

FCC Test Report

FCC ID : 2ABXLT9001
Equipment : Wireless Transceiver
Brand Name : Tile
Model Name : T9001
Applicant : Tile, Inc.
2121 S. El Camino Real Suite 900
San Mateo, CA 94403 USA
Manufacturer : Tile, Inc.
2121 S. El Camino Real Suite 900
San Mateo, CA 94403 USA
Standard : 47 CFR FCC Part 15.247

The product was received on May 29, 2019, and testing was started from Jun. 04, 2019 and completed on Jun. 05, 2019. We, SPORTON INTERNATIONAL INC. EMC & Wireless Communications 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 report must not be used by the client to claim product certification, approval, or endorsement by TAF or any agency of government.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, the test report shall not be reproduced except in full.



Approved by: Allen Lin

SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory

No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)

Table of Contents

HISTORY OF THIS TEST REPORT	3
SUMMARY OF TEST RESULT	4
1 GENERAL DESCRIPTION	5
1.1 Information.....	5
1.2 Testing Applied Standards	6
1.3 Testing Location Information	6
1.4 Measurement Uncertainty	6
2 TEST CONFIGURATION OF EUT.....	7
2.1 Test Condition.....	7
2.2 Test Channel Mode	7
2.3 The Worst Case Measurement Configuration	7
2.4 Accessories and Support Equipment	8
2.5 Test Setup Diagram	8
3 TRANSMITTER TEST RESULT	9
3.1 AC Power-line Conducted Emissions	9
3.2 DTS Bandwidth.....	11
3.3 Maximum Conducted Output Power	12
3.4 Power Spectral Density	14
3.5 Emissions in Non-restricted Frequency Bands	15
3.6 Emissions in Restricted Frequency Bands.....	16
4 TEST EQUIPMENT AND CALIBRATION DATA.....	19
APPENDIX A. TEST RESULTS OF DTS BANDWIDTH	
APPENDIX B. TEST RESULTS OF MAXIMUM CONDUCTED OUTPUT POWER	
APPENDIX C. TEST RESULTS OF POWER SPECTRAL DENSITY	
APPENDIX D. TEST RESULTS OF EMISSIONS IN NON-RESTRICTED FREQUENCY BANDS	
APPENDIX E. TEST RESULTS OF EMISSIONS IN RESTRICTED FREQUENCY BANDS	
APPENDIX F. TEST PHOTOS	
PHOTOGRAPHS OF EUT V01	



History of this test report

[illegible]

Summary of Test Result

Report Clause	Ref. Std. Clause	Test Items	Result (PASS/FAIL)	Remark
1.1.2	15.203	Antenna Requirement	PASS	FCC 15.203
3.1	15.207	AC Power-line Conducted Emissions	Not Required	FCC 15.207
3.2	15.247(a)	DTS Bandwidth	PASS	≥500kHz
3.3	15.247(b)	Maximum Conducted Output Power	PASS	Power [dBm]:30
3.4	15.247(e)	Power Spectral Density	PASS	PSD [dBm/3kHz]:8
3.5	15.247(d)	Emissions in Non-restricted Frequency Bands	PASS	Non-Restricted Bands: >30 dBc
3.6	15.247(d)	Emissions in Restricted Frequency Bands	PASS	Restricted Bands: FCC 15.209

Declaration of Conformity:

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

Comments and explanations:

None

Reviewed by: Jackson Tsai

Report Producer: Jenny Yang

1 General Description

1.1 Information

1.1.1 RF General Information

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

Band	Mode	BWch (MHz)	Nant
2.4-2.4835GHz	BT-LE(1Mbps)	1.0	1TX

Note:

- ♦ Bluetooth LE uses a GFSK (1Mbps) modulation for DSSS.
- ♦ BWch is the nominal channel bandwidth.

1.1.2 Antenna Information

Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)
1	-	-	Integral	N/A	1.13

Note 1: The EUT has one antenna.

For BT function:

For IEEE 802.15.1 Bluetooth mode (1TX/1RX)

Only Ant. 1 (port 1) can be used as transmitting/receiving antenna.

1.1.3 EUT Information

Operational Condition			
EUT Power Type	From Battery		
EUT Function	☐ Point-to-multipoint	☒ Point-to-point	
Type of EUT			
☒	Stand-alone		
☐	Combined (EUT where the radio part is fully integrated within another device)		
	Combined Equipment - Brand Name / Model No.:	...	
☐	Plug-in radio (EUT intended for a variety of host systems)		
	Host System - Brand Name / Model No.:	...	
☐	Other:		

1.1.4 Mode Test Duty Cycle

Mode	DC	DCF(dB)	T(s)	VBW(Hz) $\geq 1/T$
BT-LE(1Mbps)	0.633	1.99	395.625u	3k

Note. If DC < 0.98, the DCF was added while measuring Output power and PSD.

1.2 Testing Applied Standards

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

- ♦ 47 CFR FCC Part 15
- ♦ ANSI C63.10-2013
- ♦ KDB 558074 D01 v05r02

1.3 Testing Location Information

Testing Location				
☒	HWA YA	ADD : No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)		
		TEL : 886-3-327-3456	FAX : 886-3-327-0973	
Test site Designation No. TW1190 with FCC.				
☐	JHUBEI	ADD : No.8, Ln. 724, Bo'ai St., Zhubei City, Hsinchu County, Taiwan (R.O.C.)		
		TEL : 886-3-656-9065	FAX : 886-3-656-9085	
Test site Designation No. TW0006 with FCC.				

Test Condition	Test Site No.	Test Engineer	Test Environment	Test Date
RF Conducted	TH06-HY	Gary	23.2~23.8°C / 62~69%	04/Jun/2019
Radiated	03CH09-HY	Ryan	24.2~27.3°C / 55.8~62.8%	05/Jun/2019

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)	3.54 dB	Confidence levels of 95%
Radiated Emission (9kHz ~ 30MHz)	1.6 dB	Confidence levels of 95%
Radiated Emission (30MHz ~ 1,000MHz)	4.3 dB	Confidence levels of 95%
Radiated Emission (1GHz ~ 18GHz)	3.9 dB	Confidence levels of 95%
Radiated Emission (18GHz ~ 40GHz)	3.5 dB	Confidence levels of 95%
Conducted Emission	1.3 dB	Confidence levels of 95%
Temperature	0.7 °C	Confidence levels of 95%
Humidity	4 %	Confidence levels of 95%

2 Test Configuration of EUT

2.1 Test Condition

RF Conducted	Abbreviation	Remark
TnomVnom	Tnom	20°C
-	Vnom	3V

2.2 Test Channel Mode

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

2.3 The Worst Case Measurement Configuration

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

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	CTX		
1	Battery Mode		
Operating Mode > 1GHz	CTX		
Orthogonal Planes of EUT	X Plane	Y Plane	Z Plane
			
Worst Planes of EUT		V	

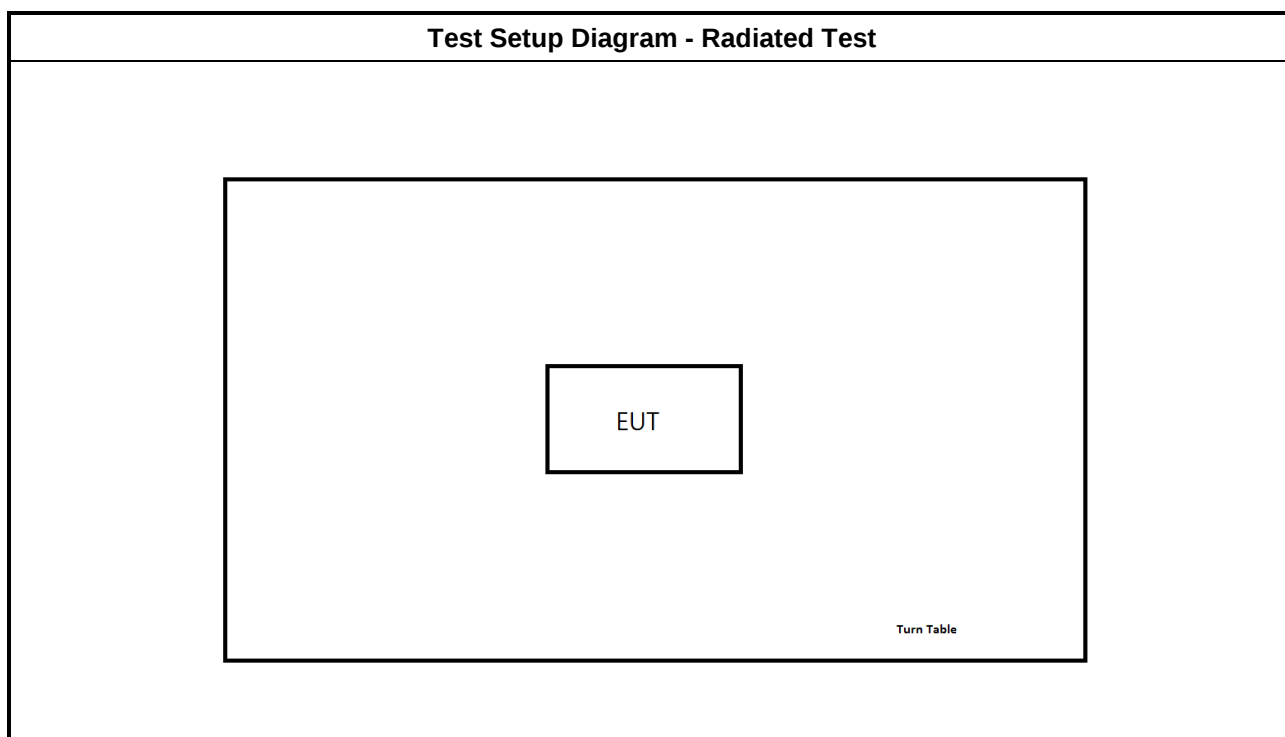
2.4 Accessories and Support Equipment

Accessories				
Battery	Brand Name	Sony	Model Name	CR1632
	Power Rating	3Vdc, 225mAh	Type	Coin Cell

Reminder: Regarding to more detail and other information, please refer to user manual.

Support Equipment – RF Conducted				
No.	Equipment	Brand Name	Model Name	FCC ID
1	DC Power Supply	GW	PSS-2005	-

2.5 Test Setup Diagram



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.

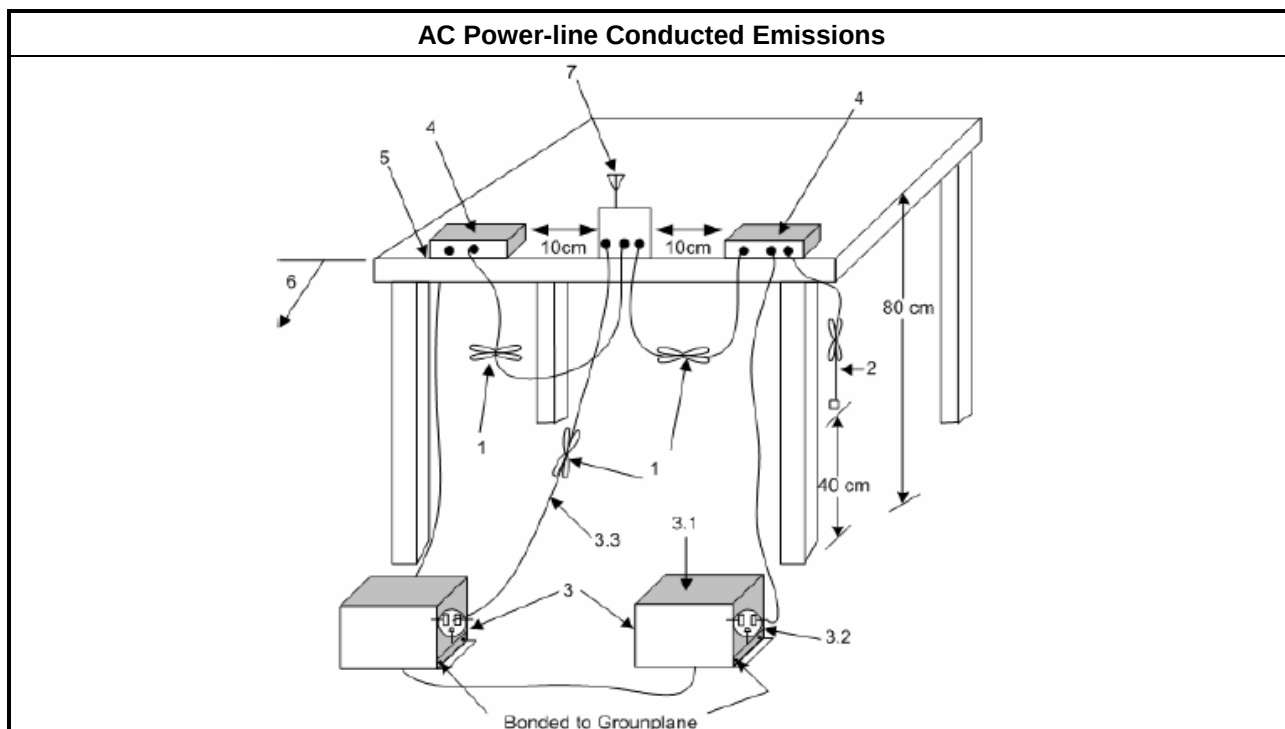
3.1.2 Measuring Instruments

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 foray power-line conducted emissions.

