TEST REPORT

Report Number. : 14888706-E1V2

Applicant	:	ENERGOUS CORPORATION 3590 NORTH FIRST STREET, SUITE 210, SAN JOSE, CA 95134, U.S.A.
Model	:	VN55, VN55-E
Brand	:	ENERGOUS
FCC ID	:	2ADNG-VN55
IC	:	23686-VN55
EUT Description	:	WIRELESS CHARGER
Test Standard(s)	:	FCC 47 CFR PART 15 C ISED RSS-247 ISSUE 3 ISED RSS-GEN ISSUE 5 + A1 + A2

Date Of Issue:
2023-10-17

Prepared by:
UL VERIFICATION SERVICES INC.
47173 Benicia Street
Fremont, CA 94538 U.S.A.
TEL: (510) 319-4000
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ACCREDITED
CERT #0751.05

REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	2023-08-14	Initial Issue	--
V2	2023-10-17	Corrected FCC standard wording and revised Section 6.5 C2PC description. Added additional model number. Added Section model number difference description. Revised RSS 247 to Issue 3.	Tina Chu

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: ENERGOUS CORPORATION
3590 NORTH FIRST STREET,
SUITE 210,
SAN JOSE, CA 95134, U.S.A.

EUT DESCRIPTION: WIRELESS CHARGER

MODEL: VN55, VN55-E (TESTED MODEL NUMBER)

BRAND: ENERGOUS

SERIAL NUMBER: D003778 (CONDUCTED/RADIATED)

SAMPLE RECEIPT DATE: 2023-07-13

DATE TESTED: 2023-07-13 to 2023-07-28

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
FCC 47 CFR Part 15 C	Complies
ISED RSS-247 Issue 3	Complies
ISED RSS-GEN Issue 5 + A1 + A2	Complies

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.

This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document.

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Approved & Released For
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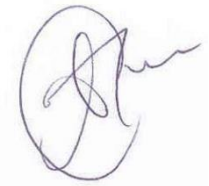

Tina Chu
Senior Project Engineer
Consumer Technology Division
UL Verification Services Inc.

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2. TEST RESULTS SUMMARY

This report contains data provided by the customer which can impact the validity of results. UL Verification Services Inc. is only responsible for the validity of results after the integration of the data provided by the customer.

Below is a list of the data provided by the customer:

1) Antenna gain and type (see section 6.3)
2) Cable Loss (see section 6.3)

FCC Clause	ISED Clause	Requirement	Result	Comment
See Comment	See Comment	Duty Cycle	Reporting purposes only	Per ANSI C63.10, Section 11.6.
FCC §15.247 (a) (1)(i)	RSS-GEN 6.7	20dB BW/99% OBW	Complies	ANSI C63.10 Sections 6.9.2 and 6.9.3
15.247 (a)(1)	RSS-247 (5.1) (b)	Hopping Frequency Separation	Complies	None.
15.247 (a)(1)(i)	RSS-247 (5.1) (c)	Number of Hopping Channels	Complies	None.
15.247 (a)(1)(i)	RSS-247 (5.1) (c)	Average Time of Occupancy	Complies	None.
15.247 (b)(2)	RSS-247 (5.4) (a)	Output Power	Complies	None.
See Comment	See Comment	Average Power	Reporting purposes only	Per ANSI C63.10, Section 11.9.2.3.2.
15.247 (d)	RSS-247 (5.5)	Conducted Spurious Emissions	Complies	None.
15.209, 15.205	RSS-GEN 8.9, 8.10	Radiated Emissions	Complies	None.
15.207	RSS-Gen 8.8	AC Mains Conducted Emissions	Not performed	Antenna changed only, no impacted on the AC powerline test.

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3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC 47 CFR Part 2, FCC 47 CFR Part 15, ANSI C63.10-2013, KDB 558074 D01 15.247 Meas Guidance v05r02, KDB 414788 D01 Radiated Test Site v01r01, RSS-GEN Issue 5 + A1 + A2, and RSS-247 Issue 3.

4. FACILITIES AND ACCREDITATION

UL Verification Services Inc. is accredited by A2LA, Certificate Number 0751.05, for all testing performed within the scope of this report. Testing was performed at the locations noted below.

	Address	ISED CABID	ISED Company Number	FCC Registration
☒	Building 1: 47173 Benicia Street Fremont, CA 94538, U.S.A	US0104	2324A	550739
☐	Building 2: 47266 Benicia Street Fremont, CA 94538, U.S.A			
☒	Building 4: 47658 Kato Rd Fremont, CA 94538, U.S.A			

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5. DECISION RULES AND MEASUREMENT UNCERTAINTY

5.1. METROLOGICAL TRACEABILITY

All test and measuring equipment utilized to perform the tests documented in this report are calibrated on a regular basis, with a maximum time between calibrations of one year or the manufacturers' recommendation, whichever is less, and where applicable is traceable to recognized national standards.

5.2. DECISION RULES

The Decision Rule is based on Simple Acceptance in accordance with ISO Guide 98-4:2012 Clause 8.2. (Measurement uncertainty is not taken into account when stating conformity with a specified requirement.)

5.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	U_{Lab}
Radio Frequency (Spectrum Analyzer)	141.16 Hz
Occupied Bandwidth	1.22%
Power Spectral Density	2.47 dB
RF Power Measurement Direct Method Using Power Meter	1.3 dB (PK) / 0.45 dB (AV)
Unwanted Emissions, Conducted	1.94 dB
Worst Case Conducted Disturbance, 9kHz to 0.15 MHz	3.78 dB
Worst Case Conducted Disturbance, 0.15 to 30 MHz	3.40 dB
Worst Case Radiated Disturbance, 9kHz to 30 MHz	2.87 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	6.01 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.73 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.51 dB
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.29 dB
Time Domain Measurements	3.39%
Temperature	0.57˚C
Humidity	3.39%
DC Supply Voltages	0.57%

Uncertainty figures are valid to a confidence level of 95%.

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5.4. SAMPLE CALCULATION

RADIATED EMISSIONS

Where relevant, the following sample calculation is provided:
Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)
36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

MAINS CONDUCTED EMISSIONS

Where relevant, the following sample calculation is provided:
Final Voltage (dBuV) = Measured Voltage (dBuV) + Cable Loss (dB) + Limiter Factor (dB) + LISN Insertion Loss.
36.5 dBuV + 0 dB +10.1 dB+ 0 dB = 46.6 dBuV

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6. EQUIPMENT UNDER TEST

6.1. EUT DESCRIPTION

The EUT is a stand-alone wireless charger with BLE and Zigbee 802.15.4 that is mounted on a ceiling. The wireless charger transmits power via a frequency hopping signal between 907MHz to 920MHz and a DTS Zigbee 802.15.4 signal between 2402MHz and 2480MHz, and charges multiple receivers at a time.

This report documents test results of the 900MHz FHSS radio portion of the wireless charger.

6.2. DESCRIPTION OF MODEL NUMBER DIFFERENCE

Model number: VN55: Original filing for EUT with internal antenna.
Model number: VN55-E: Class II permissive change filing for EUT with external antenna.
Tested model number: VN55-E.

6.3. MAXIMUM OUTPUT POWER

Refer to original test report 14262501-E1V2 for max output power.

6.4. DESCRIPTION OF AVAILABLE ANTENNAS AND CABLE LOSS

The antenna(s) gain and type, cable loss as provided by the manufacturer' are as follows:

The WPT radio utilizes one External Omni Dipole antenna, with a maximum gain of 5dBi .

Cable loss: 0.4 dB

6.5. DESCRIPTION OF CLASS II PERMISSIVE CHANGE

This class II permissive change is to add a new external antenna type and the highest gain to support SISO for all technologies and additional range on the 900MHz radio from 917.2MHz-918.8MHz to 907MHz-920MHz via firmware changed.

6.6. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was nrf5x_redux.6.0.1.7_2155_sdk_17

The test utility software used during testing was nrf5x_redux.6.0.1.7_2155_sdk_17

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6.7. WORST-CASE CONFIGURATION AND MODE

Radiated emissions below 1GHz, above 18GHz, and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

Band edge and radiated emissions between 1GHz and 18GHz were performed with the EUT set to transmit at the highest power on low, middle and high channels.

The EUT is a ceiling mounted device, and it has one USB type C port for power only. The fundamental of the antenna was investigated in three orthogonal orientations X,Y(upright), it was determined that Y orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in Y orientation.

WPT band and BLE(beaconing mode) or WPT band and 2.4G Zigbee transmit simultaneously, investigation has been performed when WPT band, BLE and 2.4G Zigbee transmit simultaneously as worst case, result of 30MHz to 18GHz radiated emissions was recorded in this report.

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6.8. DESCRIPTION OF TEST SETUP

SUPPORT TEST EQUIPMENT				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID/ DoC**
Laptop	Dell	Precision 5520	FK7QHM2	DoC
Laptop AC/DC adapter	Dell	HA130PM130	CN-0V363H-CH200-84A-03QN-A01	DoC
AC/DC Switching Adapter	CUI Inc.	HDP-QB05010U	-	DoC

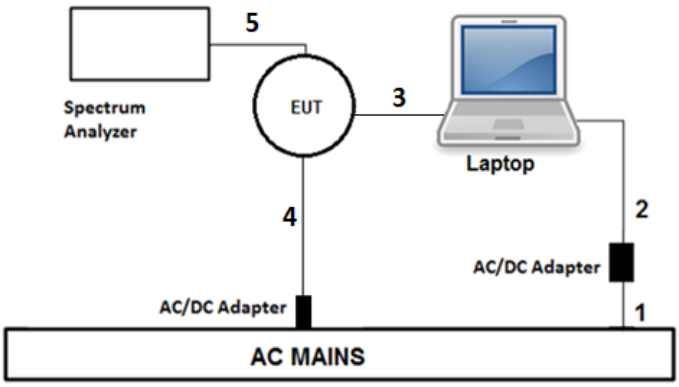
I/O CABLES (RF CONDUCTED TEST)						
Cable No.	**Port**	**# of Identical Ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	AC	1	AC	Un-shielded	1	AC Mains to AC/DC Adapter
2	DC	1	DC	Un-shielded	1.5	AC/DC Adapter to Laptop
3	USB to UART	1	USB A	Un-shielded	1.5	Laptop to EUT
4	USB	1	USB Type C	Shielded	1	EUT to AC/DC adapter
5	Antenna	1	SMA	Un-shielded	0.3	To spectrum analyzer

I/O CABLES (RF RADIATED TEST)						
Cable No.	**Port**	**# of Identical Ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	USB	1	USB Type C	Shielded	1	

TEST SETUP-RF CONDUCTED TEST

The EUT was powered by AC/DC adapter via USB cable. Test software exercised the EUT.

SETUP DIAGRAMS



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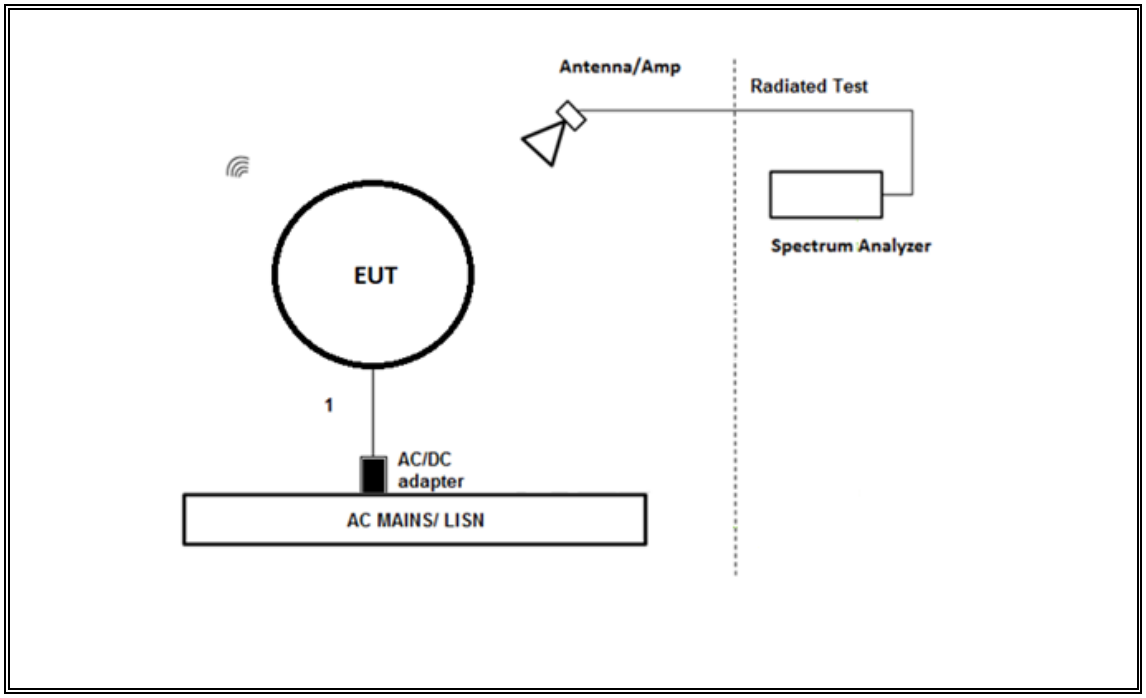
TEST SETUP- RADIATED TEST / AC LINE CONDUCTED TEST

The EUT was powered by AC/DC adapter via USB cable. Test software exercised the EUT. Laptop was removed after test setup.

