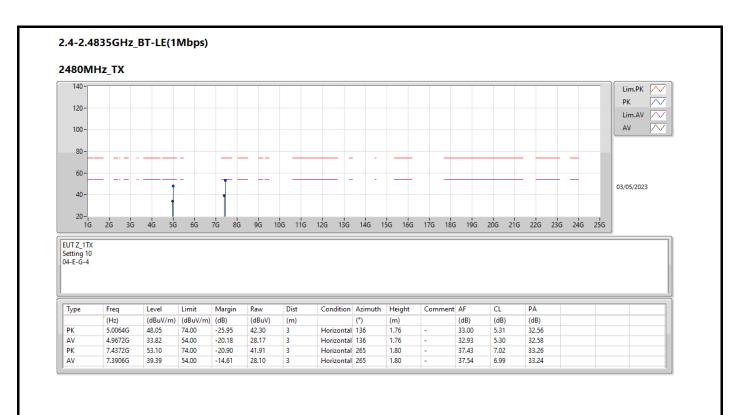




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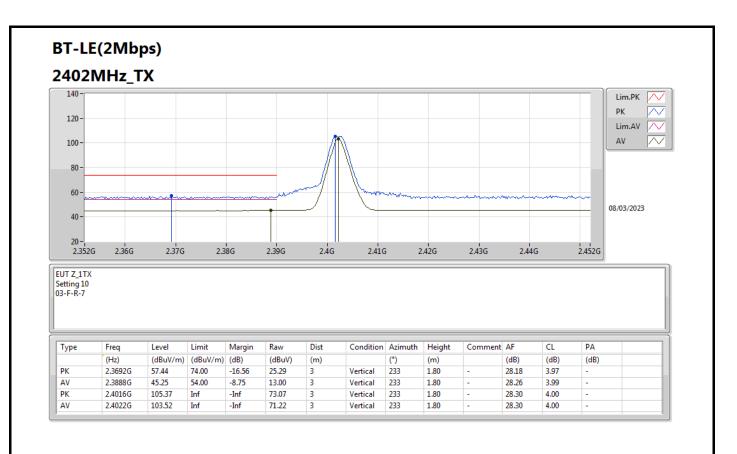




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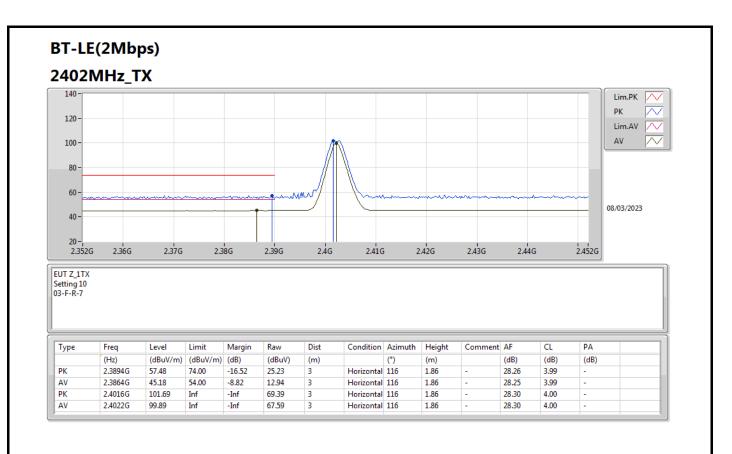




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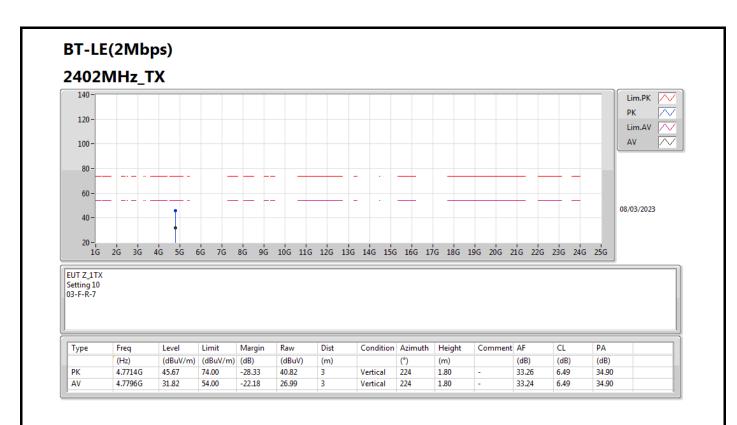