3.1.4 Test Setup





3.1.5 Test Result of AC Power-line Conducted Emissions

Please refer to FCC 15.207 which states, "Measurements to demonstrate compliance with the conducted limits are not required for devices employ Battery for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines".

Therefore, for this device, AC Power Line Conducted Emissions investigation is not required.

3.2 DTS Bandwidth

3.2.1 6dB Bandwidth Limit

6dB Bandwidth Limit	
Systems using digital modulation techniques:	
▪	6 dB bandwidth $\geq$ 500 kHz.

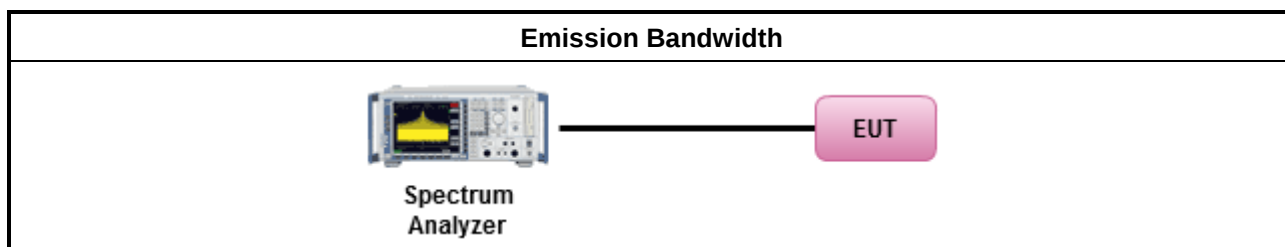
3.2.2 Measuring Instruments

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 KDB 558074, clause 8.2 (11.8 of ANSI C63.10) DTS bandwidth measurement.
☐	Refer as RSS-Gen, clause 6.7 for occupied bandwidth testing.
☐	Refer as ANSI C63.10, clause 6.9.3 for occupied bandwidth testing.

3.2.4 Test Setup



3.2.5 Test Result of Emission Bandwidth

Refer as Appendix A

3.3 Maximum Conducted Output Power

3.3.1 Maximum Conducted Output Power Limit

Maximum Conducted Output Power Limit	
	If $G_{TX} \leq 6$ dBi, then $P_{Out} \leq 30$ 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
e.i.r.p. Power Limit:	
	2400-2483.5 MHz Band
	Point-to-multipoint systems (P2M): $P_{eirp} \leq 36$ dBm (4 W)
	Point-to-point systems (P2P): $P_{eirp} \leq \text{MAX}(36, [P_{Out} + G_{TX}])$ dBm
	Smart antenna system (SAS)
	- Single beam: $P_{eirp} \leq \text{MAX}(36, P_{Out} + G_{TX})$ dBm
	- Overlap beam: $P_{eirp} \leq \text{MAX}(36, P_{Out} + G_{TX})$ dBm
	- Aggregate power on all beams: $P_{eirp} \leq \text{MAX}(36, [P_{Out} + G_{TX} + 8])$ dBm
P_{Out} = maximum peak conducted output power or maximum conducted output power in dBm, G_{TX} = the maximum transmitting antenna directional gain in dBi.	

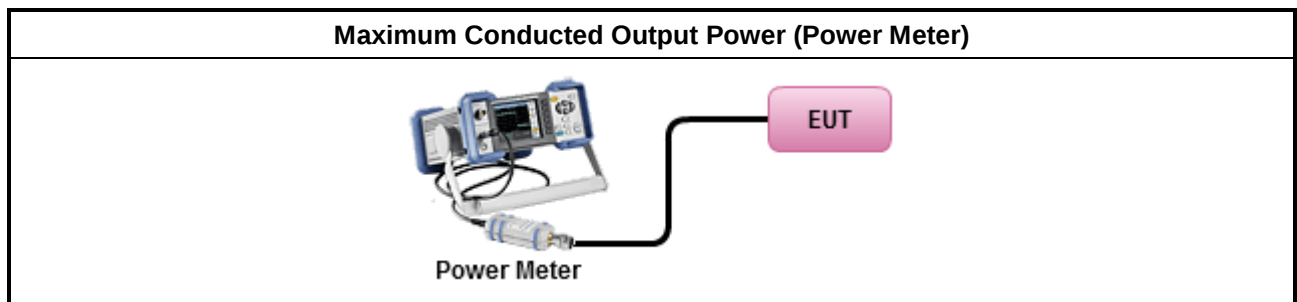
3.3.2 Measuring Instruments

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

3.3.3 Test Procedures

Test Method	
Maximum Peak Conducted Output Power	
☐	Refer as KDB 558074, clause 8.3.1.1 (11.9.1.1 of ANSI C63.10) RBW ≥ EBW method.
☐	Refer as KDB 558074, clause 8.3.1.2 (11.9.1.2 of ANSI C63.10) integrated band power method.
☐	Refer as KDB 558074, clause 8.3.1.3 (11.9.1.3 of ANSI C63.10) peak power meter.
Maximum Average Conducted Output Power	
☐	Refer as KDB 558074, clause 8.3.2.2 (11.9.2.2 of ANSI C63.10) using a spectrum analyzer.
☒	Refer as KDB 558074, clause 8.3.2.3 (11.9.2.3 of ANSI C63.10) using a power meter.
For conducted measurement.	
If the EUT supports multiple transmit chains using options given below: Refer as 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: $P_{total} = P_1 + P_2 + \dots + P_n$ (calculated in linear unit [mW] and transfer to log unit [dBm]) $EIRP_{total} = P_{total} + DG$	

3.3.4 Test Setup



3.3.5 Test Result of Maximum Conducted Output Power

Refer as Appendix B

3.4 Power Spectral Density

3.4.1 Power Spectral Density Limit

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

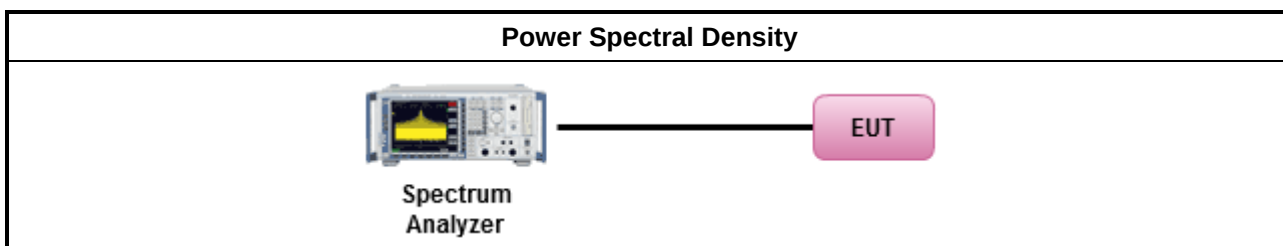
3.4.2 Measuring Instruments

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

3.4.3 Test Procedures

Test Method	
▪	Peak power spectral density procedures that the same method as used to determine the conducted output power. If maximum peak conducted output power was measured to demonstrate compliance to the output power limit, then the peak PSD procedure below (Method PKPSD) shall be used. If maximum conducted output power was measured to demonstrate compliance to the output power limit, then one of the average PSD procedures shall be used, as applicable based on the following criteria (the peak PSD procedure is also an acceptable option).
☒	Refer as KDB 558074, clause 8.4 (11.10 of ANSI C63.10) Method PKPSD.
▪	For conducted measurement.
▪	If The EUT supports multiple transmit chains using options given below:
▪	Measure and sum the spectra across the outputs. Refer as 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.

3.4.4 Test Setup



3.4.5 Test Result of Power Spectral Density

Refer as Appendix C

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 (dB)
Peak output power procedure	20
Average output power procedure	30
Note 1: If the peak output power procedure is used to measure the fundamental emission power to demonstrate compliance to requirements, then the peak conducted output power measured within any 100 kHz outside the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum measured in-band peak PSD level. Note 2: If the average output power procedure is used to measure the fundamental emission power to demonstrate compliance to requirements, then the power in any 100 kHz outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum measured in-band average PSD level.	

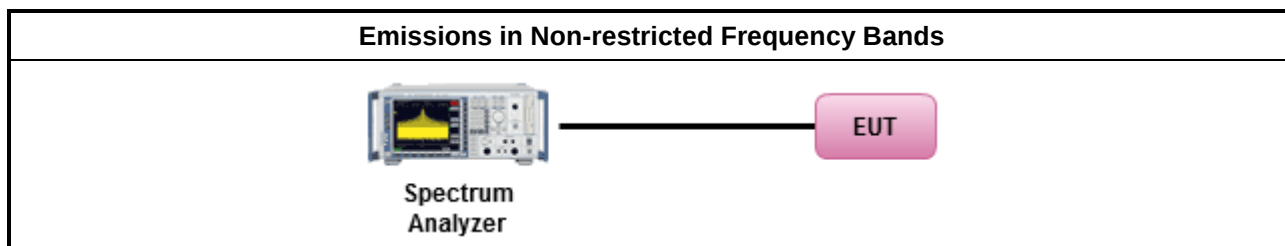
3.5.2 Measuring Instruments

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

3.5.3 Test Procedures

Test Method
Refer as KDB 558074, clause 8.5 (11.11 of ANSI C63.10) for non-restricted frequency bands.

3.5.4 Test Setup



3.5.5 Test Result of Emissions in Non-restricted Frequency Bands

Refer as Appendix D

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

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 below 30 MHz at a closer distance than the limit distance, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two or more distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB / decade). The test report shall specify the extrapolation method used to determine compliance of the EUT.