SETUP DIAGRAM



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7. MEASUREMENT METHODS

On Time and Duty Cycle: ANSI C63.10-2013 Section 11.6

Occupied BW (20dB): ANSI C63.10-2013 Section 6.9.2

Occupied BW (99%): ANSI C63.10-2013 Section 6.9.3

Carrier Frequency Separation: ANSI C63.10-2013 Section 7.8.2

Number of Hopping Frequencies: ANSI C63.10-2013 Section 7.8.3

Time of Occupancy (Dwell Time): ANSI C63.10-2013 Section 7.8.4

Peak Output Power: ANSI C63.10-2013 Section 7.8.5

Conducted Spurious Emissions: ANSI C63.10-2013 Section 7.8.8

Conducted Band-Edge: ANSI C63.10-2013 Section 6.10.4

Radiated Spurious Emissions Below 30MHz: ANSI C63.10-2013 Section 6.4

Radiated Spurious Emissions 30-1000MHz: ANSI C63.10-2013 Section 6.3 and 6.5

Radiated Spurious Emissions above 1GHz: ANSI C63.10-2013 Section 6.3 and 6.6

Radiated Band-edge: ANSI C63.10-2013 Section 6.10.5

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8. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

TEST EQUIPMENT LIST					
Description	**Manufacturer**	**Model**	**ID Num**	**Cal Due**	**Last Cal**
Antenna, Broadband Hybrid, 30MHz to 3000MHz	Sunol Sciences Corp.	JB3	174374	2024-04-30	2023-04-05
Amplifier, 10KHz to 1GHz, 32dB	SONOMA INSTRUMENT	310N	29654	2024-07-31	2023-07-13
Thermometer	Control Company	14-650-118	160656	2024-04-30	2023-04-24
EMI TEST RECEIVER	Rohde & Schwarz	ESW44	191429	2024-02-29	2023-02-15
Antenna, Horn 1-18GHz	ETS-Lindgren (Cedar Park, Texas)	3117	206806	2023-10-07	2022-10-07
RF Filter Box, 1-18GHz	FREMONT	SAC-L1	171013	2023-10-31	2021-10-31
Thermometer - Digital	Control Company	14-650-118	175731	2024-02-29	2023-02-08
EMI TEST RECEIVER	Rohde & Schwarz	ESW44	191429	2024-02-29	2023-02-15
Antenna, Horn 18 to 26.5GHz	ARA	MWH-1826/B	199659	2023-12-06	2022-12-06
Rf Amplifier, 18-26.5GHz, 60dB gain	AMPLICAL	AMP18G26.5-60	234683	2024-03-29	2023-02-18
Spectrum Analyzer, PSA, 3Hz to 26.5GHz	Keysight Technologies Inc	E4440A	125178	2024-02-29	2023-02-06
Power Meter, P-series single channel	Keysight Technologies Inc	N1911A	90757	2024-02-29	2023-02-03
Power Sensor, P - series, 50MHz to 18GHz, Wideband	Keysight Technologies Inc	N1921A	90419	2024-02-29	2023-02-03
Filter, BRF 915GHz 1.5GHz Max!	Micro-Tronics	BRC50722	156483	2024-07-31	2024-07-14
Filter, Highpass 1.2GHz	Micro-Tronics	HPM50108	152043	2023-10-20	2022-10-20
UL TEST SOFTWARE LIST					
Radiated Software	UL	UL EMC	Rev 9.5, Jan 03, 2020		

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9. ANTENNA PORT TEST RESULTS

9.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

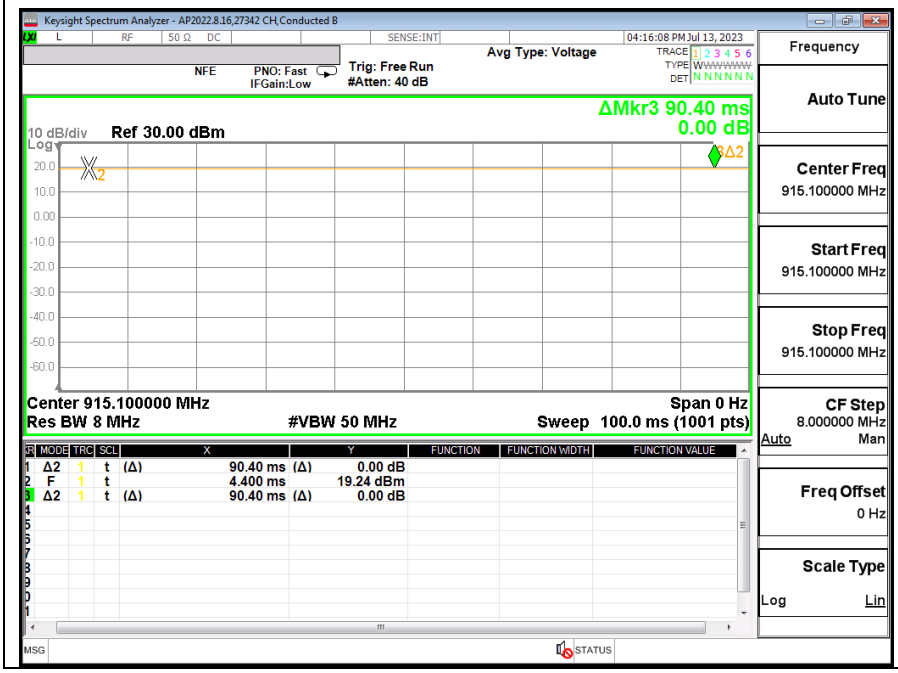
PROCEDURE

ANSI C63.10, Section 11.6 : Zero-Span Spectrum Analyzer Method.

ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/T Minimum VBW (kHz)
WPT	90.40	90.40	1.000	100.00	0.00	0.010

Test Engineer	CH 27342



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9.2. 20 dB AND 99% BANDWIDTH

LIMITS

FCC §15.247 (a) (1)(i)

(i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

RSS-247 (5.1)

(c) For FHSS in the band 902-928 MHz: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 20-second period. If the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 10-second period. The maximum 20 dB bandwidth of the hopping channel shall be 500 kHz.

TEST PROCEDURE

The RBW is set to 10kHz. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

Note: Because the measured signal is CW or CW-like adjusting the RBW per C63.10 would not be practical since measured bandwidth will always follow the RBW and the result will be approximately twice the RBW.

RESULTS

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Region Code	Channel	Frequency (MHz)	20dB Bandwidth Antenna 1 (kHz)	99% Bandwidth Antenna 1 (kHz)
1_1	Low	907	25.27	21.433
	Middle	911.68	25.27	21.435
	High	916.18	25.25	21.431
1_2	Low	910.82	25.25	21.426
	Middle	915.5	25.26	21.43
	High	920	25.28	21.433
2_1	Low	907	25.26	21.428
	Middle	911.004	25.26	21.432
	High	914.854	25.28	21.422
2_2	Low	912.146	25.24	21.431
	Middle	916.15	25.26	21.434
	High	920	25.27	21.433
3_1	Low	907	25.25	21.417
	Middle	910.016	25.27	21.429
	High	912.916	25.28	21.439
3_2	Low	914.084	25.29	21.424
	Middle	917.1	25.27	21.433
	High	920	25.29	21.436
4_1	Low	907	25.25	21.428
	Middle	908.976	25.31	21.44
	High	910.876	25.26	21.426
4_2	Low	916.124	25.26	21.426
	Middle	918.1	25.24	21.431
	High	920	25.26	21.438
5_1	Low	907	25.27	21.425
	Middle	907.988	25.28	21.431
	High	908.938	25.26	21.425
5_2	Low	918.062	25.28	21.431
	Middle	919.05	25.26	21.431
	High	920	25.27	21.431
6_1	Low	907	25.27	21.426
	Middle	907.832	25.25	21.424
	High	908.632	25.26	21.423
6_2	Low	918.368	25.26	21.426
	Middle	919.2	25.26	21.433
	High	920	25.28	21.426

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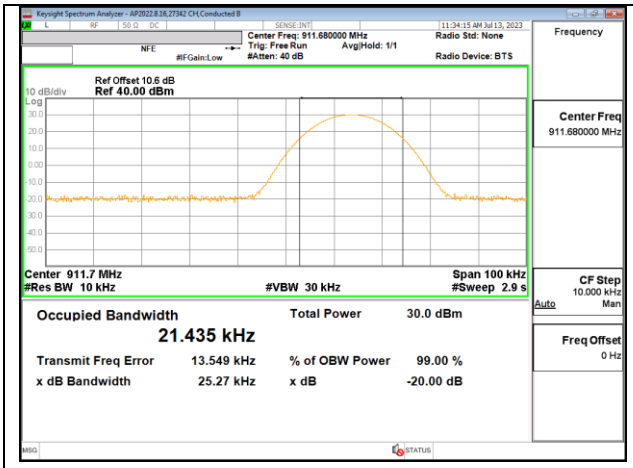
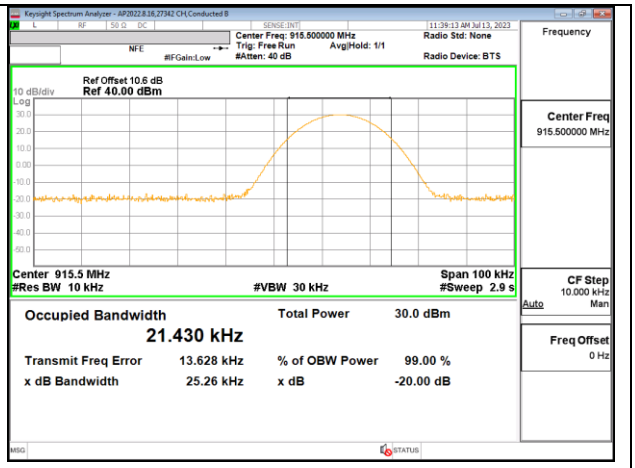


MID CHANNEL ANTENNA 1(1_1)



MID CHANNEL ANTENNA 1(1_2)

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9.3. HOPPING FREQUENCY SEPARATION

LIMITS

FCC §15.247 (a) (1)

RSS-247 (5.1) (b)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 10 kHz and the VBW is set to 30 kHz. The sweep time is coupled.

RESULTS

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Region Code	Channel	Frequency (MHz)	Hopping Freq Sepration Antenna 1 (kHz)
1_1	Low	907	180
	Middle	911.68	180
	High	916.18	180
1_2	Low	910.82	180
	Middle	915.5	180
	High	920	180
2_1	Low	907	154
	Middle	911.004	154
	High	914.854	154
2_2	Low	912.146	154
	Middle	916.15	154
	High	920	154
3_1	Low	907	116
	Middle	910.016	116
	High	912.916	116
3_2	Low	914.084	116
	Middle	917.1	116
	High	920	116
4_1	Low	907	76
	Middle	908.976	76
	High	910.876	76
4_2	Low	916.124	76
	Middle	918.1	76
	High	920	76
5_1	Low	907	38
	Middle	907.988	38
	High	908.938	38
5_2	Low	918.062	38
	Middle	919.05	38
	High	920	38
6_1	Low	907	32
	Middle	907.832	32
	High	908.632	32
6_2	Low	918.368	32
	Middle	919.2	32
	High	920	32

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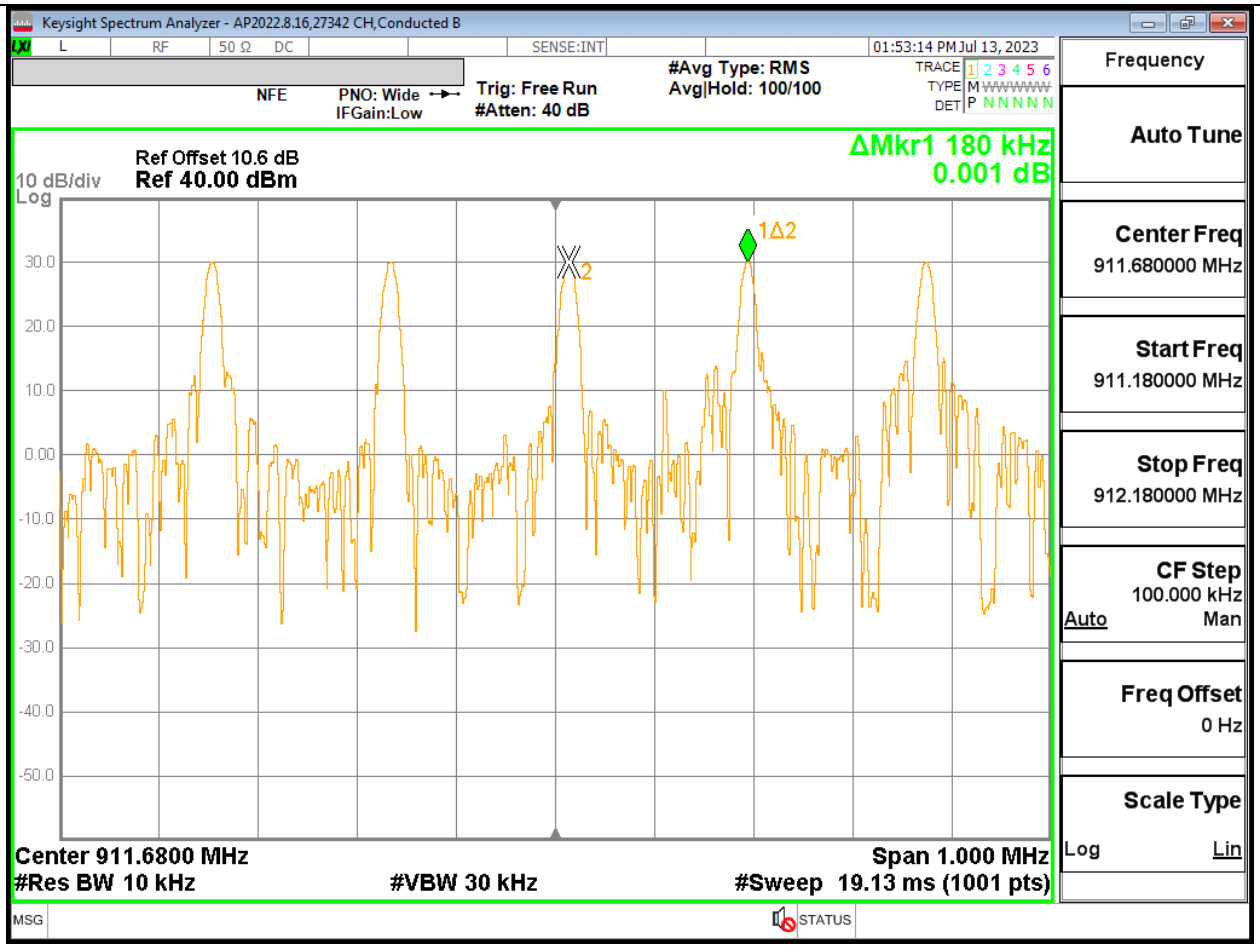