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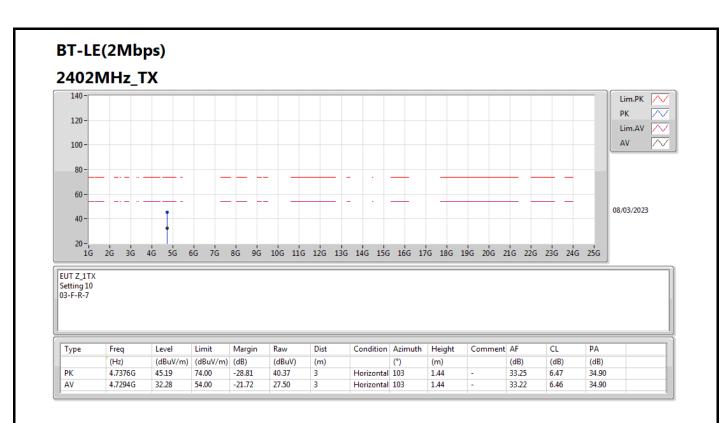




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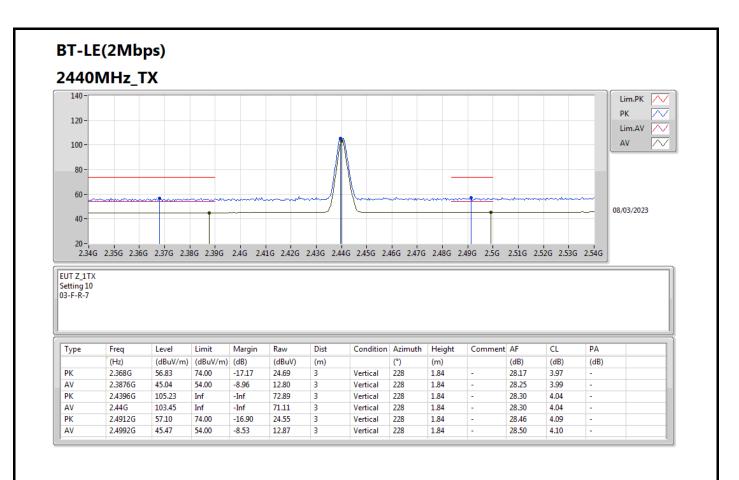




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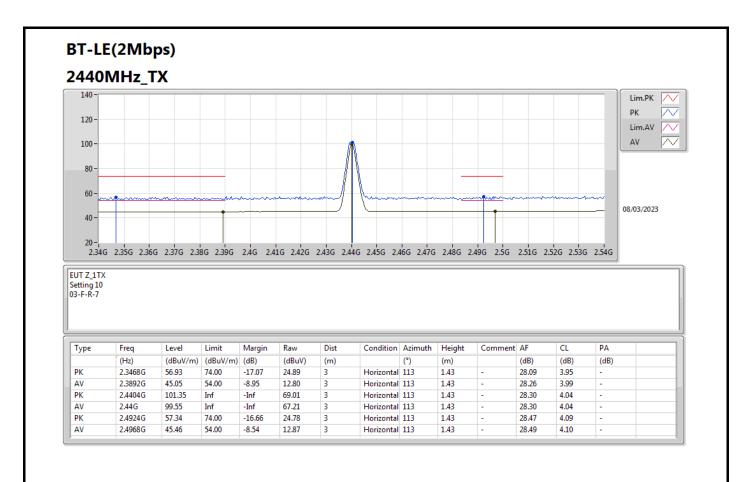




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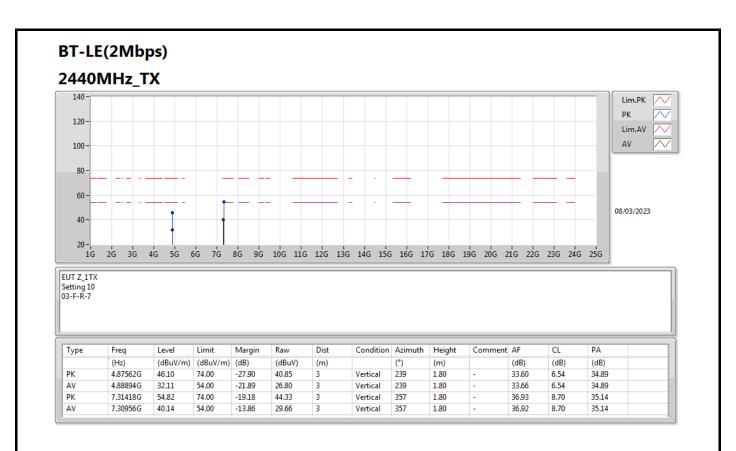
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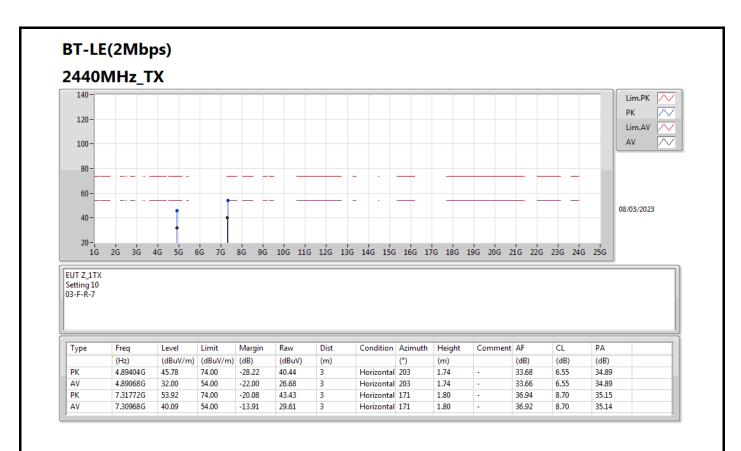