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

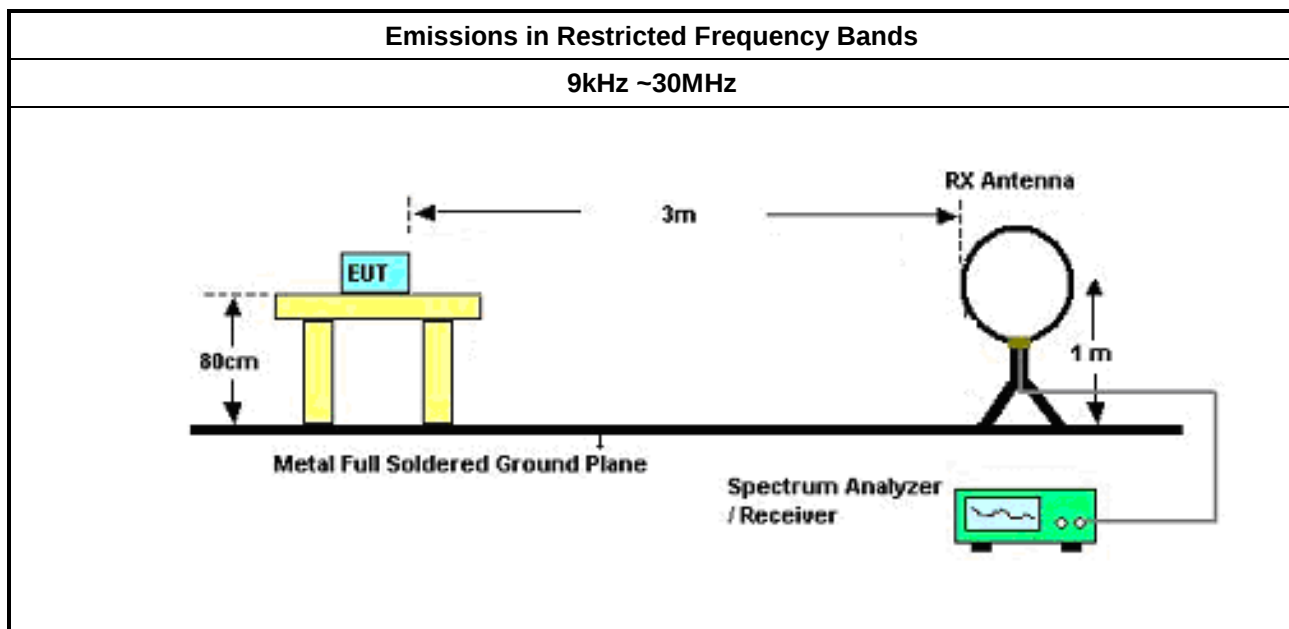
3.6.2 Measuring Instruments

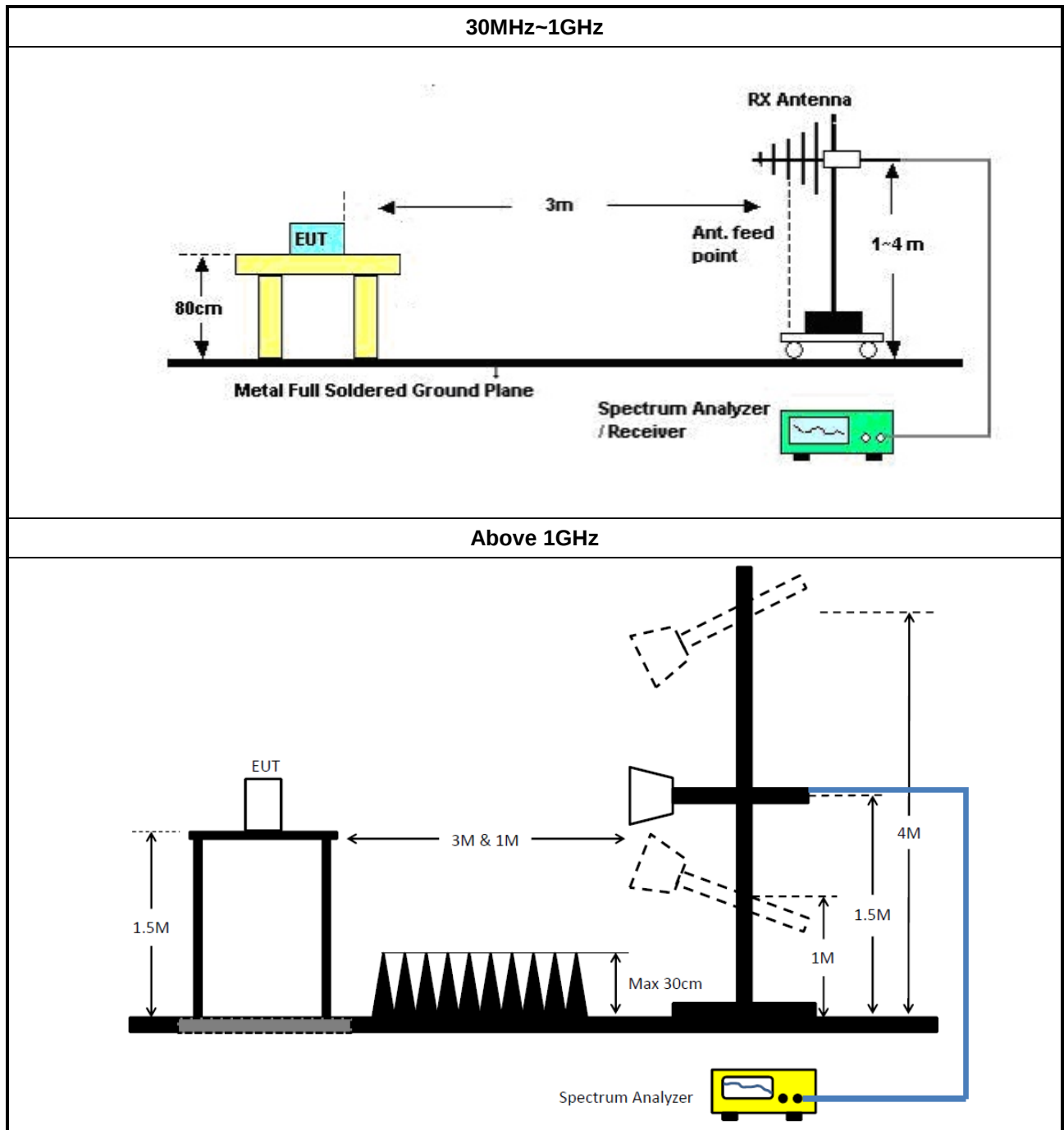
Refer a test equipment and calibration data table in this test report.

3.6.3 Test Procedures

Test Method	
The average emission levels shall be measured in [duty cycle ≥ 98 or duty factor].	
Refer as ANSI C63.10, clause 6.10.3 band-edge testing shall be performed at the lowest frequency channel and highest frequency channel within the allowed operating band.	
For the transmitter unwanted emissions shall be measured using following options below:	
	Refer as KDB 558074, clause 8.6 (11.12 of ANSI C63.10) for restricted frequency bands.
For the transmitter band-edge emissions shall be measured using following options below:	
	Refer as KDB 558074 clause 8.7.1, When the performing peak or average radiated measurements, emissions within 2 MHz of the authorized band edge may be measured using the marker-delta method described below.
	Refer as KDB 558074, clause 8.7.2 (6.10.6 of ANSI C63.10) for marker-delta method for band-edge measurements.
	Refer as KDB 558074, clause 8.7.3 for narrower resolution bandwidth (100kHz) using the band power and summing the spectral levels (i.e., 1 MHz).
Use the following spectrum analyzer settings:	
	Set RBW=100 kHz for $f < 1$ GHz; VBW=3 * RBW; Sweep = auto; Detector function = peak; Trace = max hold.
	Set RBW = 1 MHz, VBW= 3MHz for $f \geq 1$ GHz for peak measurement. For average measurement, refer as 1.1.4.

3.6.4 Test Setup





3.6.5 Test Result of Emissions in Restricted Frequency Bands (Below 30MHz)

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

3.6.6 Test Result of Emissions in Restricted Frequency Bands

Refer as Appendix E

4 Test Equipment and Calibration Data

Instrument for Conducted Test

Instrument	Manufacturer	Model No.	Serial No.	Spec.	Calibration Date	Calibration Due Date
Spectrum Analyzer	R&S	FSV 40	101013	10Hz~40GHz	13/Mar/2019	12/Mar/2020
Power Sensor	Anritsu	MA2411B	1339407	300MHz ~ 40GHz	17/Nov/2018	16/Nov/2019
Power Meter	Anritsu	ML2495A	1517010	300MHz ~ 40GHz	17/Nov/2018	16/Nov/2019
Cable 0.2m	HUBER	MY10710/4	RF Cable - 01	30MHz ~18G	10/Jan/2019	09/Jan/2020
Cable 0.2m	HUBER	MY10711/4	RF Cable - 02	30MHz ~18G	10/Jan/2019	09/Jan/2020
Cable 0.5m	HUBER	MY39470/4	RF Cable - 29	30MHz ~18G	10/Jan/2019	09/Jan/2020
CABLE 1.5m	HUBER	MY33066/4	RF Cable - 30	1 to 18GHz	10/Jan/2019	09/Jan/2020
SMB100A Signal Generator	R&S	SMB100A03	181147	100kHz~40GHz	12/Nov/2018	10/Nov/2020

Instrument for Radiated Test

Instrument	Manufacturer	Model No.	Serial No.	Spec.	Calibration Date	Calibration Due Date
3m Semi Anechoic Chamber	TDK	SAC-3M	03CH09-HY	30MHz ~ 1GHz	30/Mar/2019	29/Mar/2020
3m Semi Anechoic Chamber	TDK	SAC-3M	03CH09-HY	1GHz ~ 18GHz	30/Mar/2019	29/Mar/2020
Microwave Preamplifier	Agilent	8449B	3008A02326	1GHz ~ 26.5GHz	03/Jul/2018	02/Jul/2019
Amplifier	EMC	EMC9135	980209	9kHz ~ 1.0GHz	11/Jan/2019	10/Jan/2020
EMI Test Receiver	R&S	ESR3	102052	9kHz ~ 3.6GHz	09/Apr/2019	08/Apr/2020
EXA Signal Analyzer	KEYSIGHT	N9010A	MY54200885	10Hz ~ 44GHz	31/Jul/2018	30/Jul/2019
Bilog Antenna & 5dB Attenuator	TESEQ & MTJ	CBL6111D & MTJ6102-05	35418 / 3	30MHz~1GHz	02/Oct/2018	03/Oct/2019
Double ridged Guide Horn Antenna	COM-POWER	AH-118	10094	1GHz~18GHz	13/Jul/2018	12/Jul/2019
Broadband Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170614	18GHz~40GHz	22/May/2019	21/May/2020
Loop Antenna	TESEQ	HLA 6120	31244	9k-30MHz	15/Mar/2019	14/Mar/2020
LF-CABLE-20190 218	Jye Bao	RG142	CB028	9kHz ~ 1GHz	18/Feb/2019	17/Feb/2020
RF Cable-high	HUBER+SUHNER	SUCOFLEX104	SN 556626/4 + 556627	1GHz ~ 40GHz	14/Mar/2019	13/Mar/2020

Summary

Mode	Max-N dB (Hz)	Max-OBW (Hz)	ITU-Code	Min-N dB (Hz)	Min-OBW (Hz)
2.4-2.4835GHz	-	-	-	-	-
BT-LE(1Mbps)	716.25k	1.047M	1M05F1D	700k	1.043M

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

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

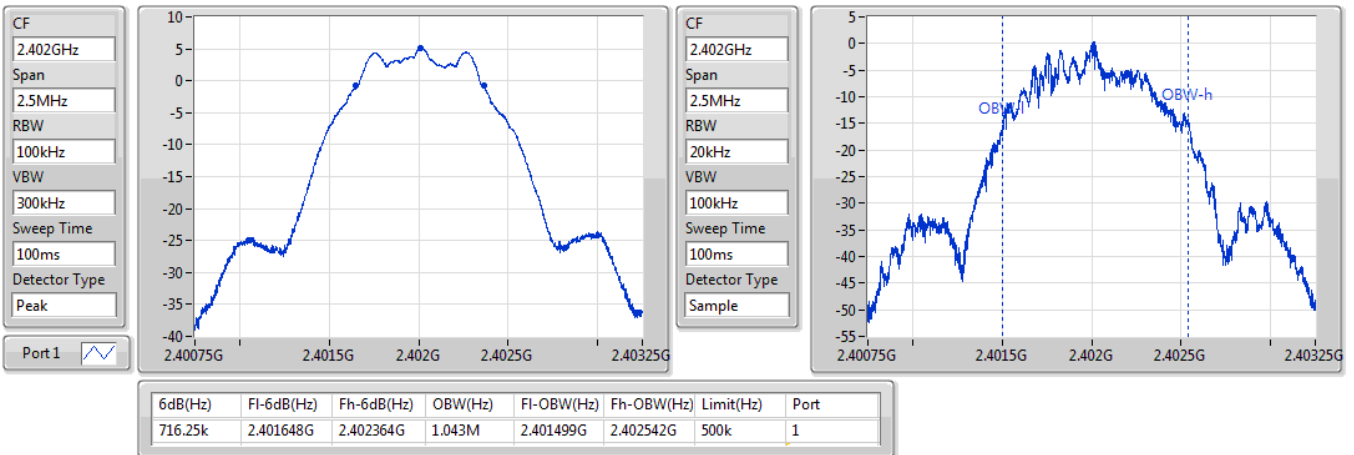
Result

Mode	Result	Limit (Hz)	Port 1-N dB (Hz)	Port 1-OBW (Hz)
BT-LE(1Mbps)	-	-	-	-
2402MHz_TnomVnom	Pass	500k	716.25k	1.043M
2440MHz_TnomVnom	Pass	500k	700k	1.047M
2480MHz_TnomVnom	Pass	500k	710k	1.046M