HOPPING FREQUENCY SEPARATION PLOT ANTENNA 1_ 1_1

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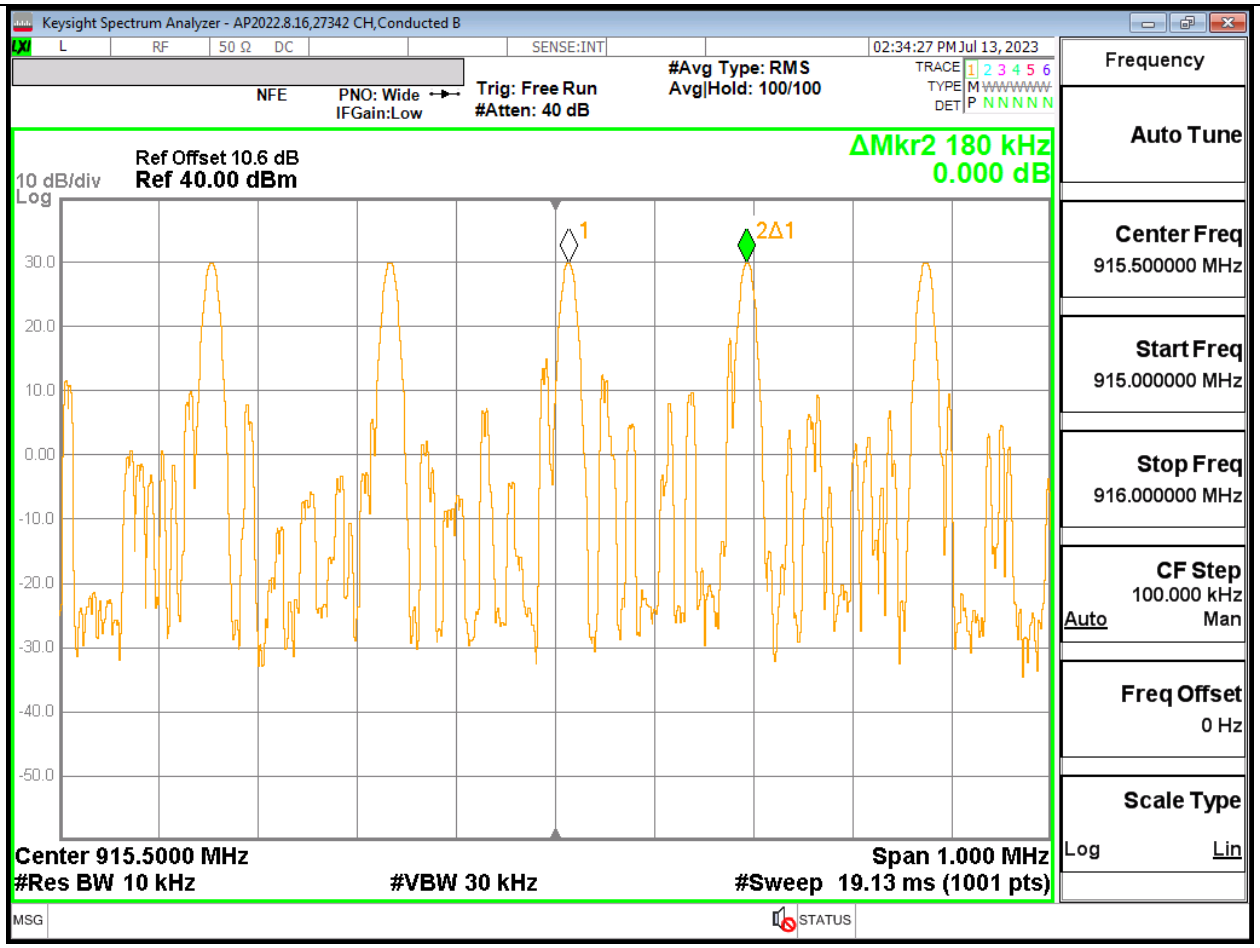

HOPPING FREQUENCY SEPARATION PLOT ANTENNA 1_ 1_2

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9.4. NUMBER OF HOPPING CHANNELS

LIMITS

FCC §15.247 (a) (1) (i)

(i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

RSS-247 (5.1)

(c) For FHSS in the band 902-928 MHz: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 20-second period. If the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 10-second period. The maximum 20 dB bandwidth of the hopping channel shall be 500 kHz.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW (set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.)is set to 10 kHz and the VBW is set to > RBW. The analyzer is set to Max Hold.

RESULTS

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Region Code	No of Hopping Channel
	Antenna 1
1_1	52
	52
	52
1_2	52
	52
	52
2_1	52
	52
	52
2_2	52
	52
	52
3_1	52
	52
	52
3_2	52
	52
	52
4_1	52
	52
	52
4_2	52
	52
	52
5_1	52
	52
	52
5_2	52
	52
	52
6_1	52
	52
	52
6_2	52
	52
	52

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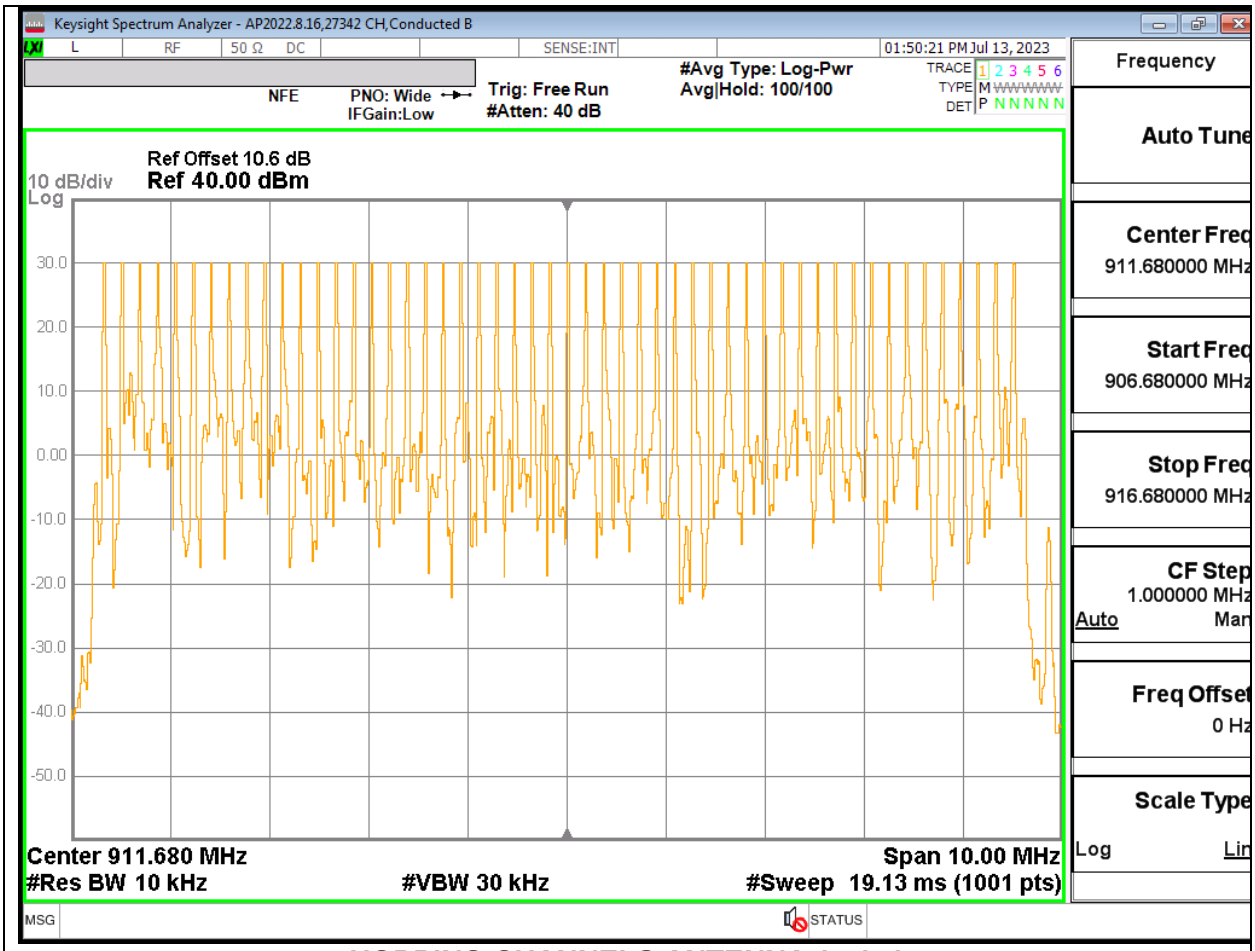

HOPPING CHANNELS ANTENNA 1 _1_1

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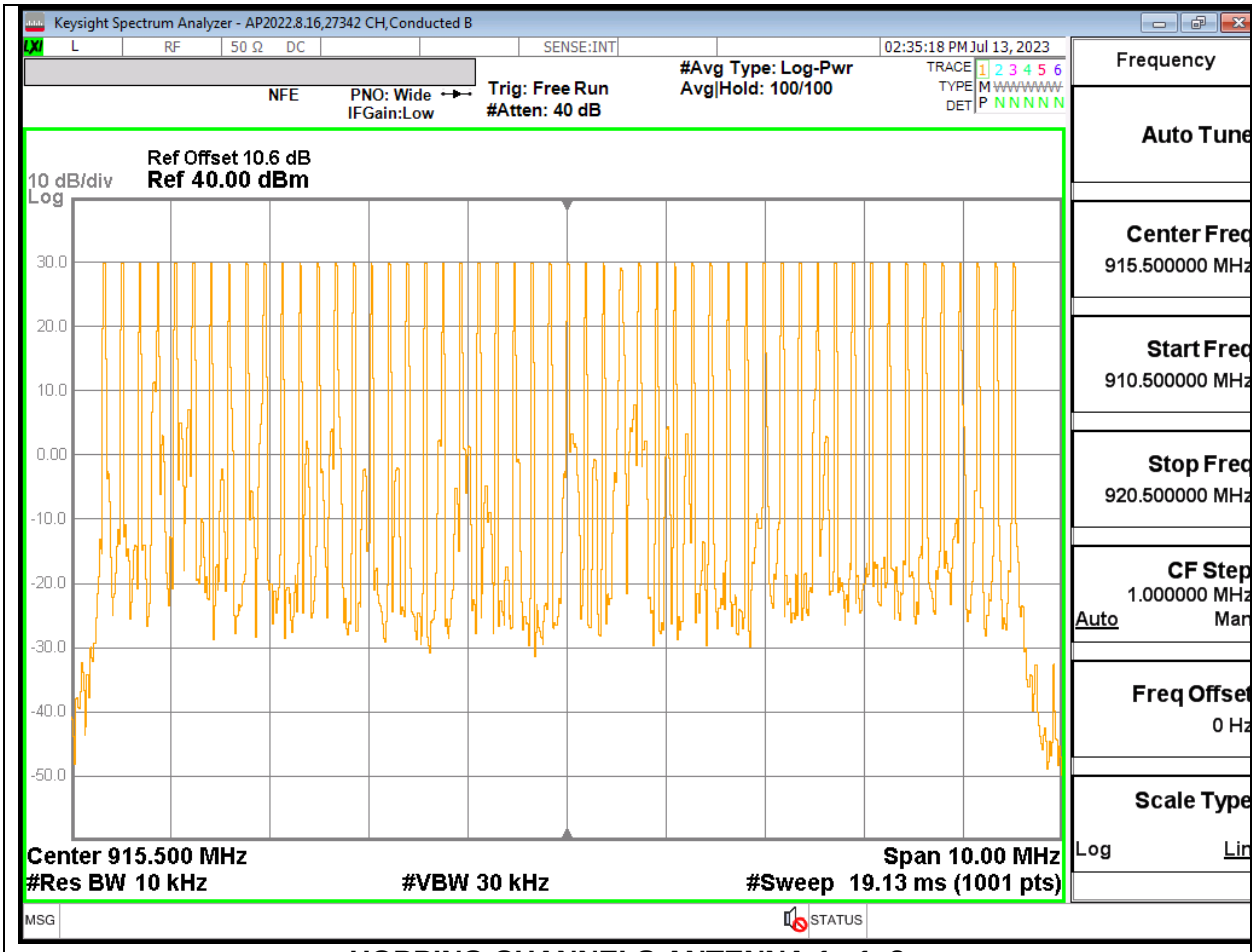

HOPPING CHANNELS ANTENNA 1 _1_2

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9.5. AVERAGE TIME OF OCCUPANCY

LIMITS

FCC §15.247 (a) (1) (i)

(i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period;

RSS-247 (5.1)

(c) For FHSS in the band 902-928 MHz: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 20-second period.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 20 second scan, to enable resolution of each occurrence.

RESULTS

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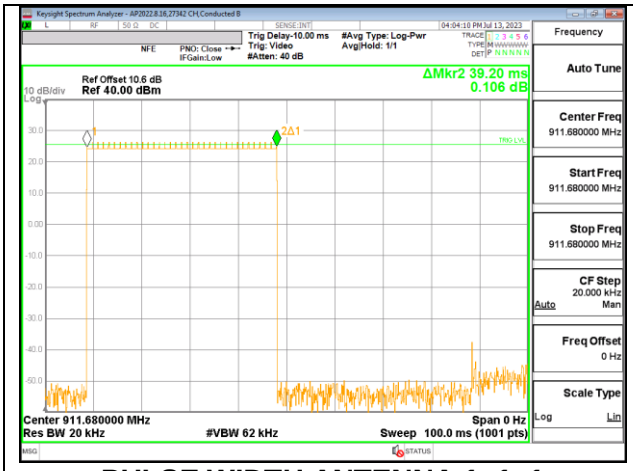
Region Code	Pulse Width (msec)	Number of Pulses in 20 seconds	Average Time of Occupancy in 20 seconds (sec) Antenna 1	Limit (sec)	Margin (sec)
1_1	39.2	9	0.3528	0.4	-0.0472
1_2	39.3	10	0.3930	0.4	-0.0070
2_1	39.3	10	0.3930	0.4	-0.0070
2_2	39.3	10	0.3930	0.4	-0.0070
3_1	39.3	10	0.3930	0.4	-0.0070
3_2	39.2	10	0.3920	0.4	-0.0080
4_1	39.3	10	0.3930	0.4	-0.0070
4_2	39.2	9	0.3528	0.4	-0.0472
5_1	39.2	9	0.3528	0.4	-0.0472
5_2	39.3	10	0.3930	0.4	-0.0070
6_1	39.3	10	0.3930	0.4	-0.0070
6_2	39.3	10	0.3930	0.4	-0.0070



PULSE WIDTH ANTENNA 1_1_1

NUMBER OF PULSES IN 20 SECONDS OBSERVATION PERIOD ANTENNA 1_1_1

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9.6. OUTPUT POWER

LIMITS

15.247 (b) (2)

(2) For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels as permitted under paragraph (a)(1)(i) of this section.

RSS-247 (5.4)

(a)For FHSS operating in the band 902-928 MHz, the maximum peak conducted output power shall not exceed 1.0 W, and the e.i.r.p. shall not exceed 4 W if the hopset uses 50 or more hopping channels.

TEST PROCEDURE

The transmitter output is connected to a power meter.

The power output was measured on the EUT antenna port using SMA cable with 10dB attenuator connected to a power meter via wideband power sensor. Peak output power was read directly from power meter.