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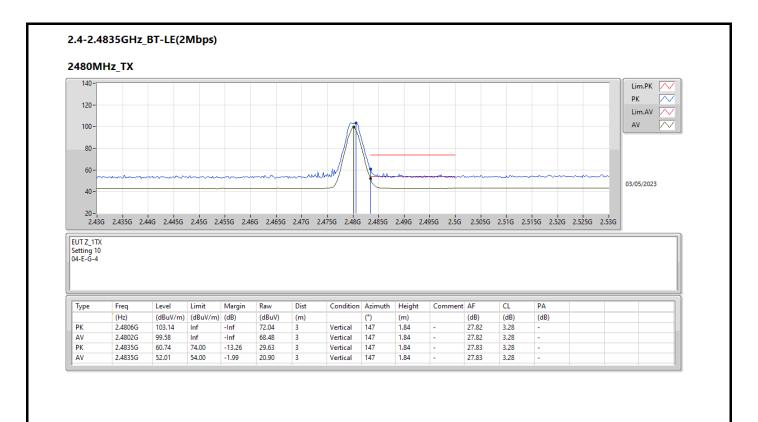




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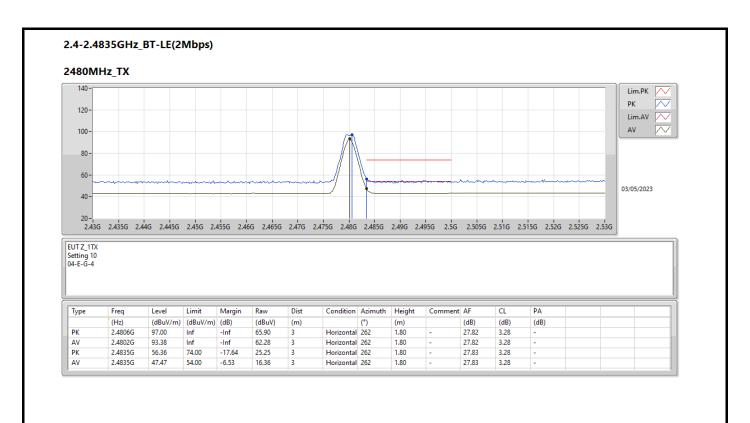




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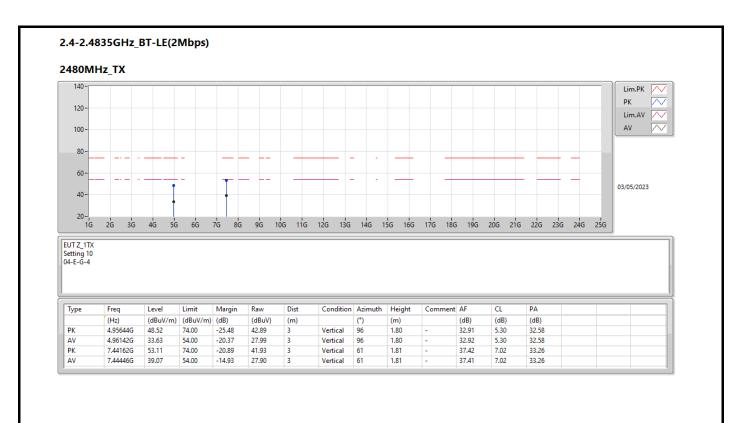




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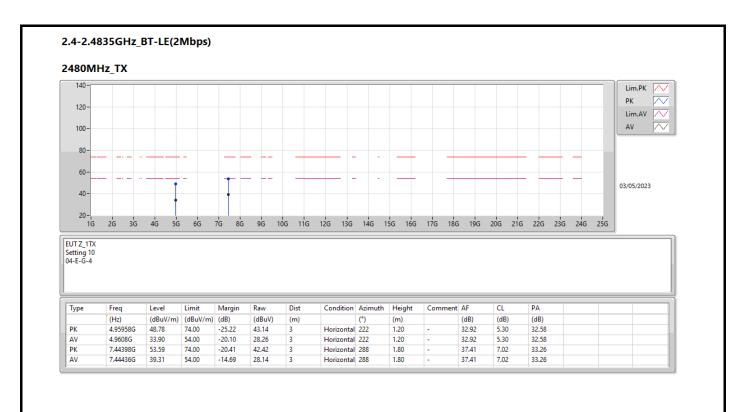




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