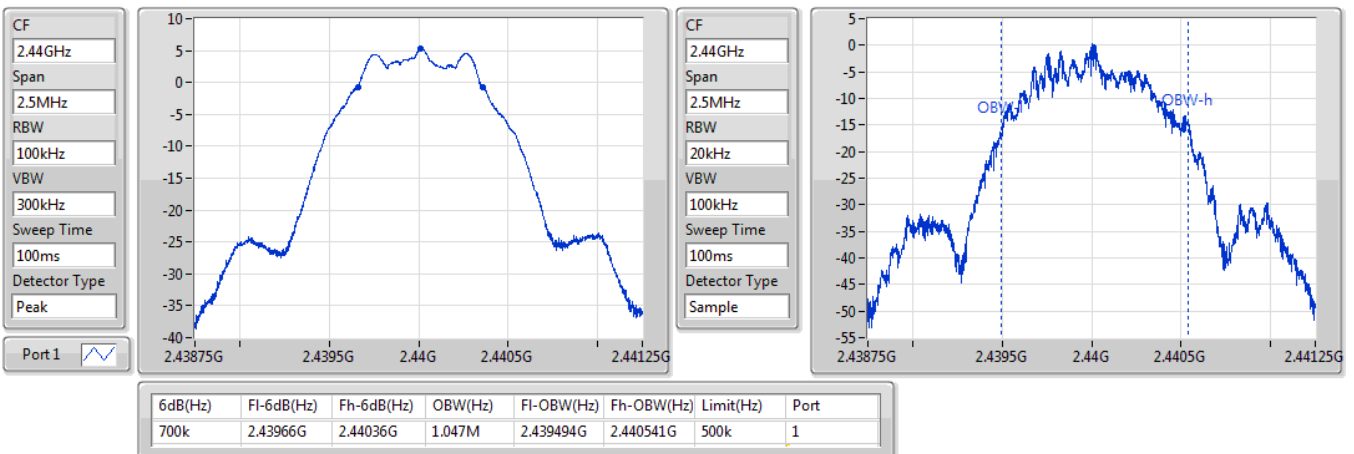
Port X-N dB = Port X 6dB down bandwidth; **Port X-OBW** = Port X 99% occupied bandwidth;

BT-LE(1Mbps)
2402MHz
EBW

04/06/2019


BT-LE(1Mbps)
2440MHz
EBW

04/06/2019

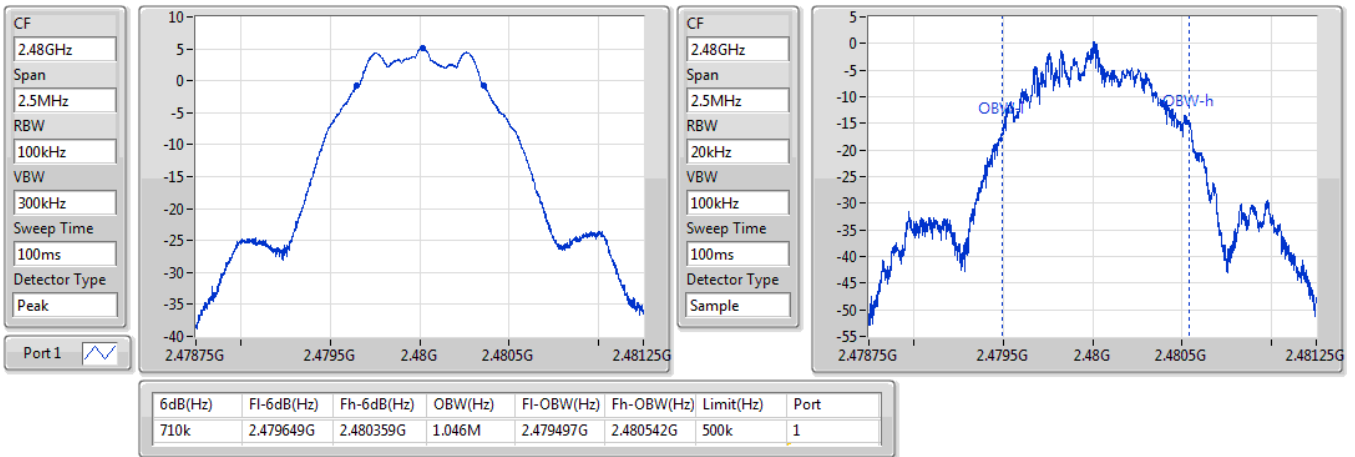


BT-LE(1Mbps)

2480MHz

EBW

04/06/2019





Summary

Mode	Power (dBm)	Power (W)
2.4-2.4835GHz	-	-
BT-LE(1Mbps)	4.75	0.00299



Result

Mode	Result	Gain (dBi)	Power (dBm)	Power Limit (dBm)
BT-LE(1Mbps)	-	-	-	-
2402MHz_TnomVnom	Pass	1.13	4.68	30.00
2440MHz_TnomVnom	Pass	1.13	4.75	30.00
2480MHz_TnomVnom	Pass	1.13	4.68	30.00

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



Summary

Mode	PD (dBm/RBW)
2.4-2.4835GHz	-
BT-LE(1Mbps)	-10.26

RBW=3 kHz.

Result

Mode	Result	Gain (dBi)	PD (dBm/RBW)	PD Limit (dBm/RBW)
BT-LE(1Mbps)	-	-	-	-
2402MHz_TnomVnom	Pass	1.13	-10.31	8.00
2440MHz_TnomVnom	Pass	1.13	-10.26	8.00
2480MHz_TnomVnom	Pass	1.13	-10.52	8.00

DG = Directional Gain; RBW=3 kHz;

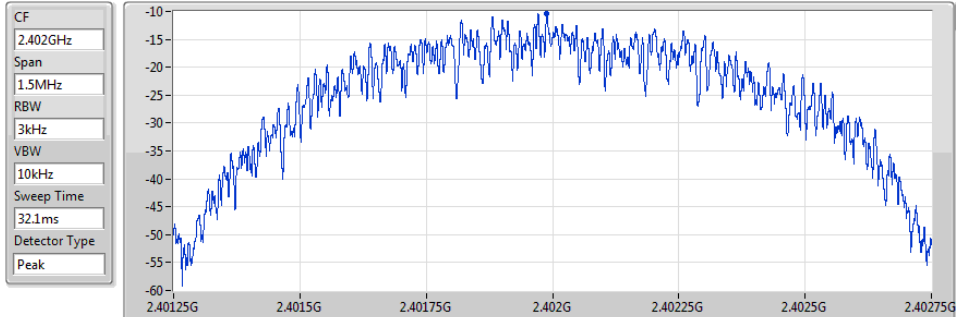
PD = trace bin-by-bin of each transmits port summing can be performed maximum power density; **Port X** = Port X power density;

BT-LE(1Mbps)

PSD

2402MHz

04/06/2019



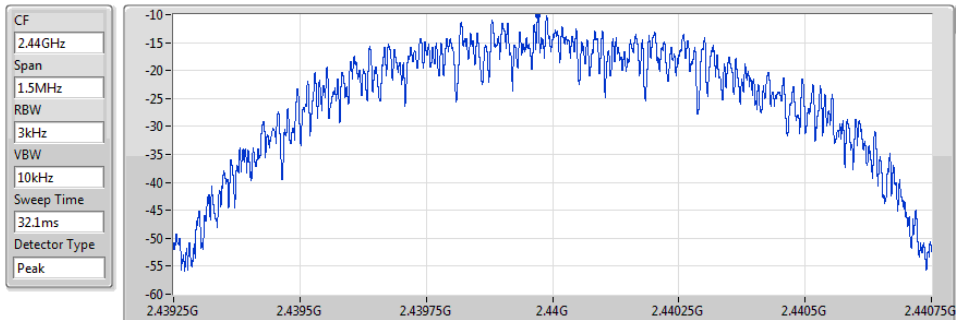
Sum	PD	Port 1
(dBm/RBW)	(dBm/RBW)	(dBm/RBW)
-10.31	-10.31	-10.31

BT-LE(1Mbps)

PSD

2440MHz

04/06/2019



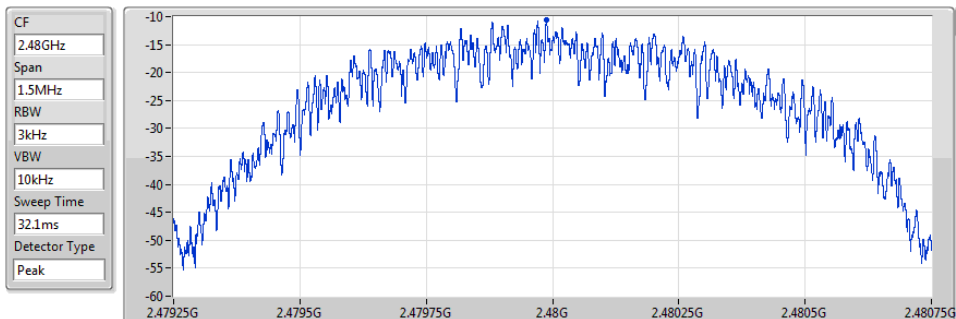
Sum	PD	Port 1
(dBm/RBW)	(dBm/RBW)	(dBm/RBW)
-10.26	-10.26	-10.26

BT-LE(1Mbps)

PSD

2480MHz

04/06/2019



Sum	PD	Port 1
(dBm/RBW)	(dBm/RBW)	(dBm/RBW)
-10.52	-10.52	-10.52



Summary

Mode	Result	Ref (Hz)	Ref (dBm)	Limit (dBm)	Freq (Hz)	Level (dBm)	Freq (Hz)	Level (dBm)	Freq (Hz)	Level (dBm)	Freq (Hz)	Level (dBm)	Port
2.4-2.4835GHz	-	-	-	-	-	-	-	-	-	-	-	-	-
BT-LE(1Mbps)	Pass	2.44004G	4.97	-25.03	2.39415G	-54.31	2.39974G	-45.15	2.48473G	-54.73	2.52771G	-47.75	1

Result

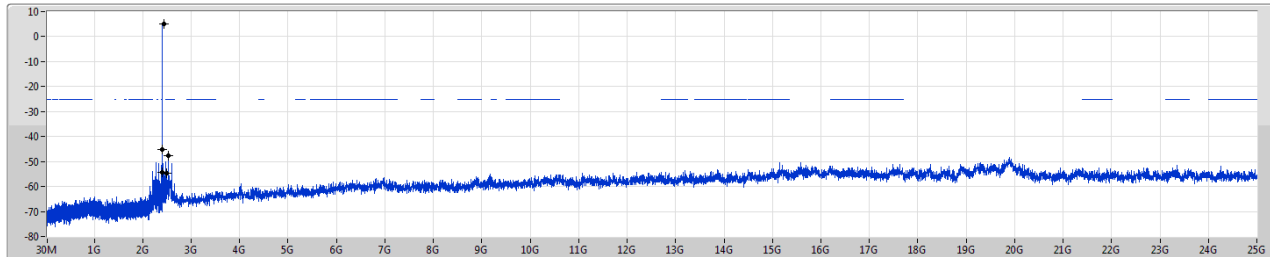
Mode	Result	Ref (Hz)	Ref (dBm)	Limit (dBm)	Freq (Hz)	Level (dBm)	Freq (Hz)	Level (dBm)	Freq (Hz)	Level (dBm)	Freq (Hz)	Level (dBm)	Port
BT-LE(1Mbps)	-	-	-	-	-	-	-	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	2.44004G	4.97	-25.03	2.39415G	-54.31	2.39974G	-45.15	2.48473G	-54.73	2.52771G	-47.75	1
2440MHz_TnomVnom	Pass	2.44004G	4.97	-25.03	2.39208G	-59.05	2.39974G	-54.84	2.48518G	-57.13	2.56712G	-46.69	1
2480MHz_TnomVnom	Pass	2.44004G	4.97	-25.03	2.30387G	-58.81	2.39995G	-57.59	2.48352G	-48.36	2.60652G	-47.80	1