RESULTS

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Application	Channel	Frequency (MHz)	Output Power Peak (dBm)		Total Peak power (dBm)	Limit (dBm)
			Ant1	Ant2	Ant1+ Ant2	
Original	Low	917.2	27.49	26.25	29.92	30
	Middle	918	27.51	26.37	**29.99**	30
	High	918.8	26.92	26.85	29.90	30

Tested By:	CH 27342
Date:	2023-07-13

Region Code	Channel	Frequency (MHz)	Output Power Peak (dBm)	Limit (dBm)	Margin (dB)
1_1	Low	907	29.83	30	-0.17
	Middle	911.68	29.84	30	-0.16
	High	916.18	29.86	30	-0.14
1_2	Low	910.82	29.92	30	-0.08
	Middle	915.5	29.92	30	-0.08
	High	920	29.88	30	-0.12
2_1	Low	907	29.89	30	-0.11
	Middle	911.004	29.89	30	-0.11
	High	914.854	29.88	30	-0.12
2_2	Low	912.146	29.89	30	-0.11
	Middle	916.15	29.89	30	-0.11
	High	920	29.88	30	-0.12
3_1	Low	907	29.86	30	-0.14
	Middle	910.016	29.87	30	-0.13
	High	912.916	29.88	30	-0.12
3_2	Low	914.084	29.87	30	-0.13
	Middle	917.1	29.86	30	-0.14
	High	920	29.86	30	-0.14
4_1	Low	907	29.87	30	-0.13
	Middle	908.976	29.9	30	-0.10
	High	910.876	29.88	30	-0.12
4_2	Low	916.124	29.89	30	-0.11
	Middle	918.1	29.89	30	-0.11
	High	920	29.88	30	-0.12
5_1	Low	907	29.9	30	-0.10
	Middle	907.988	29.9	30	-0.10
	High	908.938	29.9	30	-0.10
5_2	Low	918.062	29.89	30	-0.11
	Middle	919.05	29.9	30	-0.10
	High	920	29.91	30	-0.09
6_1	Low	907	**29.97**	30	-0.03
	Middle	907.832	29.95	30	-0.05
	High	908.632	29.95	30	-0.05
6_2	Low	918.368	29.93	30	-0.07
	Middle	919.2	29.93	30	-0.07
	High	920	29.92	30	-0.08

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9.7. AVERAGE POWER

LIMITS

None; for reporting purposes only

TEST PROCEDURE

The transmitter output is connected to a power meter.

The power output was measured on the EUT antenna port using SMA cable with 10dB attenuator connected to a power meter via wideband power sensor. Gated average output power was read directly from power meter.

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RESULTS

Application	Channel	Frequency (MHz)	Output Power Avg (dBm)		Total avg power (dBm)
			Ant1	Ant2	Ant1+ Ant2
Original	Low	917.2	27.44	26.16	29.86
	Middle	918	27.46	26.25	29.91
	High	918.8	26.85	26.29	29.59

Tested By:	CH 27342
Date:	2023-07-13

Region Code	Channel	Frequency (MHz)	Output Power Avg (dBm)
1_1	Low	907	29.78
	Middle	911.68	29.78
	High	916.18	29.79
1_2	Low	910.82	29.85
	Middle	915.5	29.84
	High	920	29.82
2_1	Low	907	29.83
	Middle	911.004	29.84
	High	914.854	29.82
2_2	Low	912.146	29.83
	Middle	916.15	29.82
	High	920	29.83
3_1	Low	907	29.81
	Middle	910.016	29.82
	High	912.916	29.83
3_2	Low	914.084	29.82
	Middle	917.1	29.81
	High	920	29.82
4_1	Low	907	29.83
	Middle	908.976	29.85
	High	910.876	29.84
4_2	Low	916.124	29.84
	Middle	918.1	29.84
	High	920	29.83
5_1	Low	907	29.85
	Middle	907.988	29.85
	High	908.938	29.85
5_2	Low	918.062	29.84
	Middle	919.05	29.84
	High	920	29.85
6_1	Low	907	29.91
	Middle	907.832	29.9
	High	908.632	29.9
6_2	Low	918.368	29.88
	Middle	919.2	29.88
	High	920	29.87

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9.8. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

RSS-247 (5.5)

Limit = -20 dBc

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

The bandedges at 902MHz and 928MHz are investigated with the transmitter set to the normal hopping mode.

RESULTS

Output power is similar, only selective channel as below are chosen as a representative:

Region Code	Channel	Frequency (MHz)
1_1	Low	907
1_2	Middle	915.5
1_2	High	920
1_2	Hopping	

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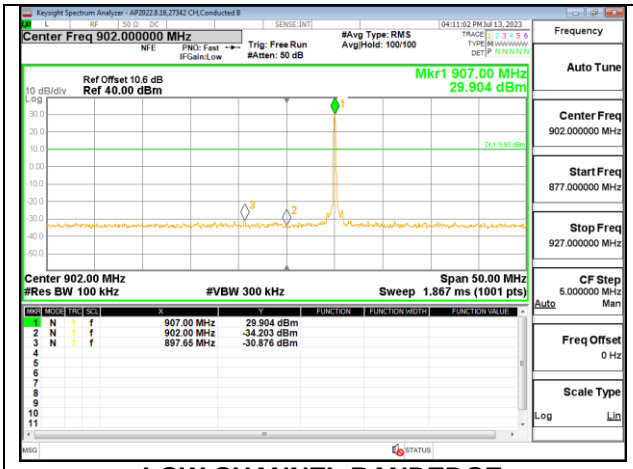
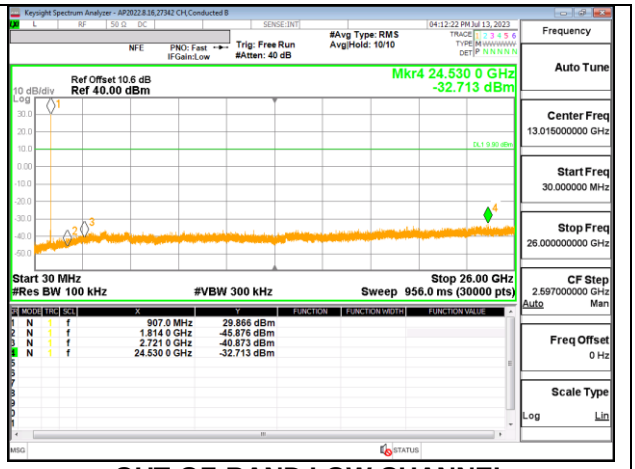
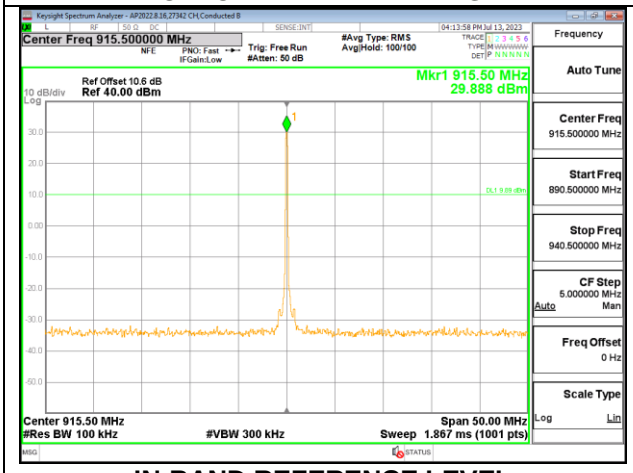
SPURIOUS EMISSIONS, NON-HOPPING



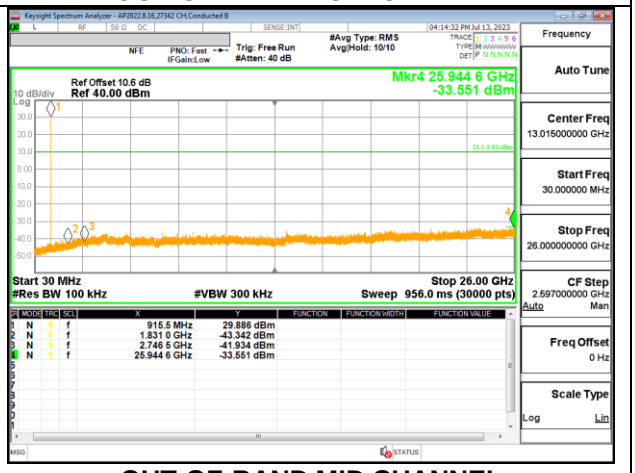
LOW CHANNEL BANDEDGE



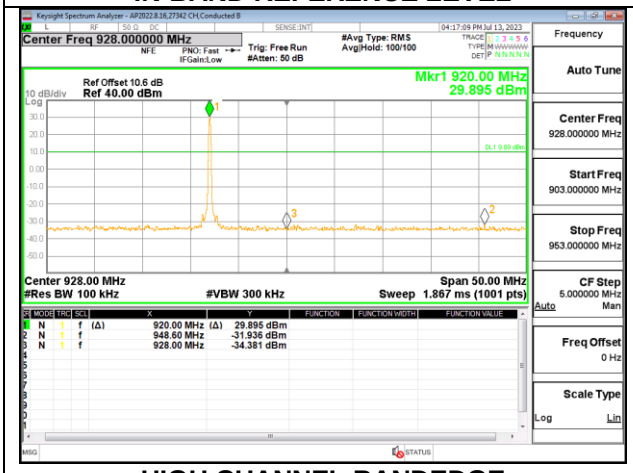
OUT-OF-BAND LOW CHANNEL



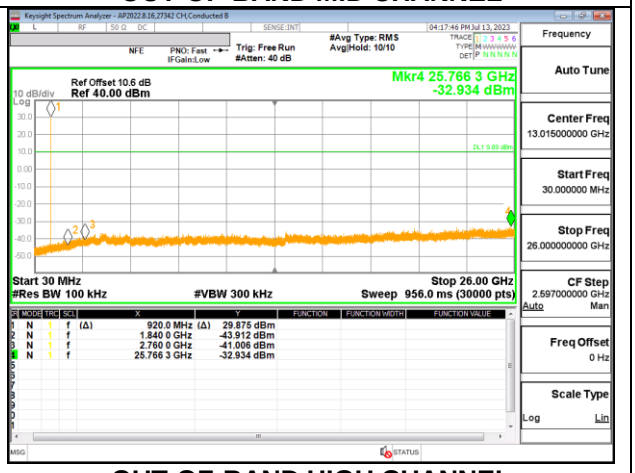
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL



HIGH CHANNEL BANDEDGE



OUT-OF-BAND HIGH CHANNEL

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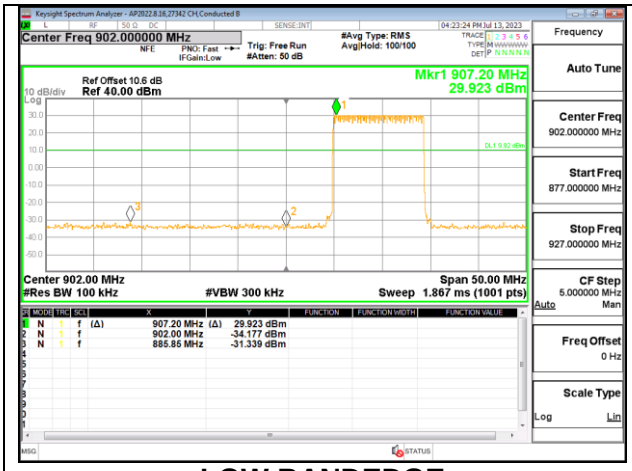
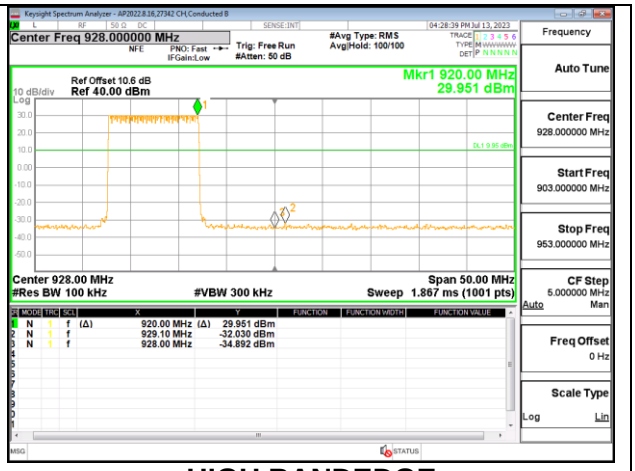
SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



LOW BANDEDGE



HIGH BANDEDGE

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10. RADIATED TEST RESULTS

LIMITS

FCC §15.205 and §15.209

RSS-GEN, Section 8.9 and 8.10.

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
0.009-0.490	2400/F(kHz) @ 300 m	-
0.490-1.705	24000/F(kHz) @ 30 m	-
1.705 - 30	30 @ 30m	-
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane for measurement below 1GHz; 1.5 m above the ground plane for measurement above 1GHz. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.10. The EUT is set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements in the 30-1000MHz range, 9kHz for peak and/or quasi-peak detection measurements in the 0.15-30MHz range and 200Hz for peak and/or quasi-peak detection measurements in the 9 to 150kHz range. Peak detection is used unless otherwise noted as quasi-peak or average (9-90kHz and 110-490kHz).

For pre-scans above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 30 KHz for peak measurements.

For final measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz for peak measurements and 1 MHz resolution bandwidth with 1/T video bandwidth with peak detector for average measurements.

The spectrum from 1 GHz to 18 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band. Below 1GHz and above 18GHz emissions, the channel with the highest output power was tested.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

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For below 30MHz testing, investigation was done on three antenna orientations (parallel, perpendicular, and ground-parallel), parallel and perpendicular are the worst orientations, therefore testing was performed on these two orientations only. Blue color trace on plots: Parallel orientation. Green color trace on plots: Perpendicular orientation.

Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.

KDB 414788 Open Field Site(OFS) and Chamber Correlation Justification

OFS and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

NOTE: The limits in FCC 47 CFR, Part 15, Subpart C, paragraph 15.209(a), are identical to those in RSS-Gen section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table), using the free space impedance of 377 Ohms. For example the measurement at frequency X kHz resulted in a level of Y dBuV/m, which is equivalent to Y – 51.5 = Z dBuA/m, which has the same margin, W dB, to the corresponding RSS-Gen Table 6 limit as it has to 15.209(a) limit.