BT-LE(1Mbps)

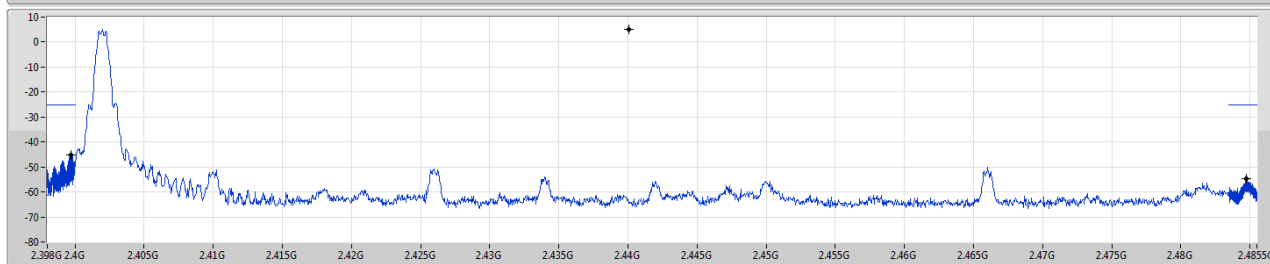
CSE NdB

2402MHz

04/06/2019



Port1



RBW (Hz)
100k
VBW (Hz)
300k
Detector
Peak

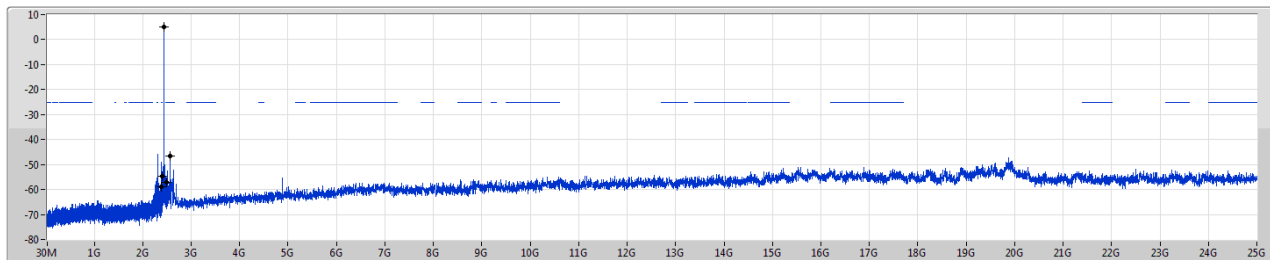
Ref(Hz)	Ref(dBm)	Limit(dBm)	Freq(Hz)	Level(dBm)	Freq(Hz)	Level(dBm)	Freq(Hz)	Level(dBm)	Freq(Hz)	Level(dBm)	Port
2.44004G	4.97	-25.03	2.39415G	-54.31	2.39974G	-45.15	2.48473G	-54.73	2.52771G	-47.75	1

BT-LE(1Mbps)

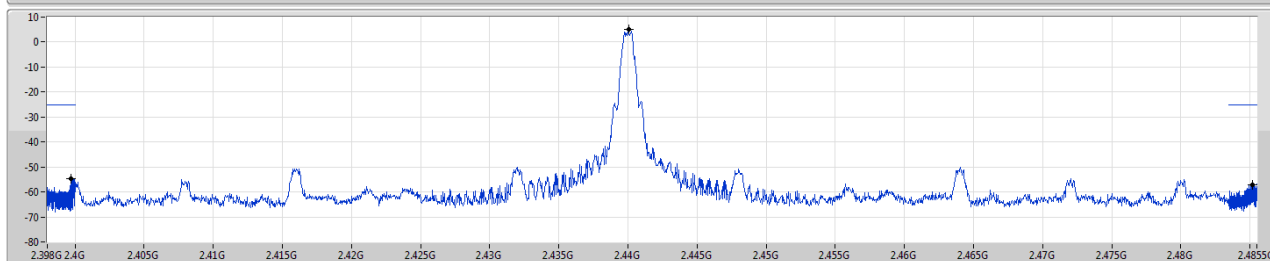
CSE NdB

2440MHz

04/06/2019



Port1



RBW (Hz)
100k
VBW (Hz)
300k
Detector
Peak

Ref(Hz)	Ref(dBm)	Limit(dBm)	Freq(Hz)	Level(dBm)	Freq(Hz)	Level(dBm)	Freq(Hz)	Level(dBm)	Freq(Hz)	Level(dBm)	Port
2.44004G	4.97	-25.03	2.39208G	-59.05	2.39974G	-54.84	2.48518G	-57.13	2.56712G	-46.69	1

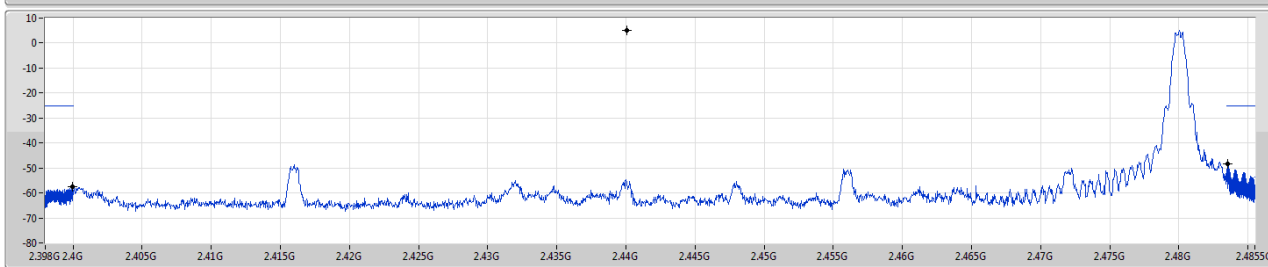
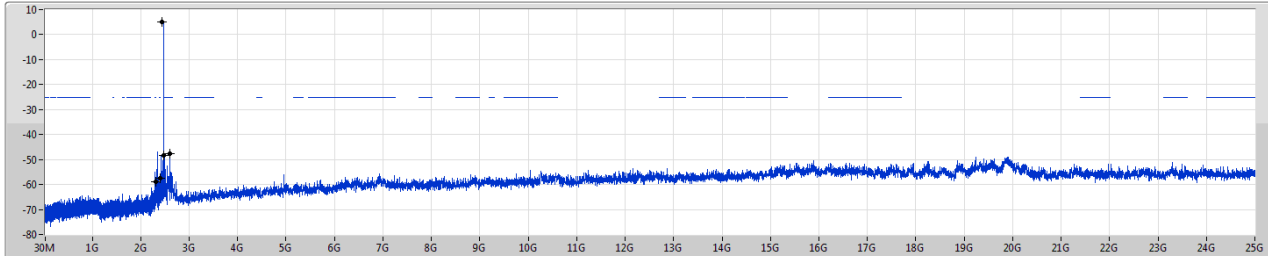
BT-LE(1Mbps)

2480MHz

CSE NdB

04/06/2019

Port1



RBW (Hz)
100k
VBW (Hz)
300k
Detector
Peak

Ref(Hz)	Ref(dBm)	Limit(dBm)	Freq(Hz)	Level(dBm)	Freq(Hz)	Level(dBm)	Freq(Hz)	Level(dBm)	Freq(Hz)	Level(dBm)	Port
2.44004G	4.97	-25.03	2.30387G	-58.81	2.39995G	-57.59	2.48352G	-48.36	2.60652G	-47.80	1

**Summary**

Mode	Result	Type	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Factor (dB)	Dist (m)	Condition	Azimuth (°)	Height (m)	Comments
2.4-2.4835GHz	-	-	-	-	-	-	-	-	-	-	-	-
BT-LE(1Mbps)	Pass	PK	30M	24.76	40.00	-15.24	-8.16	3	Vertical	0	1.00	-

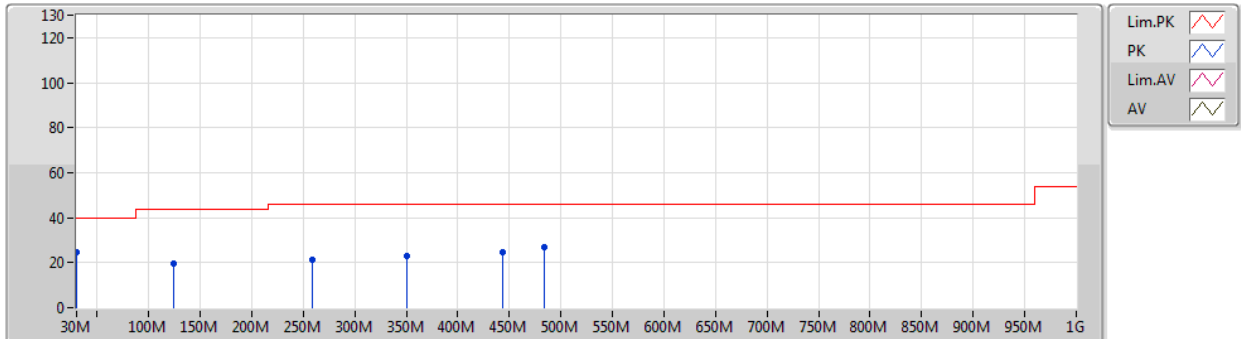
Result

Mode	Result	Type	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Factor (dB)	Dist (m)	Condition	Azimuth (°)	Height (m)	Comments
BT-LE(1Mbps)	-	-	-	-	-	-	-	-	-	-	-	-
2440MHz_Battery	Pass	PK	30M	24.76	40.00	-15.24	-8.16	3	Vertical	0	1.00	-
2440MHz_Battery	Pass	PK	124.19M	19.78	43.50	-23.72	-13.79	3	Vertical	0	1.00	-
2440MHz_Battery	Pass	PK	259.14M	21.54	46.00	-24.46	-11.21	3	Vertical	0	1.00	-
2440MHz_Battery	Pass	PK	350.52M	22.82	46.00	-23.18	-10.24	3	Vertical	0	1.00	-
2440MHz_Battery	Pass	PK	443.3M	24.88	46.00	-21.12	-7.37	3	Vertical	0	1.00	-
2440MHz_Battery	Pass	PK	484.07M	26.67	46.00	-19.33	-6.37	3	Vertical	0	1.00	-
2440MHz_Battery	Pass	PK	30M	24.60	40.00	-15.40	-8.16	3	Horizontal	360	1.00	-
2440MHz_Battery	Pass	PK	117.16M	19.15	43.50	-24.35	-13.76	3	Horizontal	360	1.00	-
2440MHz_Battery	Pass	PK	268.99M	21.20	46.00	-24.80	-11.56	3	Horizontal	360	1.00	-
2440MHz_Battery	Pass	PK	406.75M	28.35	46.00	-17.65	-8.15	3	Horizontal	360	1.00	-
2440MHz_Battery	Pass	PK	554.36M	28.42	46.00	-17.58	-4.84	3	Horizontal	360	1.00	-
2440MHz_Battery	Pass	PK	652.77M	29.35	46.00	-16.65	-4.03	3	Horizontal	360	1.00	-

BT-LE(1Mbps)