RESULTS

Output power is similar, only selective channel as below are chosen as a representative:

Region Code	Channel	Frequency (MHz)
1_1	Low	907
1_2	Middle	915.5
1_2	High	920

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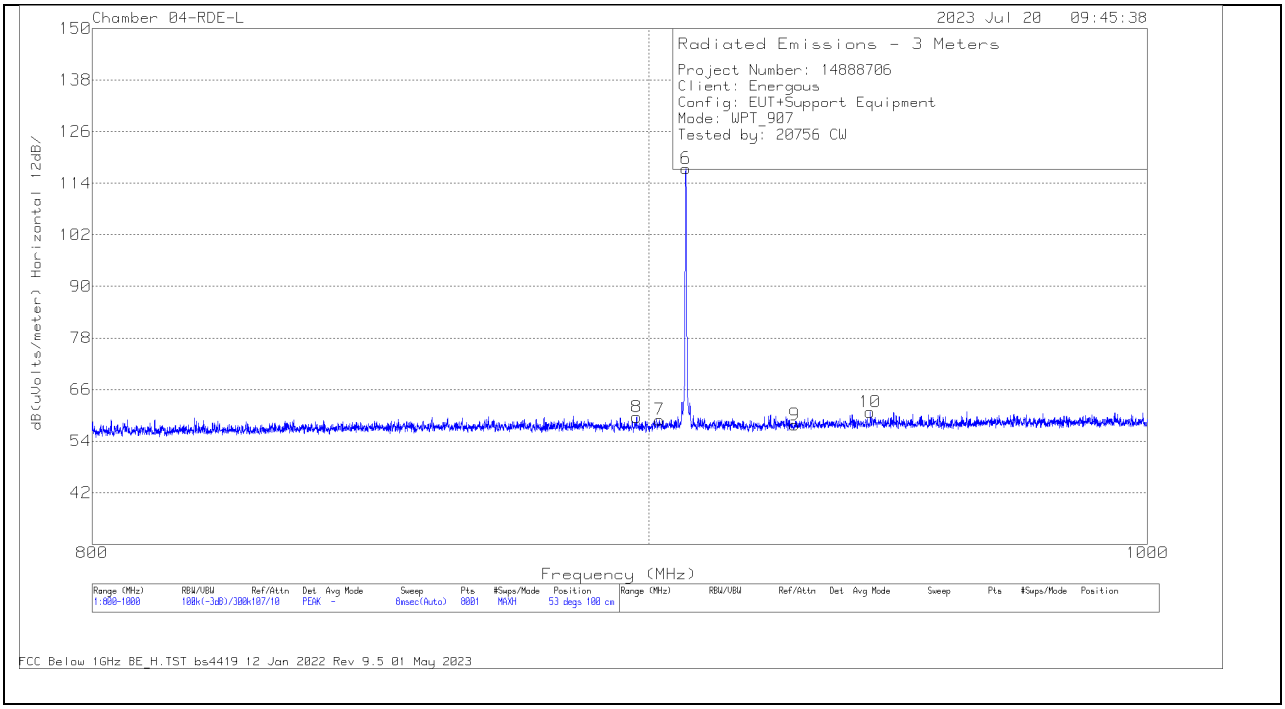
10.1. TRANSMITTER BELOW 1 GHz

-20 dBc BANDEDGE WITHOUT NOTCH FILTER AND PRE-AMPLIFIER (LOW CHANNEL)

HORIZONTAL RESULT



Radiated Emissions

Range 1: Horizontal 800 - 1000MHz									
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	174374 ANSI ACF 10 m H UL_	Cbl (dB)	Corrected Reading dB(uVolts/meter)	Azimuth (Degs)	Height (cm)	Polarity
6	907.025	85.02	Pk	28.2	4.2	117.42	53	100	H
7	901.975	26.69	Pk	28	4.3	58.99	53	100	H
8	897.625	27.41	Pk	28	4.2	59.61	53	100	H
9	928.1	25.17	Pk	28.3	4.3	57.77	53	100	H
10	943.075	27.96	Pk	28.6	4.2	60.76	53	100	H

Pk - Peak detector

M8 and M10 are not under restricted bands. With 20dBc from M6 117.42 dBuV/m= 97.42 dBuV/m as limit, M8 and M10 are passing.

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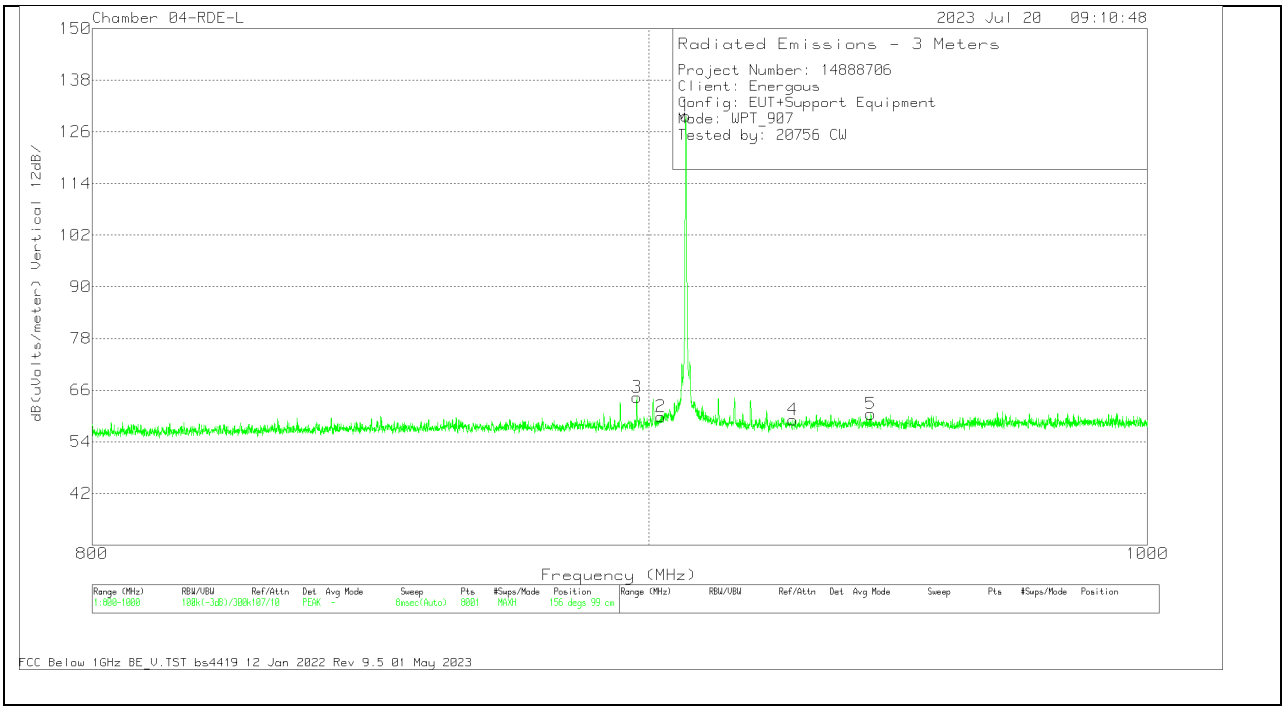
VERTICAL RESULT



Radiated Emissions

Range 1: Vertical 800 - 1000MHz									
Marker	**Frequency (MHz)**	**Meter Reading (dBuV)**	**Det**	**174374 ANSI ACF 10 m H UL_**	**Cbl (dB)**	**Corrected Reading dB(uVolts/meter)**	**Azimuth (Degs)**	**Height (cm)**	**Polarity**
1	907.025	97.29	Pk	28.2	4.2	129.69	156	99	V
2	902.2	27.54	Pk	28	4.3	59.84	156	99	V
3	897.65	32.16	Pk	28	4.2	64.36	156	99	V
4	927.8	26.51	Pk	28.3	4.3	59.11	156	99	V
5	943.225	27.67	Pk	28.6	4.2	60.47	156	99	V

Pk - Peak detector

M3 and M5 are not under restricted bands. With 20dBc from M1 129.69 dBuV/m= 109.69 dBuV/m as limit, M3 and M5 are passing.

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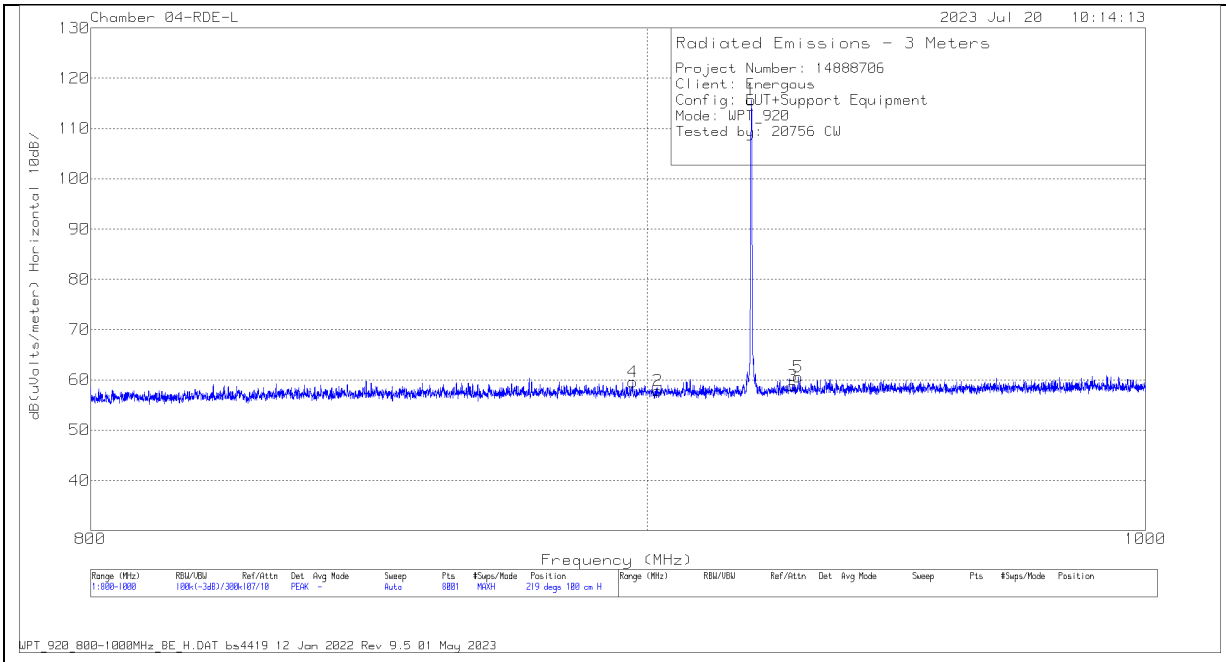
-20 dBc BANDEDGE WITHOUT NOTCH FILTER AND PRE-AMPLIFIER (HIGH CHANNEL)

HORIZONTAL RESULT



Radiated Emissions

Range 1: Horizontal 800 - 1000MHz									
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	174374 ANSI ACF 10 m H UL_	Cbl (dB)	Corrected Reading dB(uVolts/meter)	Azimuth (Degs)	Height (cm)	Polarity
1	920.025	83.33	Pk	28.1	4.2	115.63	219	100	H
2	902	25.53	Pk	28	4.3	57.83	219	100	H
3	928.025	26.28	Pk	28.3	4.3	58.88	219	100	H
4	897.2	27.34	Pk	28	4.2	59.54	219	100	H
5	929.2	28	Pk	28.3	4.3	60.6	219	100	H

Pk - Peak detector

M4 and M5 are not under restricted bands. With 20dBc from M1 115.63 dBuV/m= 95.63 dBuV/m as limit, M4 and M5 are passing.

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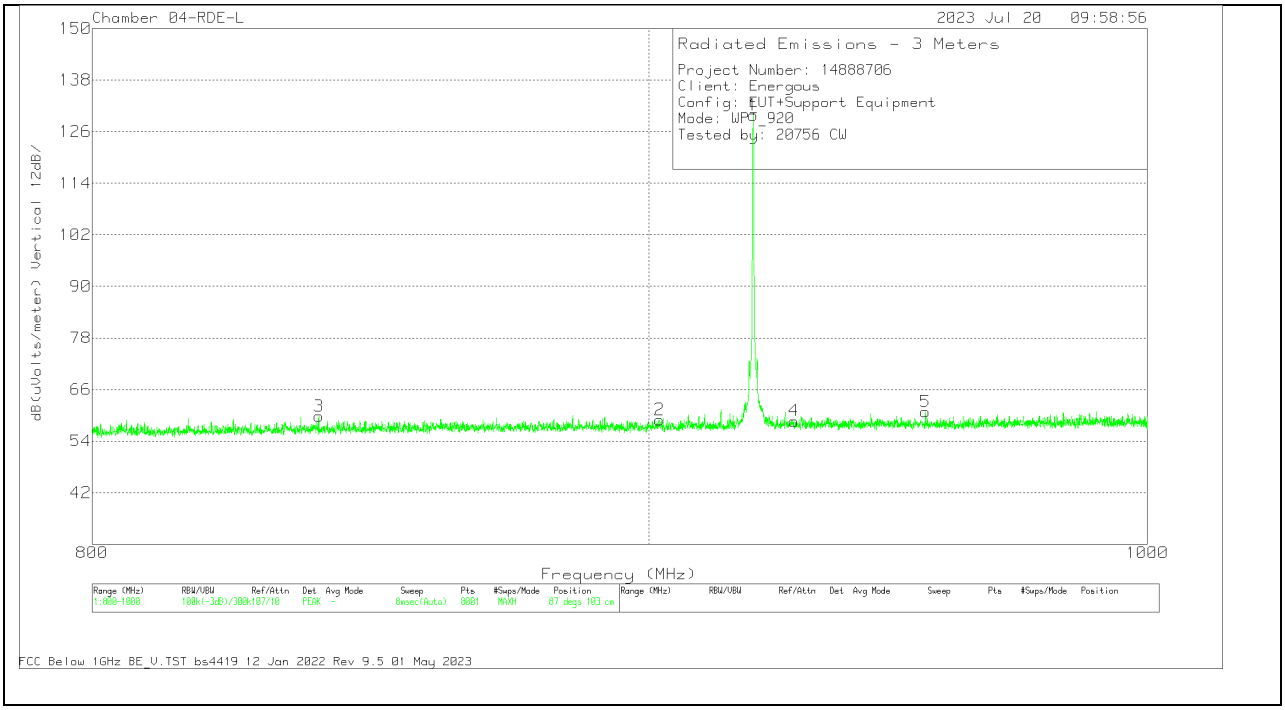
VERTICAL RESULT



Radiated Emissions

Range 1: Vertical 800 - 1000MHz									
Marker	**Frequency (MHz)**	**Meter Reading (dBuV)**	**Det**	**174374 ANSI ACF 10 m H UL_**	**Cbl (dB)**	**Corrected Reading dB(uVolts/meter)**	**Azimuth (Degs)**	**Height (cm)**	**Polarity**
1	920.025	97.57	Pk	28.1	4.2	129.87	87	103	V
2	902	26.64	Pk	28	4.3	58.94	87	103	V
3	839.275	28.49	Pk	27.4	3.9	59.79	87	103	V
4	927.975	26.1	Pk	28.3	4.3	58.7	87	103	V
5	954.175	27.99	Pk	28.5	4.3	60.79	87	103	V

Pk - Peak detector

M3 and M5 are not under restricted bands. With 20dBc from M 129.87 dBuV/m= 109.87 dBuV/m as limit, M3 and M5 are passing.

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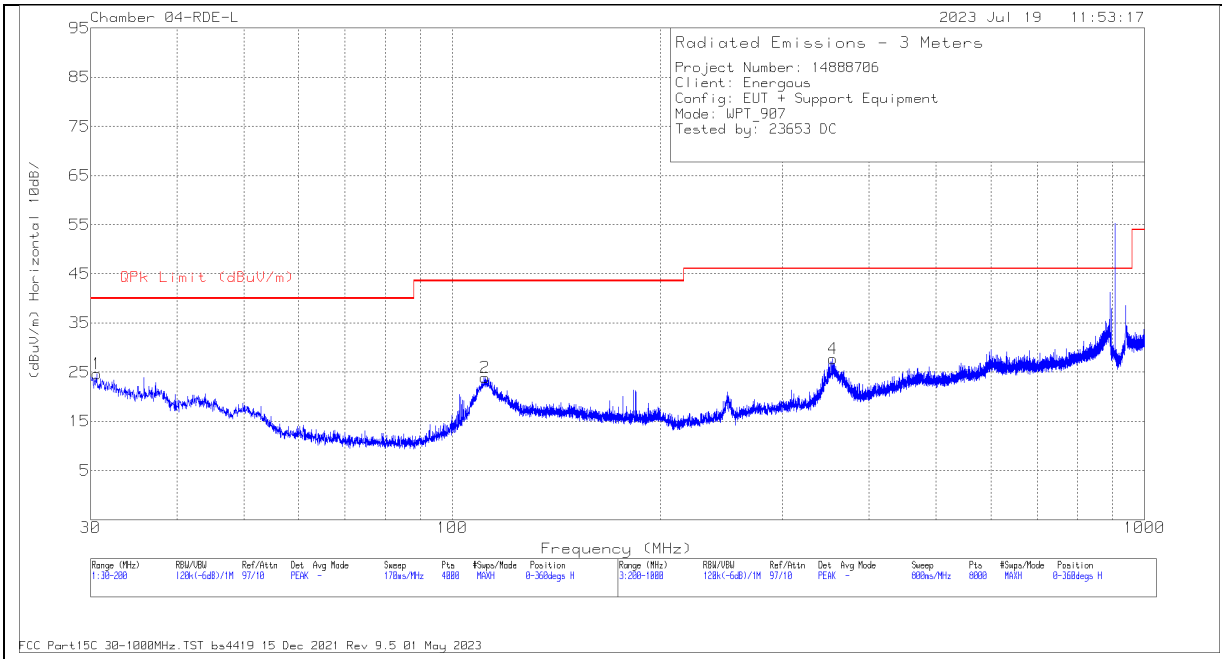
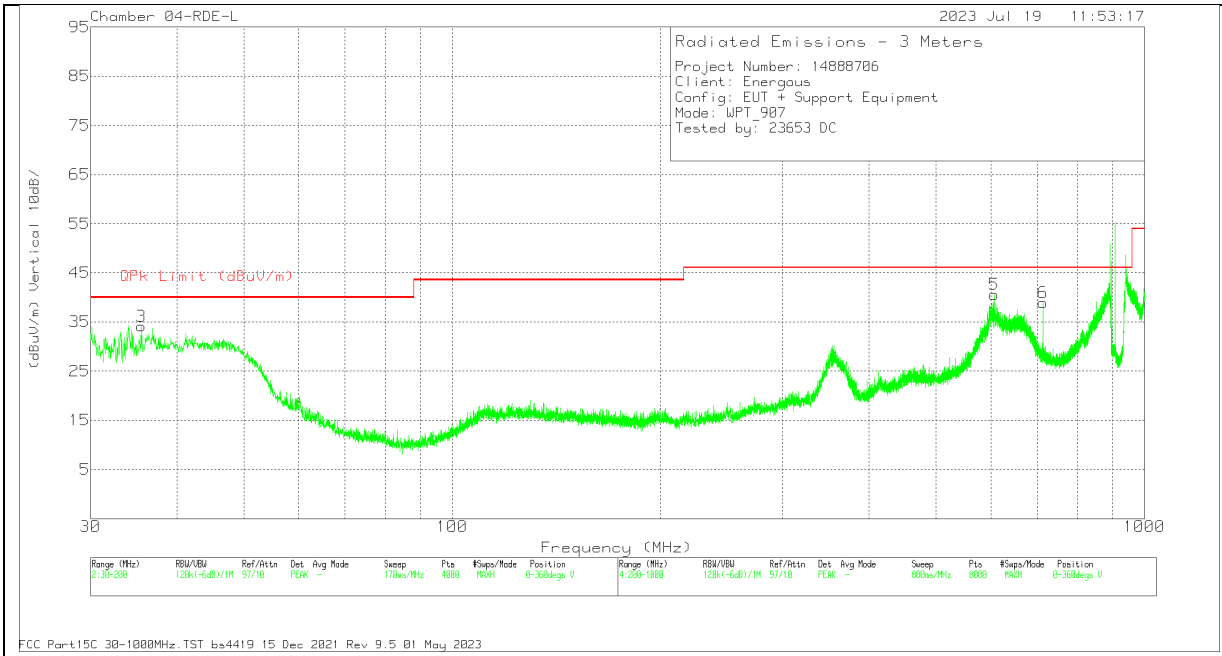
HARMONICS AND SPURIOUS EMISSIONS (WITH NOTCH FILTER)

LOW CHANNEL RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	174374 ANSI ACF 10 m H UL_	Amp/Cbl (dB)	156483 BRF (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	31.111	21.54	Qp	25.8	-31.1	0	16.24	40	-23.76	149	225	H
2	* 112.349	29.11	Qp	18.8	-30.3	.1	17.71	43.52	-25.81	357	305	H
3	48.4719	42.6	Qp	14.5	-30.9	.1	26.3	40	-13.7	171	129	V
4	353.949	29	Qp	20.4	-28.8	.2	20.8	46.02	-25.22	190	280	H
5	604.61	36.21	Qp	24.6	-28.1	.3	33.01	46.02	-13.01	131	163	V
6	684.552	32.03	Qp	25.7	-28	.3	30.03	46.02	-15.99	212	164	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Qp - Quasi-Peak detector

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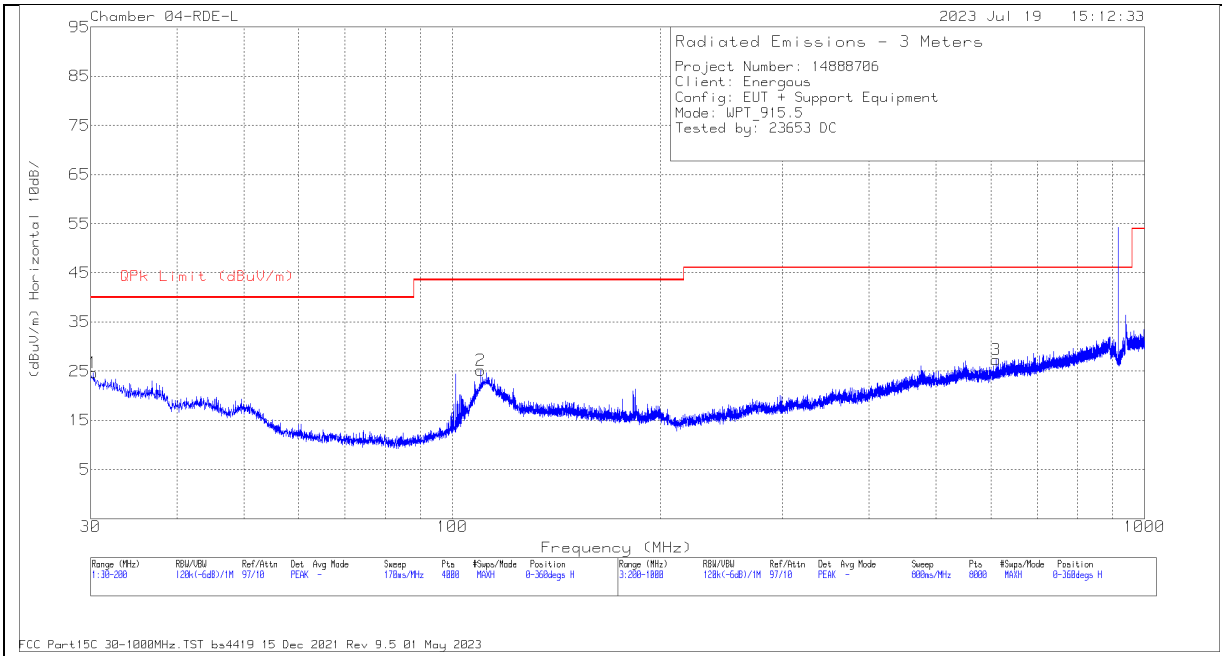
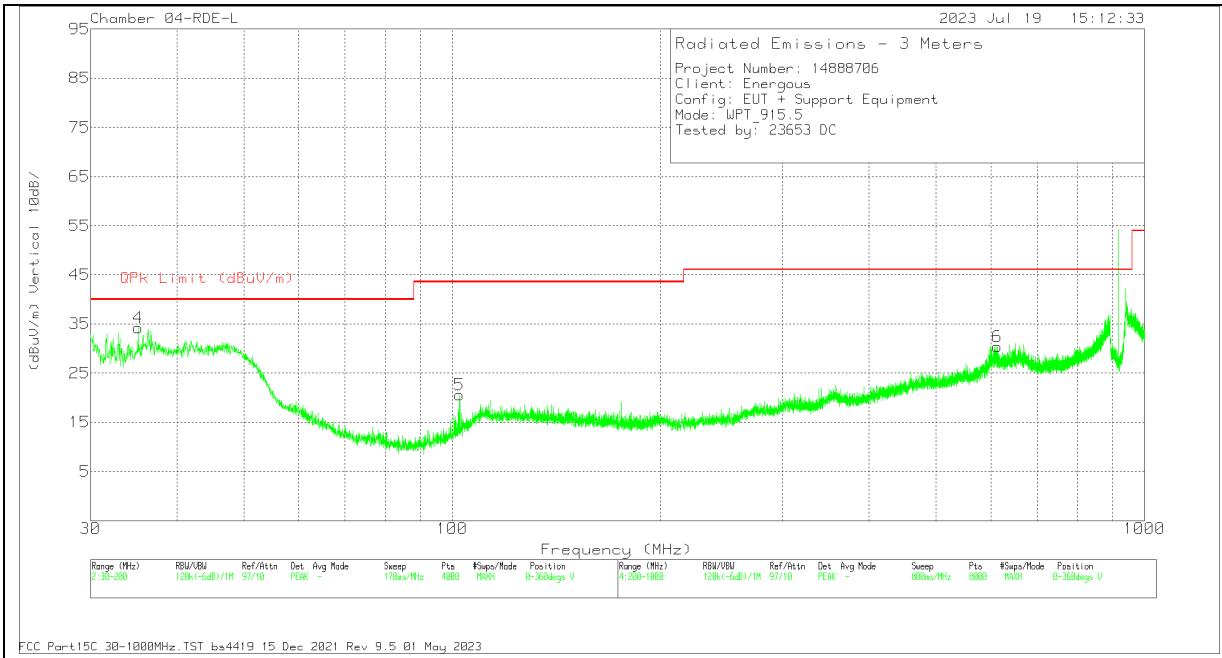
MID CHANNEL RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	174374 ANSI ACF 10 m H UL_	Amp/Cbl (dB)	156483 BRF (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	30.0818	21.75	Qp	26.8	-31.1	0	17.45	40	-22.55	176	338	H
2	* 112.04	31.33	Qp	18.7	-30.3	.1	19.83	43.52	-23.69	145	261	H
3	37.4673	33.86	Qp	21.5	-31	0	24.36	40	-15.64	139	158	V
4	100.93	21.26	Qp	16.3	-30.4	.1	7.26	43.52	-36.26	87	223	V
5	* 610.156	21.69	Qp	24.7	-27.9	.3	18.79	46.02	-27.23	264	153	H
6	* 612.71	26.53	Qp	24.8	-27.9	.3	23.73	46.02	-22.29	136	182	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Qp - Quasi-Peak detector

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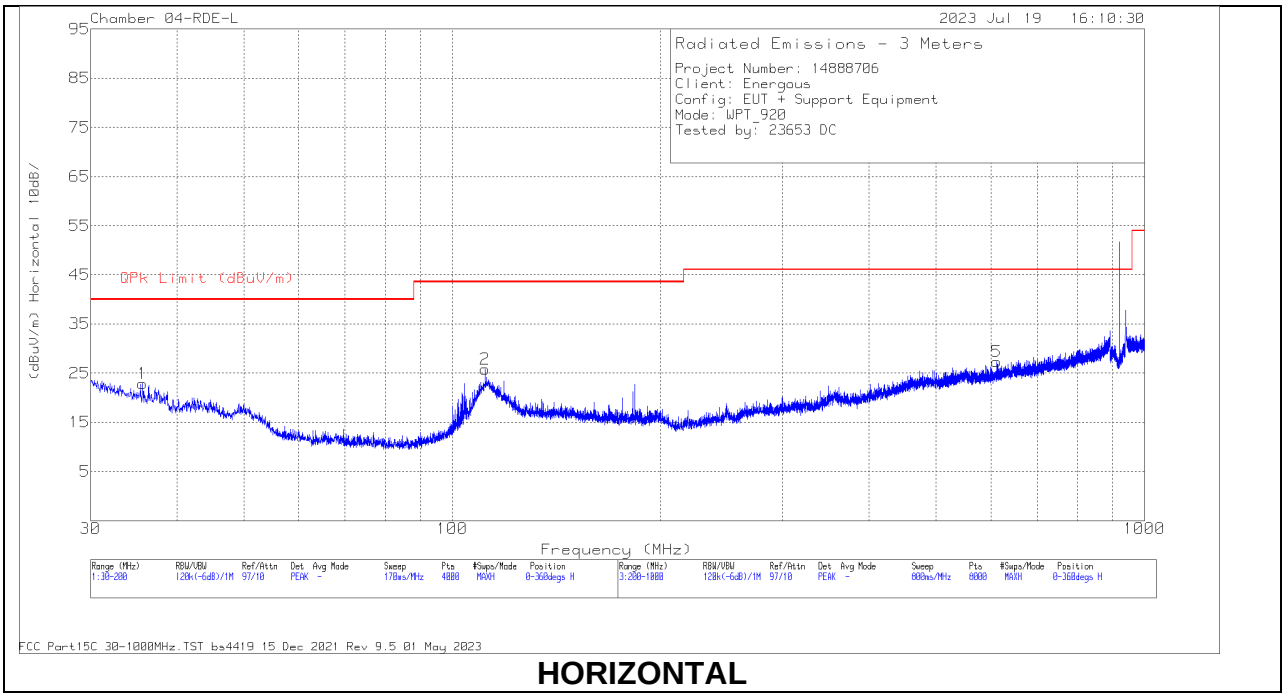
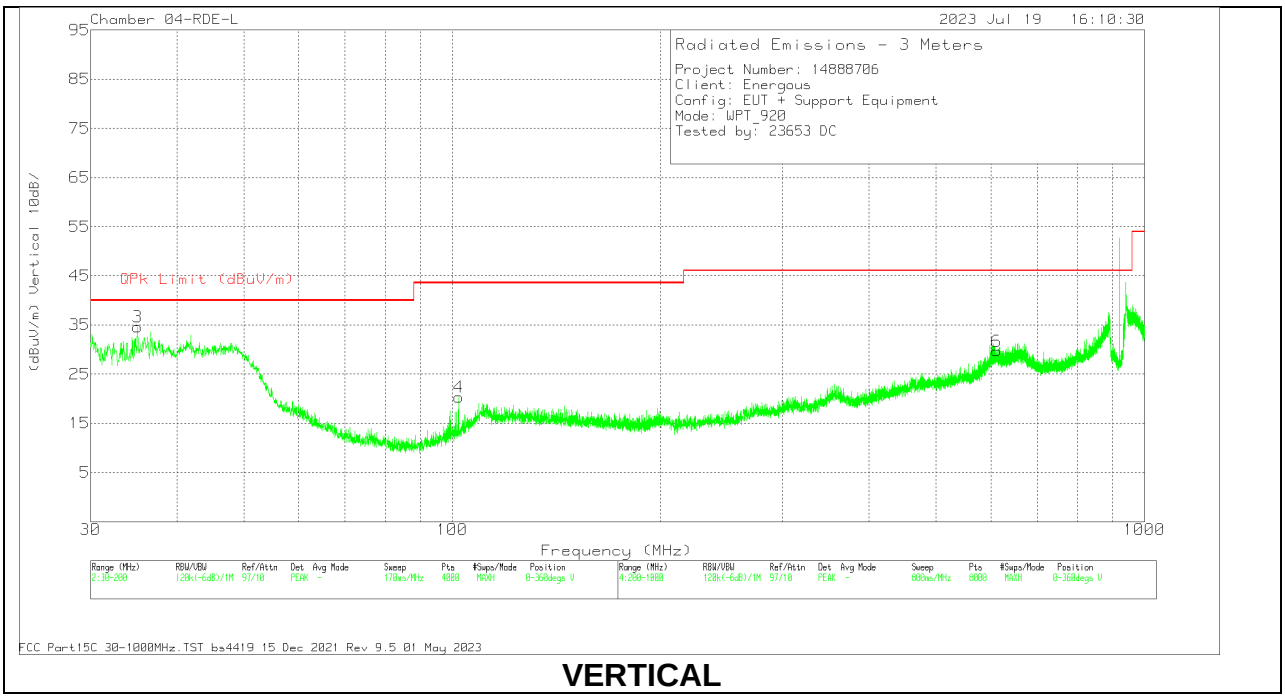
HIGH CHANNEL RESULTS