2440MHz_Battery

05/06/2019

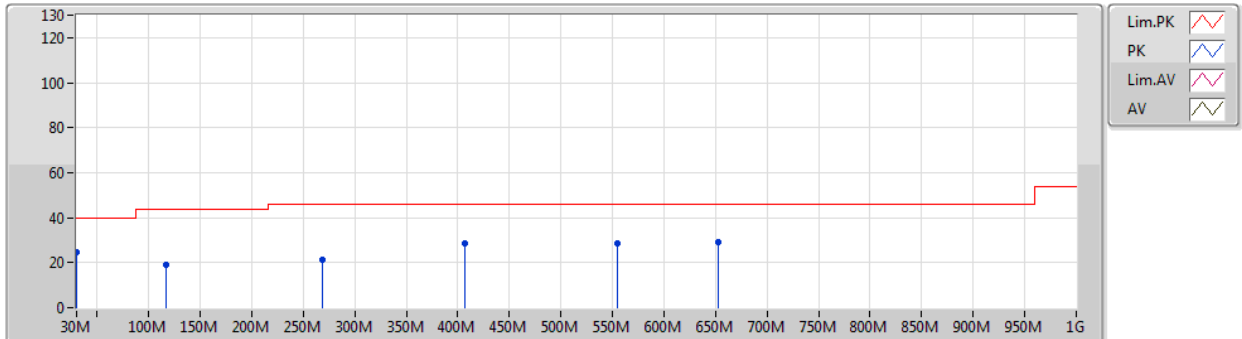


Type	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Factor (dB)	Dist (m)	Condition	Azimuth (°)	Height (m)	Comment				
PK	30M	24.76	40.00	-15.24	-8.16	3	Vertical	0	1.00	-				
PK	124.19M	19.78	43.50	-23.72	-13.79	3	Vertical	0	1.00	-				
PK	259.14M	21.54	46.00	-24.46	-11.21	3	Vertical	0	1.00	-				
PK	350.52M	22.82	46.00	-23.18	-10.24	3	Vertical	0	1.00	-				
PK	443.3M	24.88	46.00	-21.12	-7.37	3	Vertical	0	1.00	-				
PK	484.07M	26.67	46.00	-19.33	-6.37	3	Vertical	0	1.00	-				

BT-LE(1Mbps)

2440MHz_Battery

05/06/2019



Type	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Factor (dB)	Dist (m)	Condition	Azimuth (°)	Height (m)	Comment				
PK	30M	24.60	40.00	-15.40	-8.16	3	Horizontal	360	1.00	-				
PK	117.16M	19.15	43.50	-24.35	-13.76	3	Horizontal	360	1.00	-				
PK	268.99M	21.20	46.00	-24.80	-11.56	3	Horizontal	360	1.00	-				
PK	406.75M	28.35	46.00	-17.65	-8.15	3	Horizontal	360	1.00	-				
PK	554.36M	28.42	46.00	-17.58	-4.84	3	Horizontal	360	1.00	-				
PK	652.77M	29.35	46.00	-16.65	-4.03	3	Horizontal	360	1.00	-				



Summary

Mode	Result	Type	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Factor (dB)	Dist (m)	Condition	Azimuth (°)	Height (m)	Comments
2.4-2.4835GHz	-	-	-	-	-	-	-	-	-	-	-	-
BT-LE(1Mbps)	Pass	AV	2.4868G	49.50	54.00	-4.50	31.31	3	Horizontal	335	2.53	-

Result

Mode	Result	Type	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Factor (dB)	Dist (m)	Condition	Azimuth (°)	Height (m)	Comments
BT-LE(1Mbps)	-	-	-	-	-	-	-	-	-	-	-	-
2402MHz	Pass	AV	2.3858G	49.36	54.00	-4.64	30.94	3	Vertical	96	1.33	-
2402MHz	Pass	AV	2.402G	98.75	Inf	-Inf	31.00	3	Vertical	96	1.33	-
2402MHz	Pass	PK	2.3804G	59.48	74.00	-14.52	30.93	3	Vertical	96	1.33	-
2402MHz	Pass	PK	2.4018G	99.01	Inf	-Inf	31.00	3	Vertical	96	1.33	-
2402MHz	Pass	AV	2.3526G	48.52	54.00	-5.48	30.83	3	Horizontal	192	2.50	-
2402MHz	Pass	AV	2.402G	90.34	Inf	-Inf	31.00	3	Horizontal	192	2.50	-
2402MHz	Pass	PK	2.3738G	59.88	74.00	-14.12	30.90	3	Horizontal	192	2.50	-
2402MHz	Pass	PK	2.4022G	90.68	Inf	-Inf	31.00	3	Horizontal	192	2.50	-
2402MHz	Pass	AV	4.80406G	41.17	54.00	-12.83	1.62	3	Vertical	104	1.24	-
2402MHz	Pass	PK	4.80406G	52.90	74.00	-21.10	1.62	3	Vertical	104	1.24	-
2402MHz	Pass	AV	4.804G	39.76	54.00	-14.24	1.62	3	Horizontal	148	2.88	-
2402MHz	Pass	PK	4.80358G	47.76	74.00	-26.24	1.62	3	Horizontal	148	2.88	-
2440MHz	Pass	AV	2.376G	49.15	54.00	-4.85	30.90	3	Vertical	123	1.20	-
2440MHz	Pass	AV	2.44G	98.80	Inf	-Inf	31.14	3	Vertical	123	1.20	-
2440MHz	Pass	AV	2.4972G	49.32	54.00	-4.68	31.35	3	Vertical	123	1.20	-
2440MHz	Pass	PK	2.3808G	59.30	74.00	-14.70	30.93	3	Vertical	123	1.20	-
2440MHz	Pass	PK	2.4404G	99.12	Inf	-Inf	31.14	3	Vertical	123	1.20	-
2440MHz	Pass	PK	2.4992G	60.17	74.00	-13.83	31.36	3	Vertical	123	1.20	-
2440MHz	Pass	AV	2.34G	48.52	54.00	-5.48	30.78	3	Horizontal	335	2.53	-
2440MHz	Pass	AV	2.44G	89.81	Inf	-Inf	31.14	3	Horizontal	335	2.53	-
2440MHz	Pass	AV	2.4868G	49.50	54.00	-4.50	31.31	3	Horizontal	335	2.53	-
2440MHz	Pass	PK	2.3756G	58.98	74.00	-15.02	30.90	3	Horizontal	335	2.53	-
2440MHz	Pass	PK	2.4404G	90.22	Inf	-Inf	31.14	3	Horizontal	335	2.53	-
2440MHz	Pass	PK	2.4835G	60.30	74.00	-13.70	31.30	3	Horizontal	335	2.53	-
2440MHz	Pass	AV	4.88G	44.84	54.00	-9.16	1.81	3	Vertical	102	1.02	-
2440MHz	Pass	AV	7.31958G	43.06	54.00	-10.94	7.50	3	Vertical	162	2.52	-
2440MHz	Pass	PK	4.88012G	53.19	74.00	-20.81	1.81	3	Vertical	102	1.02	-
2440MHz	Pass	PK	7.32054G	52.39	74.00	-21.61	7.50	3	Vertical	162	2.52	-
2440MHz	Pass	AV	4.88696G	43.97	54.00	-10.03	1.83	3	Horizontal	345	1.16	-
2440MHz	Pass	AV	7.3194G	43.10	54.00	-10.90	7.50	3	Horizontal	195	1.77	-
2440MHz	Pass	PK	4.87646G	52.00	74.00	-22.00	1.81	3	Horizontal	345	1.16	-
2440MHz	Pass	PK	7.32066G	53.09	74.00	-20.91	7.50	3	Horizontal	195	1.77	-
2480MHz	Pass	AV	2.48G	92.52	Inf	-Inf	31.57	3	Vertical	86	1.00	-
2480MHz	Pass	AV	2.499G	45.38	54.00	-8.62	31.58	3	Vertical	86	1.00	-
2480MHz	Pass	PK	2.4802G	93.55	Inf	-Inf	31.57	3	Vertical	86	1.00	-
2480MHz	Pass	PK	2.4914G	56.91	74.00	-17.09	31.58	3	Vertical	86	1.00	-
2480MHz	Pass	AV	2.48G	95.58	Inf	-Inf	31.57	3	Horizontal	186	1.50	-
2480MHz	Pass	AV	2.4908G	45.34	54.00	-8.66	31.58	3	Horizontal	186	1.50	-
2480MHz	Pass	PK	2.4802G	96.62	Inf	-Inf	31.57	3	Horizontal	186	1.50	-
2480MHz	Pass	PK	2.4835G	58.42	74.00	-15.58	31.58	3	Horizontal	186	1.50	-
2480MHz	Pass	AV	4.96001G	42.04	54.00	-11.96	7.86	3	Vertical	259	1.02	-
2480MHz	Pass	AV	7.4393G	44.12	54.00	-9.88	13.54	3	Vertical	203	2.89	-
2480MHz	Pass	PK	4.95933G	50.10	74.00	-23.90	7.86	3	Vertical	259	1.02	-
2480MHz	Pass	PK	7.44016G	54.71	74.00	-19.29	13.53	3	Vertical	203	2.89	-
2480MHz	Pass	AV	4.96051G	36.64	54.00	-17.36	7.86	3	Horizontal	196	1.00	-
2480MHz	Pass	AV	7.43952G	43.61	54.00	-10.39	13.53	3	Horizontal	175	1.00	-
2480MHz	Pass	PK	4.95998G	47.61	74.00	-26.39	7.86	3	Horizontal	196	1.00	-



RSE TX above 1GHz

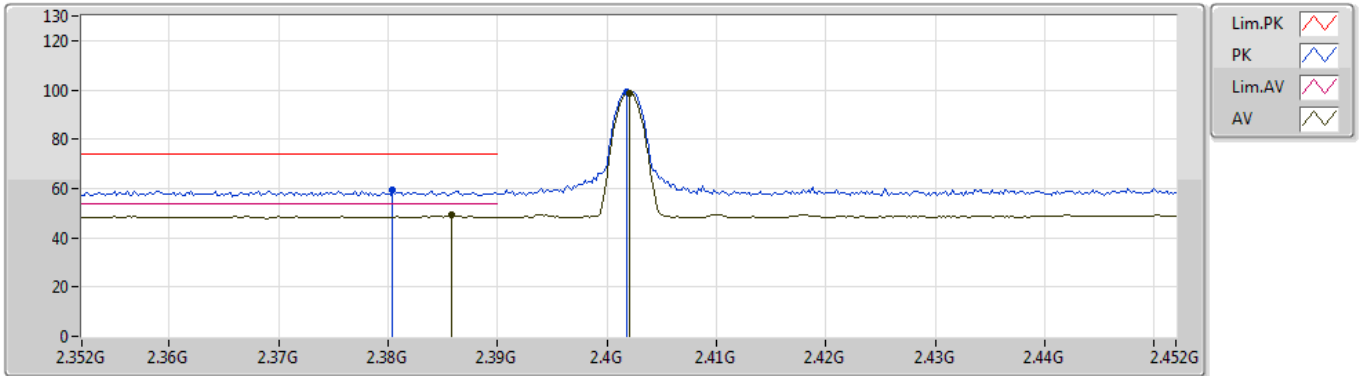
Appendix E.2

Mode	Result	Type	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Factor (dB)	Dist (m)	Condition	Azimuth (°)	Height (m)	Comments
2480MHz	Pass	PK	7.44083G	54.61	74.00	-19.39	13.54	3	Horizontal	175	1.00	-

BT-LE(1Mbps)

05/06/2019

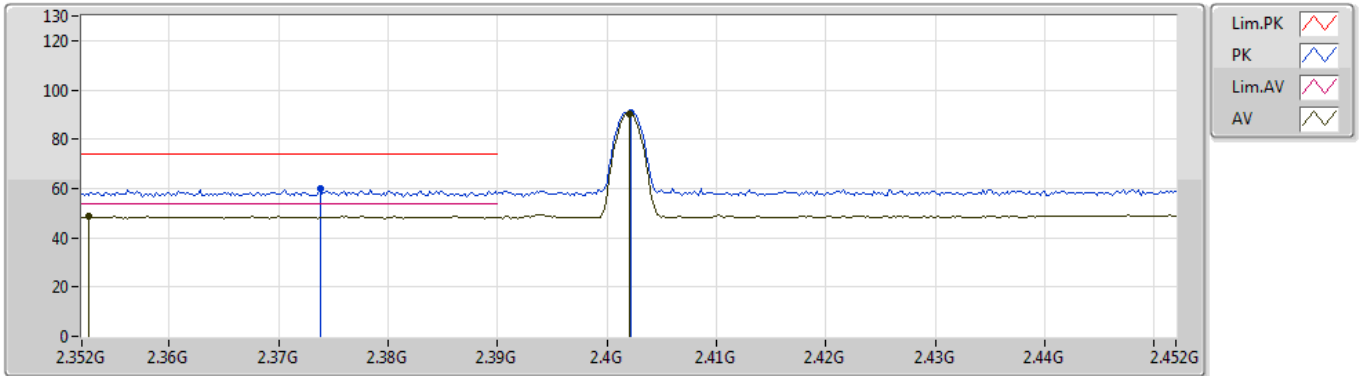
2402MHz_TX



BT-LE(1Mbps)