HORIZONTAL



VERTICAL

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47173 Benicia Street, Fremont, CA 94538, USA TEL:(510) 319-4000 FAX:(510) 661-0888

RADIATED EMISSIONS

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	174374 ANSI ACF 10 m H UL_	Amp/Cbl (dB)	156483 BRF (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	35.6896	22.8	Qp	22.6	-31.1	0	14.3	40	-25.7	165	135	H
2	* 111.51	30.26	Qp	18.7	-30.3	.1	18.76	43.52	-24.76	132	194	H
3	35.1122	30.98	Qp	22.9	-31.1	0	22.78	40	-17.22	139	167	V
4	101.992	21.24	Qp	16.6	-30.4	.1	7.54	43.52	-35.98	94	210	V
5	* 611.934	22.06	Qp	24.8	-27.9	.3	19.26	46.02	-26.76	261	154	H
6	* 611.088	24.82	Qp	24.7	-27.9	.3	21.92	46.02	-24.1	245	139	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Qp - Quasi-Peak detector

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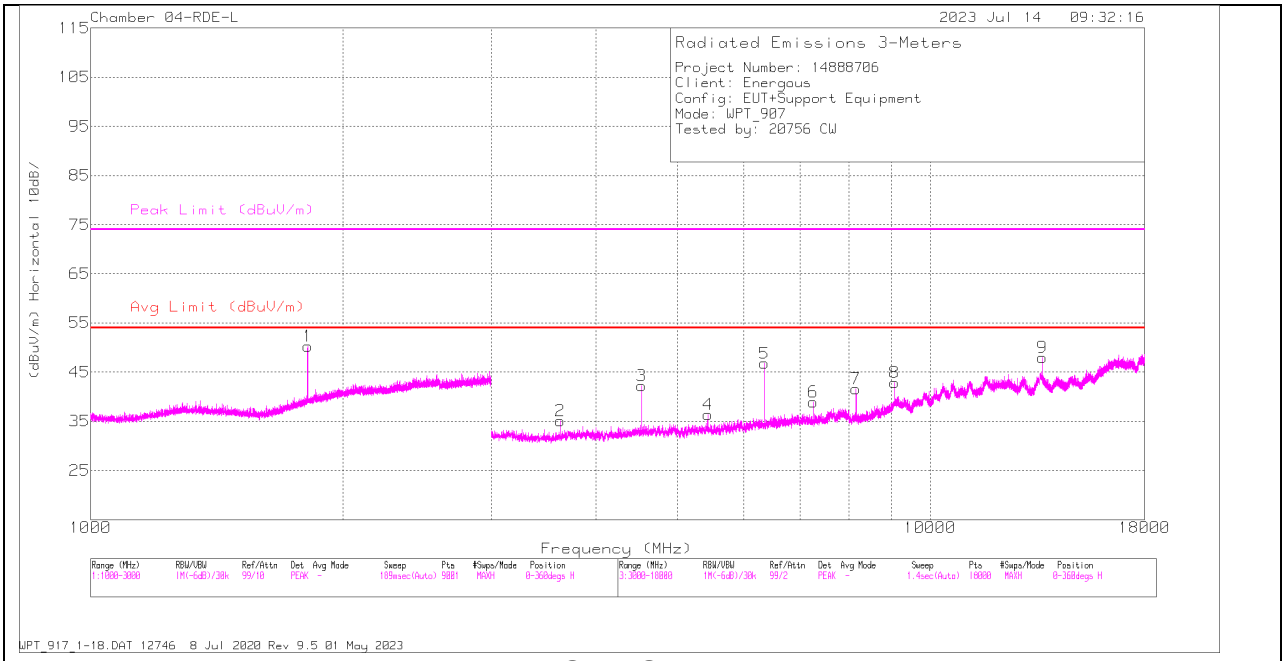
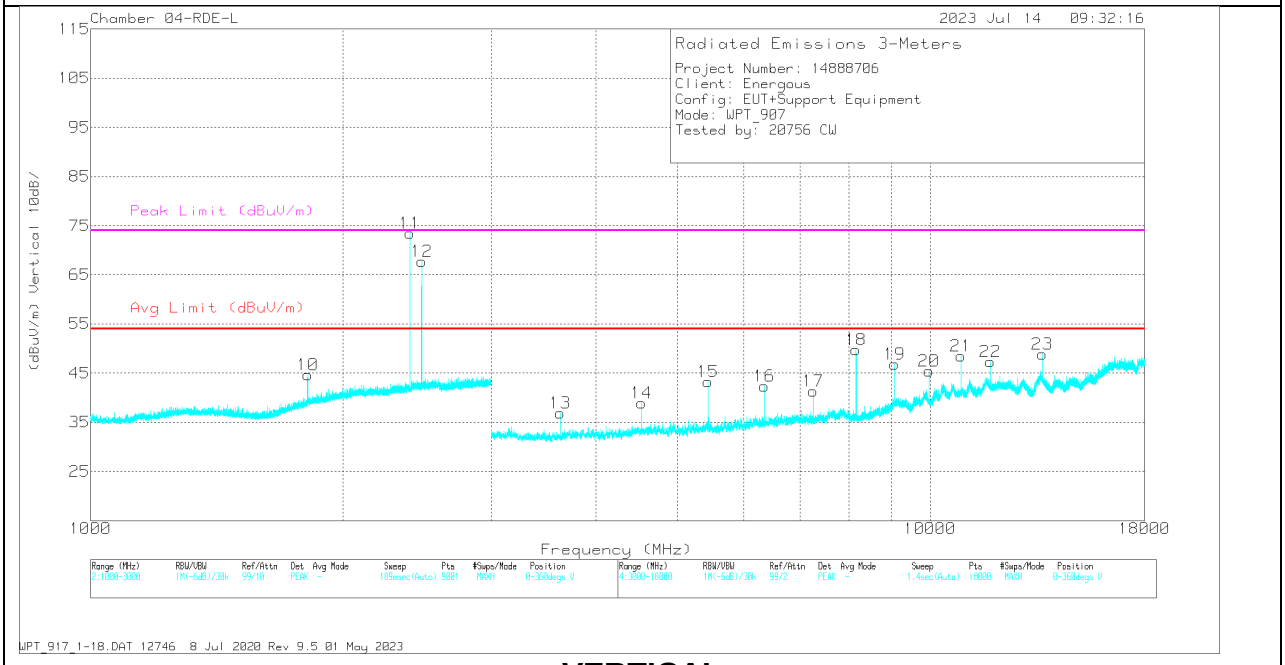
10.2. TRANSMITTER ABOVE 1 GHz

HARMONICS AND SPURIOUS EMISSIONS (WITH HPF 204786)

LOW CHANNEL RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	206806 ACF (dB) 3mH	AMP/C BL	152043 HPF	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
3	* 4535.095	36.96	PKFH	34	-25.7	0.45	45.71	-	-	74	-28.29	355	103	H
	* 4535.067	31.76	VA1T	34	-25.7	0.45	40.51	54	-13.49	-	-	355	103	H
7	* 8163.083	30.61	PKFH	35.7	-19.4	0.43	47.34	-	-	74	-26.66	253	163	H
	* 8163.118	24.56	VA1T	35.7	-19.4	0.43	41.29	54	-12.71	-	-	253	163	H
8	* 9070.345	30.7	PKFH	36.1	-18.1	0.41	49.11	-	-	74	-24.89	359	234	H
	* 9070.105	20.68	VA1T	36.1	-18.1	0.41	39.09	54	-14.91	-	-	359	234	H
18	* 8163.154	36.26	PKFH	35.7	-19.4	0.43	52.99	-	-	74	-21.01	27	263	V
	* 8163.114	33.61	VA1T	35.7	-19.4	0.43	50.34	54	-3.66	-	-	27	263	V
21	* 10884.075	30.66	PKFH	37.7	-15.9	0.6	53.06	-	-	74	-20.94	28	101	V
	* 10884.167	24.39	VA1T	37.7	-15.9	0.6	46.79	54	-7.21	-	-	28	101	V
22	* 11791.096	31.33	PKFH	38.4	-16.5	1.3	54.53	-	-	74	-19.47	259	287	V
	* 11791.169	23.53	VA1T	38.4	-16.5	1.3	46.73	54	-7.27	-	-	259	287	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PKFH FHSS/BT RB=100k for Frequencies<1GHz / RB=1MHz for Frequencies>1GHz, VB=3 x RB, Peak
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

Markers 11 and 12 are BLE fundamental signals.
Markers 1, 5, 9, 10, 11, 12, 16, 20, 23 are under non restricted bands.
Markers 3, 7, 8, 18, 21, 22 are chosen as the worst 6 worst markers.

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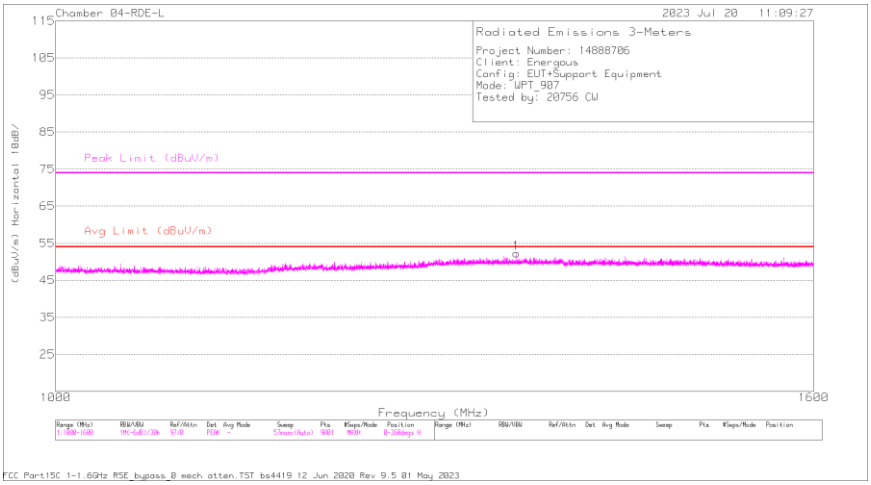
Spurious Emissions 1GHz – 1.6GHz without a Band Reject Filter, without 1.2 GHz HPF, and without amplifier

Horizontal



DATA

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	206806 ACF (dB) 3mH	Cbl (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1333.795	23.21	PKFH	28.7	6.7	58.61	-	-	74	-15.39	110	235	H
	* 1334.339	9.81	VA1T	28.7	6.7	45.21	54	-8.79	-	-	110	235	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PKFH FHSS/BT RB=100k for Frequencies<1GHz / RB=1MHz for Frequencies>1GHz, VB=3 x RB, Peak
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration
Note:

- Test was performed @ 3 meter distance.

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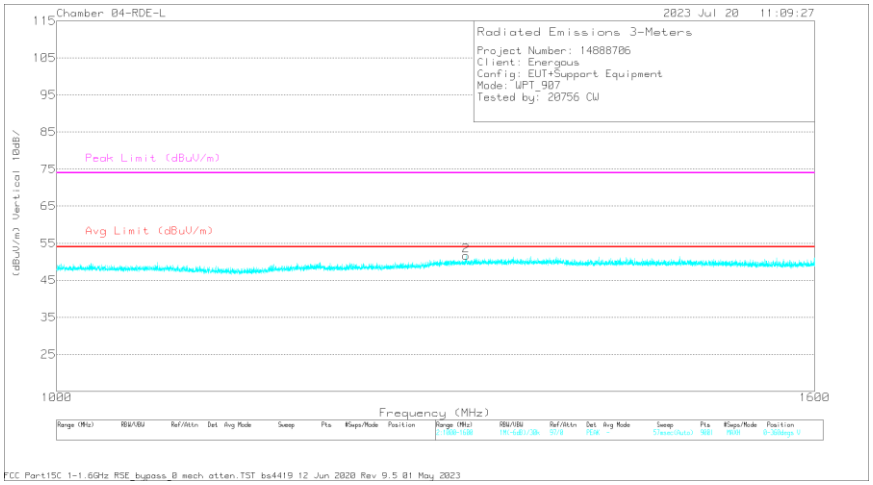
Vertical



DATA

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	206806 ACF (dB) 3mH	Cbl (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	* 1288.228	23.12	PKFH	28.8	6.5	58.42	-	-	74	-15.58	317	380	V
	* 1289.6	9.66	VA1T	28.8	6.5	44.96	54	-9.04	-	-	317	380	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PKFH FHSS/BT RB=100k for Frequencies<1GHz / RB=1MHz for Frequencies>1GHz, VB=3 x RB, Peak
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration
Note:

- Test was performed @ 3 meter distance.