05/06/2019

2402MHz_TX

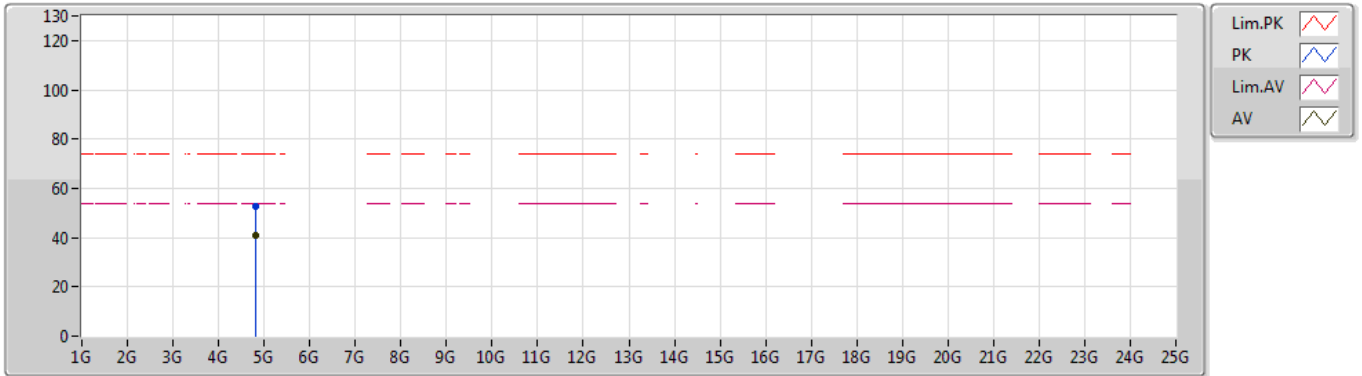


Type	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Factor (dB)	Dist (m)	Condition	Azimuth (°)	Height (m)	Comment				
AV	2.3526G	48.52	54.00	-5.48	30.83	3	Horizontal	192	2.50	-				
AV	2.402G	90.34	Inf	-Inf	31.00	3	Horizontal	192	2.50	-				
PK	2.3738G	59.88	74.00	-14.12	30.90	3	Horizontal	192	2.50	-				
PK	2.4022G	90.68	Inf	-Inf	31.00	3	Horizontal	192	2.50	-				

BT-LE(1Mbps)

05/06/2019

2402MHz_TX

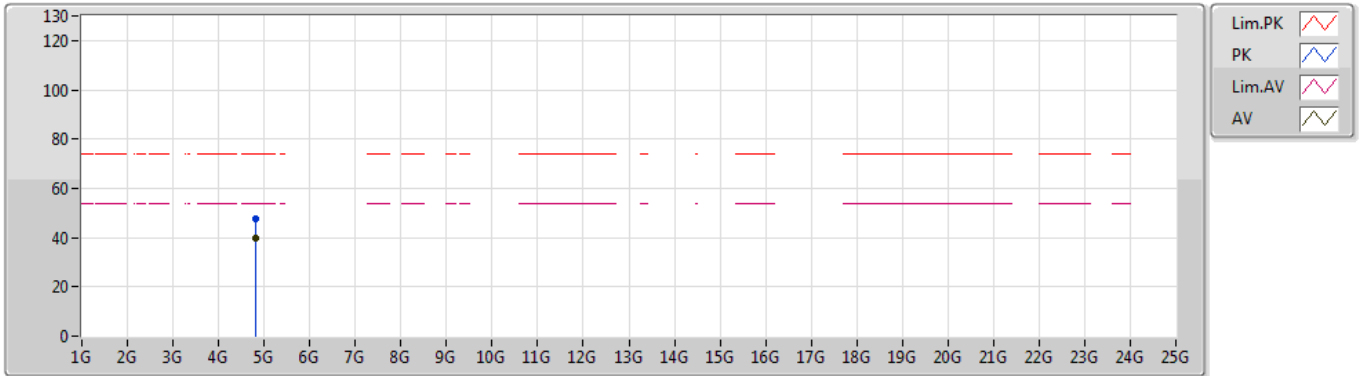


Type	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Factor (dB)	Dist (m)	Condition	Azimuth (°)	Height (m)	Comment				
AV	4.80406G	41.17	54.00	-12.83	1.62	3	Vertical	104	1.24	-				
PK	4.80406G	52.90	74.00	-21.10	1.62	3	Vertical	104	1.24	-				

BT-LE(1Mbps)

05/06/2019

2402MHz_TX

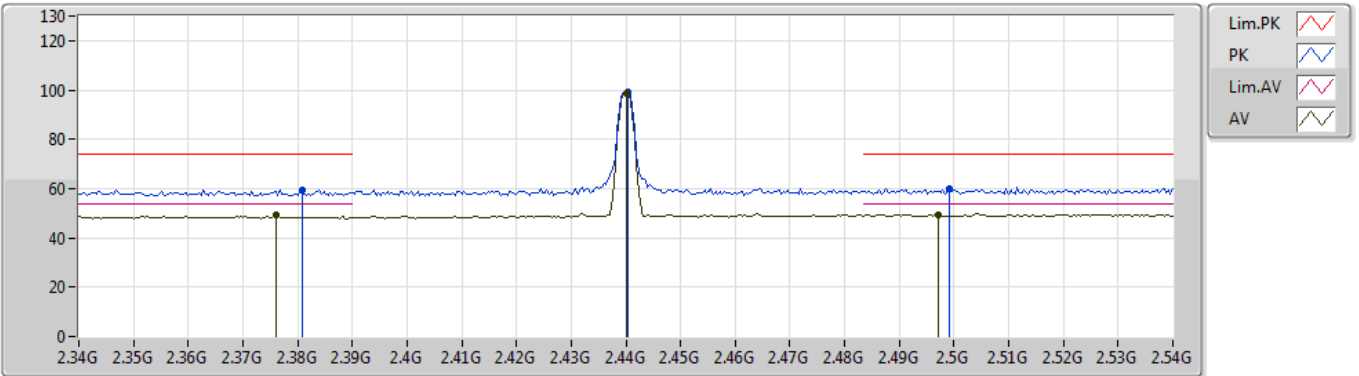


Type	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Factor (dB)	Dist (m)	Condition	Azimuth (°)	Height (m)	Comment				
AV	4.804G	39.76	54.00	-14.24	1.62	3	Horizontal	148	2.88	-				
PK	4.80358G	47.76	74.00	-26.24	1.62	3	Horizontal	148	2.88	-				

BT-LE(1Mbps)

2440MHz_TX

05/06/2019

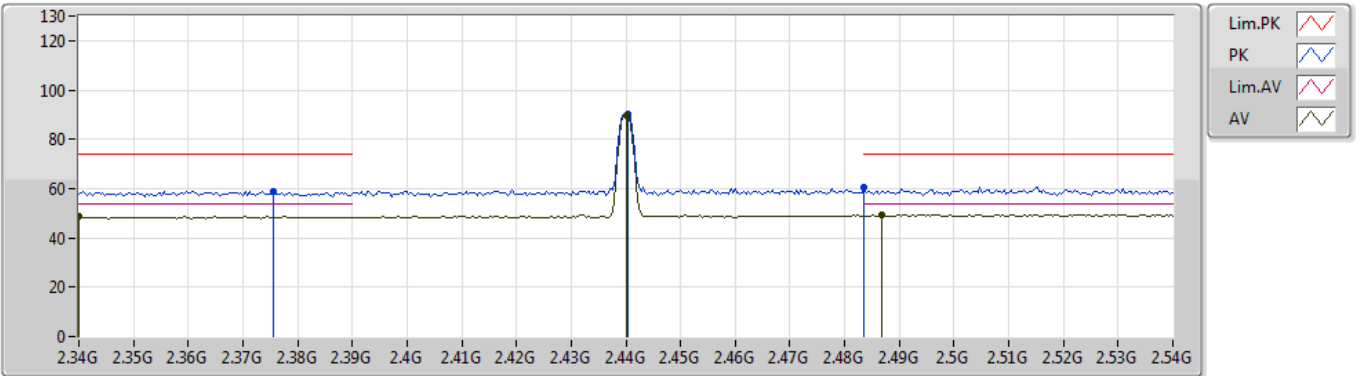


Type	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Factor (dB)	Dist (m)	Condition	Azimuth (°)	Height (m)	Comment				
AV	2.376G	49.15	54.00	-4.85	30.90	3	Vertical	123	1.20	-				
AV	2.44G	98.80	Inf	-Inf	31.14	3	Vertical	123	1.20	-				
AV	2.4972G	49.32	54.00	-4.68	31.35	3	Vertical	123	1.20	-				
PK	2.3808G	59.30	74.00	-14.70	30.93	3	Vertical	123	1.20	-				
PK	2.4404G	99.12	Inf	-Inf	31.14	3	Vertical	123	1.20	-				
PK	2.4992G	60.17	74.00	-13.83	31.36	3	Vertical	123	1.20	-				

BT-LE(1Mbps)

05/06/2019

2440MHz_TX

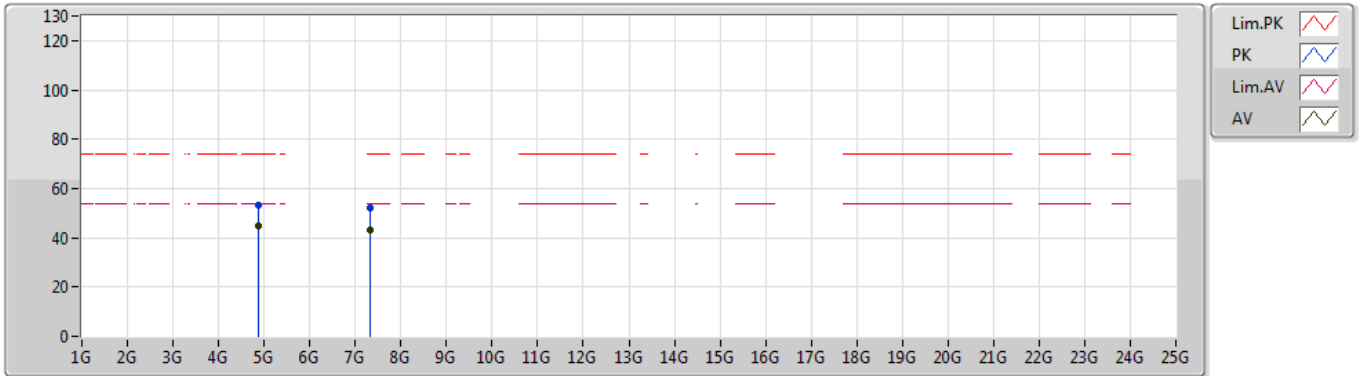


Type	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Factor (dB)	Dist (m)	Condition	Azimuth (°)	Height (m)	Comment				
AV	2.34G	48.52	54.00	-5.48	30.78	3	Horizontal	335	2.53	-				
AV	2.44G	89.81	Inf	-Inf	31.14	3	Horizontal	335	2.53	-				
AV	2.4868G	49.50	54.00	-4.50	31.31	3	Horizontal	335	2.53	-				
PK	2.3756G	58.98	74.00	-15.02	30.90	3	Horizontal	335	2.53	-				
PK	2.4404G	90.22	Inf	-Inf	31.14	3	Horizontal	335	2.53	-				
PK	2.4835G	60.30	74.00	-13.70	31.30	3	Horizontal	335	2.53	-				

BT-LE(1Mbps)

05/06/2019

2440MHz_TX

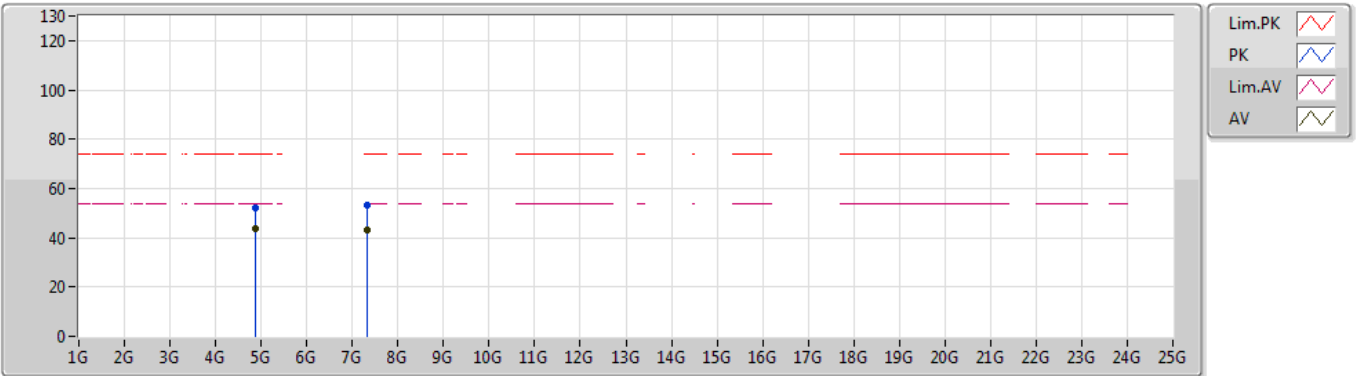


Type	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Factor (dB)	Dist (m)	Condition	Azimuth (°)	Height (m)	Comment				
AV	4.88G	44.84	54.00	-9.16	1.81	3	Vertical	102	1.02	-				
AV	7.31958G	43.06	54.00	-10.94	7.50	3	Vertical	162	2.52	-				
PK	4.88012G	53.19	74.00	-20.81	1.81	3	Vertical	102	1.02	-				
PK	7.32054G	52.39	74.00	-21.61	7.50	3	Vertical	162	2.52	-				

BT-LE(1Mbps)

2440MHz_TX

05/06/2019

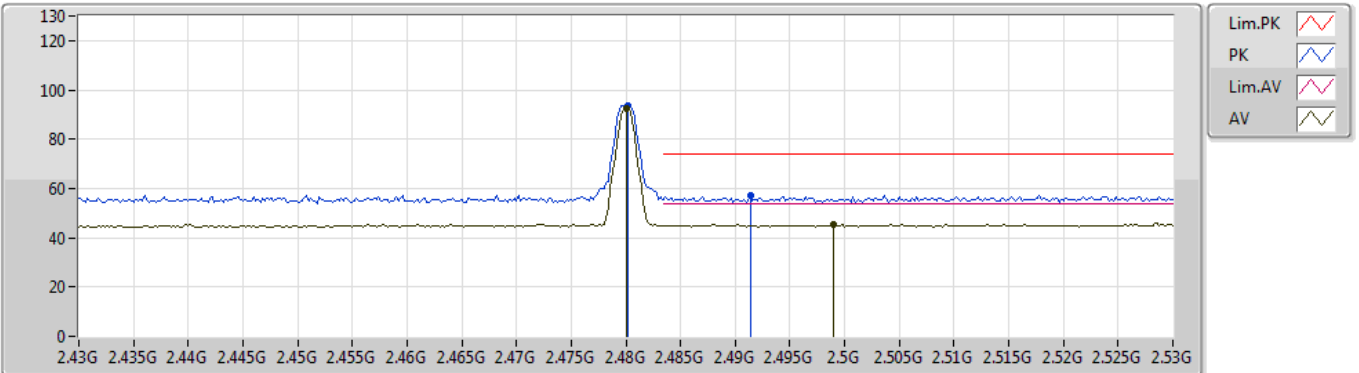


Type	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Factor (dB)	Dist (m)	Condition	Azimuth (°)	Height (m)	Comment				
AV	4.88696G	43.97	54.00	-10.03	1.83	3	Horizontal	345	1.16	-				
AV	7.3194G	43.10	54.00	-10.90	7.50	3	Horizontal	195	1.77	-				
PK	4.87646G	52.00	74.00	-22.00	1.81	3	Horizontal	345	1.16	-				
PK	7.32066G	53.09	74.00	-20.91	7.50	3	Horizontal	195	1.77	-				

BT-LE(1Mbps)

05/06/2019

2480MHz_TX

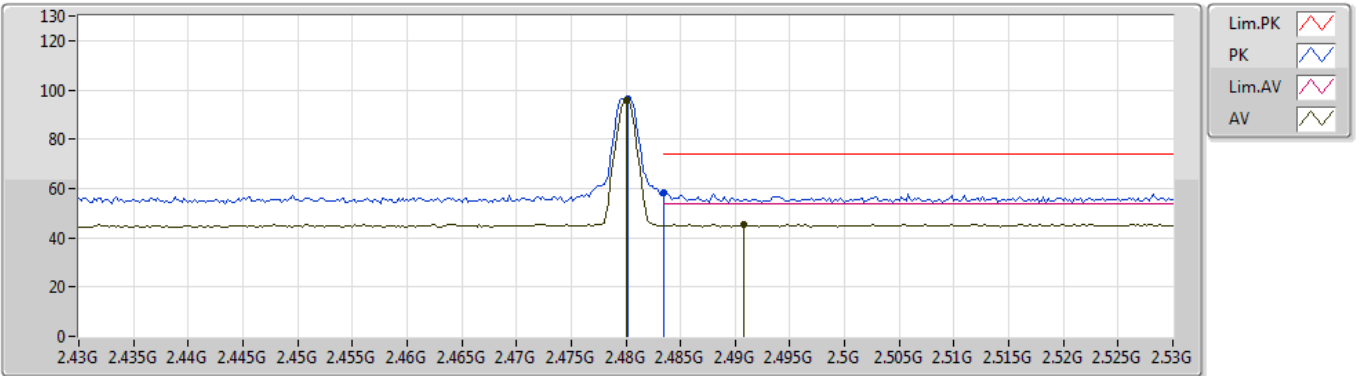


Type	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Factor (dB)	Dist (m)	Condition	Azimuth (°)	Height (m)	Comment				
AV	2.48G	92.52	Inf	-Inf	31.57	3	Vertical	86	1.00	-				
AV	2.499G	45.38	54.00	-8.62	31.58	3	Vertical	86	1.00	-				
PK	2.4802G	93.55	Inf	-Inf	31.57	3	Vertical	86	1.00	-				
PK	2.4914G	56.91	74.00	-17.09	31.58	3	Vertical	86	1.00	-				

BT-LE(1Mbps)

05/06/2019

2480MHz_TX

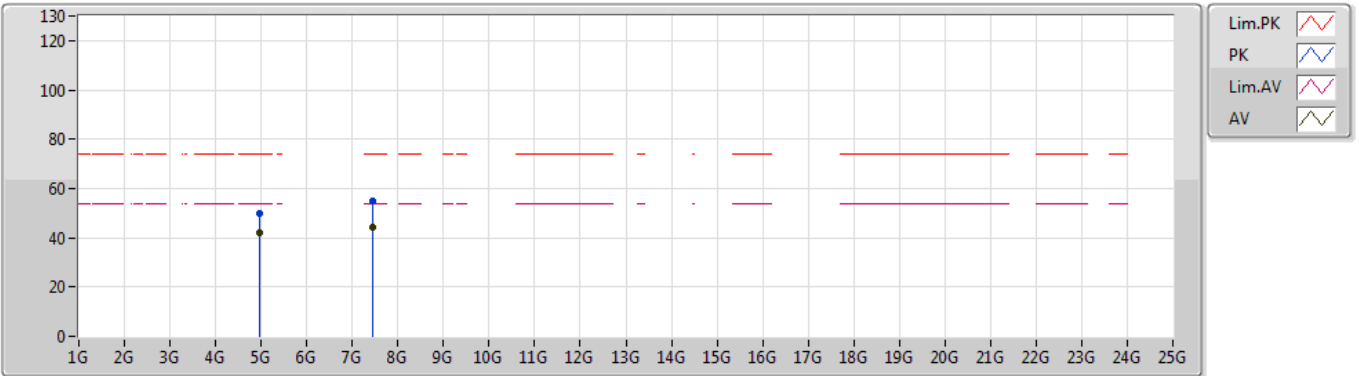


Type	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Factor (dB)	Dist (m)	Condition	Azimuth (°)	Height (m)	Comment				
AV	2.48G	95.58	Inf	-Inf	31.57	3	Horizontal	186	1.50	-				
AV	2.4908G	45.34	54.00	-8.66	31.58	3	Horizontal	186	1.50	-				
PK	2.4802G	96.62	Inf	-Inf	31.57	3	Horizontal	186	1.50	-				
PK	2.4835G	58.42	74.00	-15.58	31.58	3	Horizontal	186	1.50	-				

BT-LE(1Mbps)

05/06/2019

2480MHz_TX

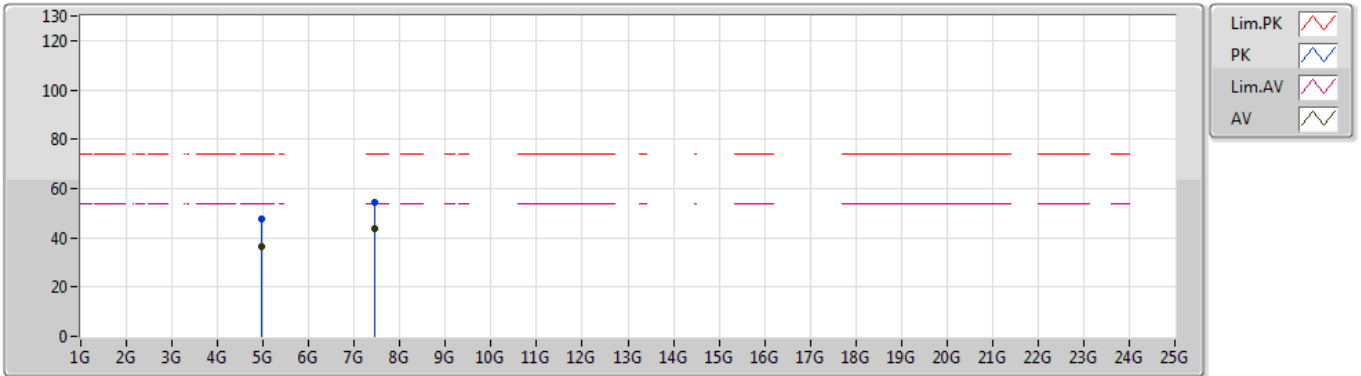


Type	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Factor (dB)	Dist (m)	Condition	Azimuth (°)	Height (m)	Comment				
AV	4.96001G	42.04	54.00	-11.96	7.86	3	Vertical	259	1.02	-				
AV	7.4393G	44.12	54.00	-9.88	13.54	3	Vertical	203	2.89	-				
PK	4.95933G	50.10	74.00	-23.90	7.86	3	Vertical	259	1.02	-				
PK	7.44016G	54.71	74.00	-19.29	13.53	3	Vertical	203	2.89	-				

BT-LE(1Mbps)

05/06/2019

2480MHz_TX



Type	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Factor (dB)	Dist (m)	Condition	Azimuth (°)	Height (m)	Comment				
AV	4.96051G	36.64	54.00	-17.36	7.86	3	Horizontal	196	1.00	-				
AV	7.43952G	43.61	54.00	-10.39	13.53	3	Horizontal	175	1.00	-				
PK	4.95998G	47.61	74.00	-26.39	7.86	3	Horizontal	196	1.00	-				
PK	7.44083G	54.61	74.00	-19.39	13.54	3	Horizontal	175	1.00	-				