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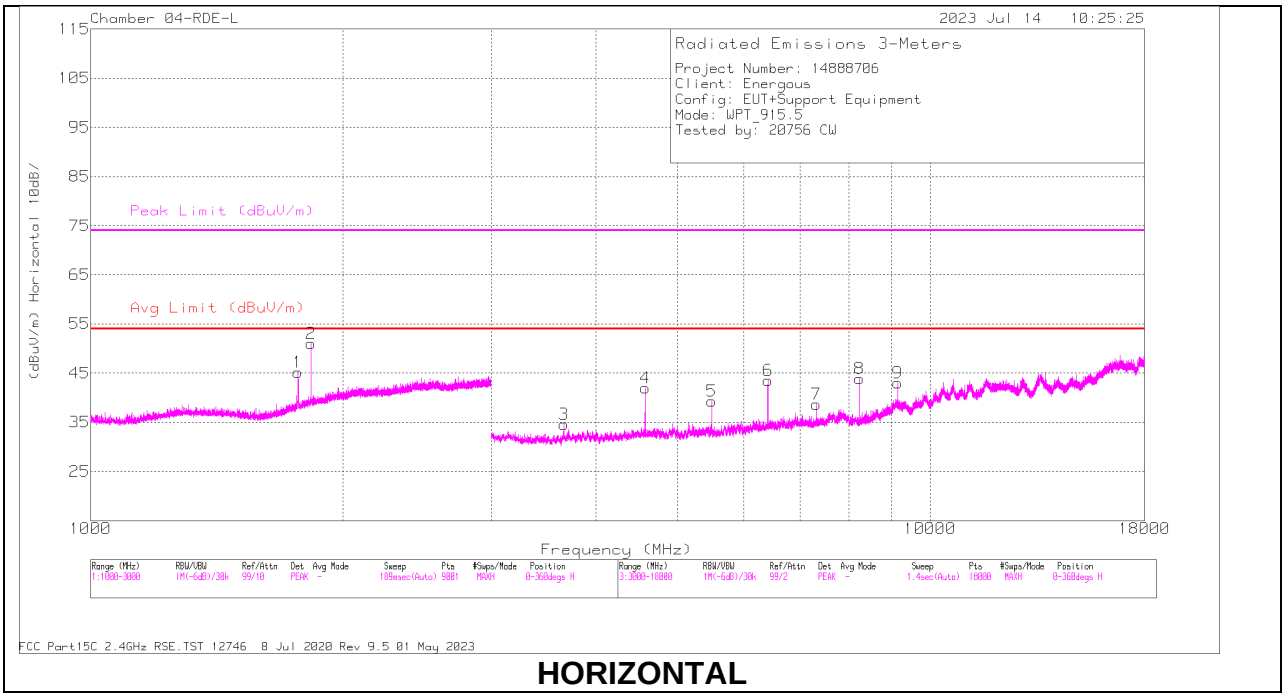
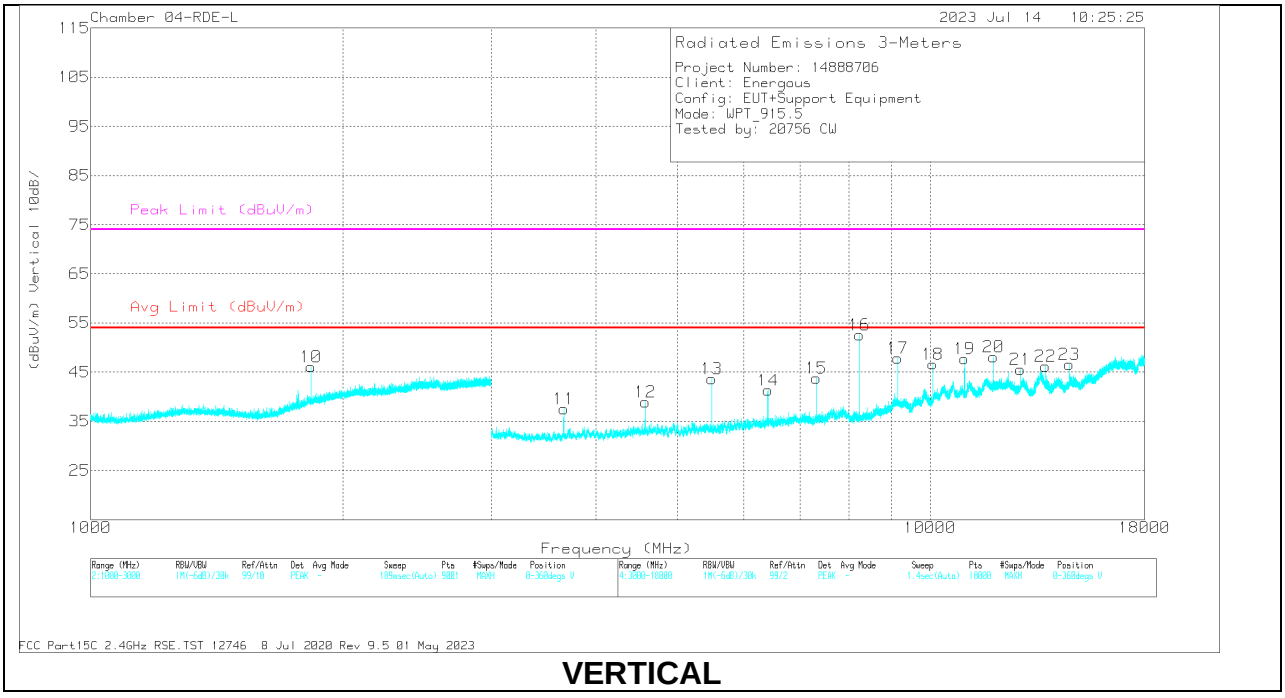
MID CHANNEL RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	206806 ACF (dB) 3mH	AMP/CBL	152043 HPF	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
4	* 4577.528	36.27	PKFH	34.1	-25.6	0.61	45.38	-	-	74	-28.62	357	110	H
	* 4577.556	31.11	VA1T	34.1	-25.6	0.61	40.22	54	-13.78	-	-	357	110	H
8	* 8239.545	31.59	PKFH	35.7	-20.2	0.54	47.63	-	-	74	-26.37	248	222	H
	* 8239.627	25.44	VA1T	35.7	-20.2	0.54	41.48	54	-12.52	-	-	248	222	H
9	* 9155.34	30.57	PKFH	36.1	-18	0.4	49.07	-	-	74	-24.93	354	233	H
	* 9155.126	21.25	VA1T	36.1	-18	0.4	39.75	54	-14.25	-	-	354	233	H
16	* 8239.686	38.48	PKFH	35.7	-20.2	0.54	54.52	-	-	74	-19.48	27	270	V
	* 8239.615	35.81	VA1T	35.7	-20.2	0.54	51.85	54	-2.15	-	-	27	270	V
17	* 9154.909	31.81	PKFH	36.1	-18	0.4	50.31	-	-	74	-23.69	265	249	V
	* 9155.133	25.39	VA1T	36.1	-18	0.4	43.89	54	-10.11	-	-	265	249	V
20	* 11901.656	30.77	PKFH	38.5	-16	1.34	54.61	-	-	74	-19.39	11	101	V
	* 11901.661	23.08	VA1T	38.5	-16	1.34	46.92	54	-7.08	-	-	11	101	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PKFH FHSS/BT RB=100k for Frequencies<1GHz / RB=1MHz for Frequencies>1GHz, VB=3 x RB, Peak
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

Markers 1, 2, 5, 6, 10, 13, 14, 18, 21, 22, 23 are under non restricted bands.
Markers 4, 8, 9, 16, 17, 20 are chosen as the worst 6 worst markers.

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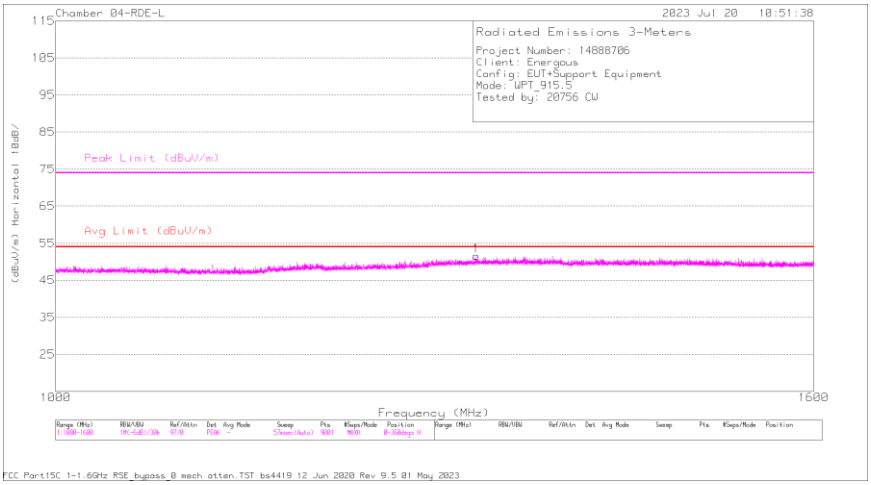
Spurious Emissions 1GHz – 1.6GHz without a Band Reject Filter, without 1.2 GHz HPF, and without amplifier

Horizontal



DATA

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	206806 ACF (dB) 3mH	Cbl (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1298.328	21.92	PKFH	28.8	6.6	57.32	-	-	74	-16.68	221	247	H
	* 1297.56	9.66	VA1T	28.8	6.6	45.06	54	-8.94	-	-	221	247	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PKFH FHSS/BT RB=100k for Frequencies<1GHz / RB=1MHz for Frequencies>1GHz, VB=3 x RB, Peak
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration
Note:

- Test was performed @ 3 meter distance.

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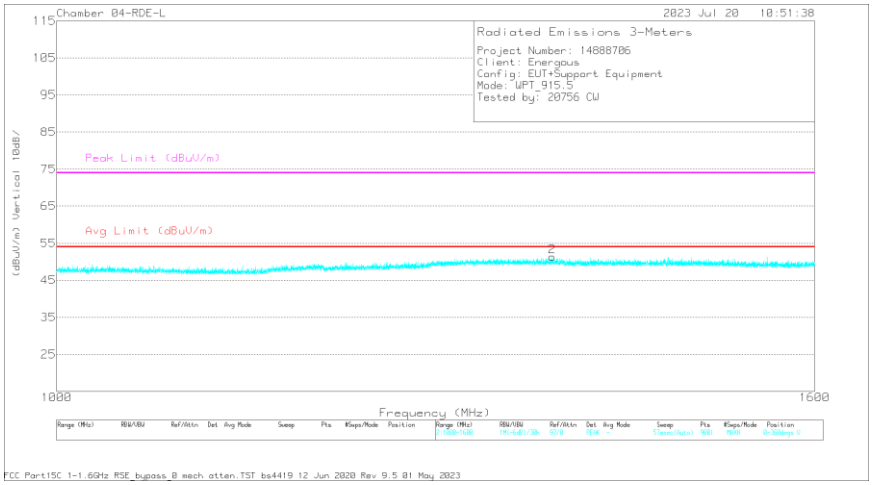
Vertical



DATA

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	206806 ACF (dB) 3mH	Cbl (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	* 1359.64	22.41	PKFH	28.7	6.7	57.81	-	-	74	-16.19	226	343	V
	* 1361.795	9.74	VA1T	28.7	6.7	45.14	54	-8.86	-	-	226	343	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PKFH FHSS/BT RB=100k for Frequencies<1GHz / RB=1MHz for Frequencies>1GHz, VB=3 x RB, Peak
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration
Note:

- Test was performed @ 3 meter distance.

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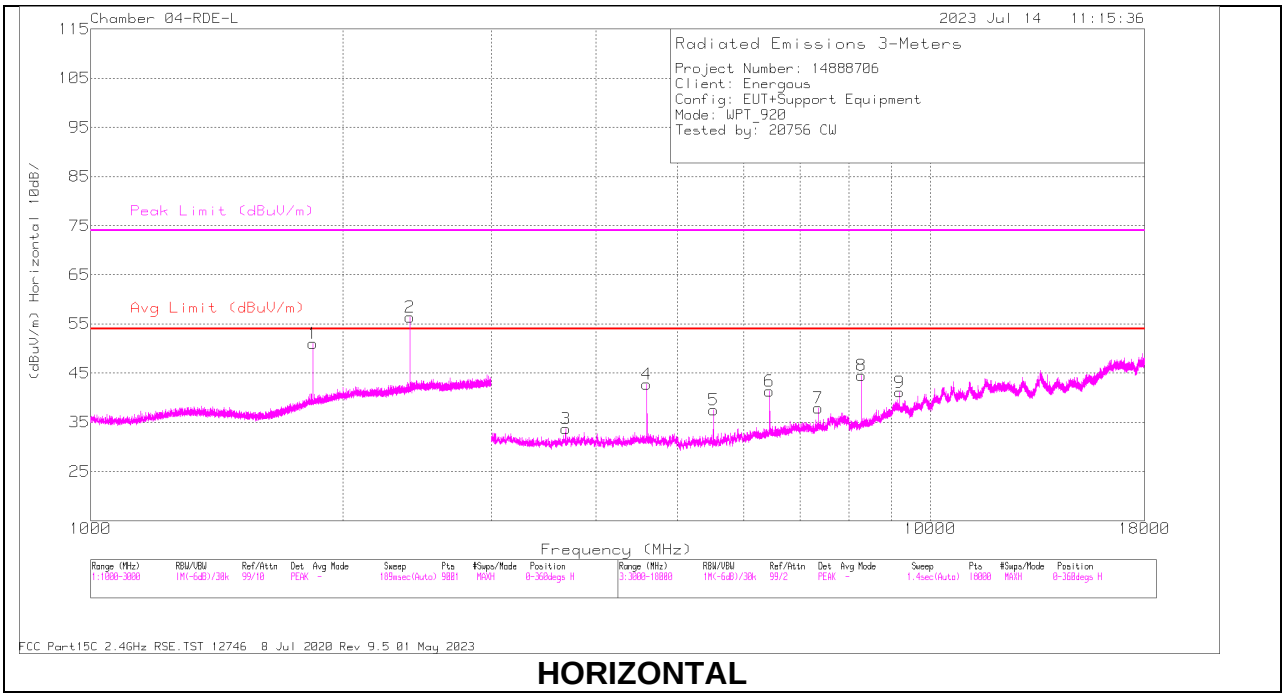
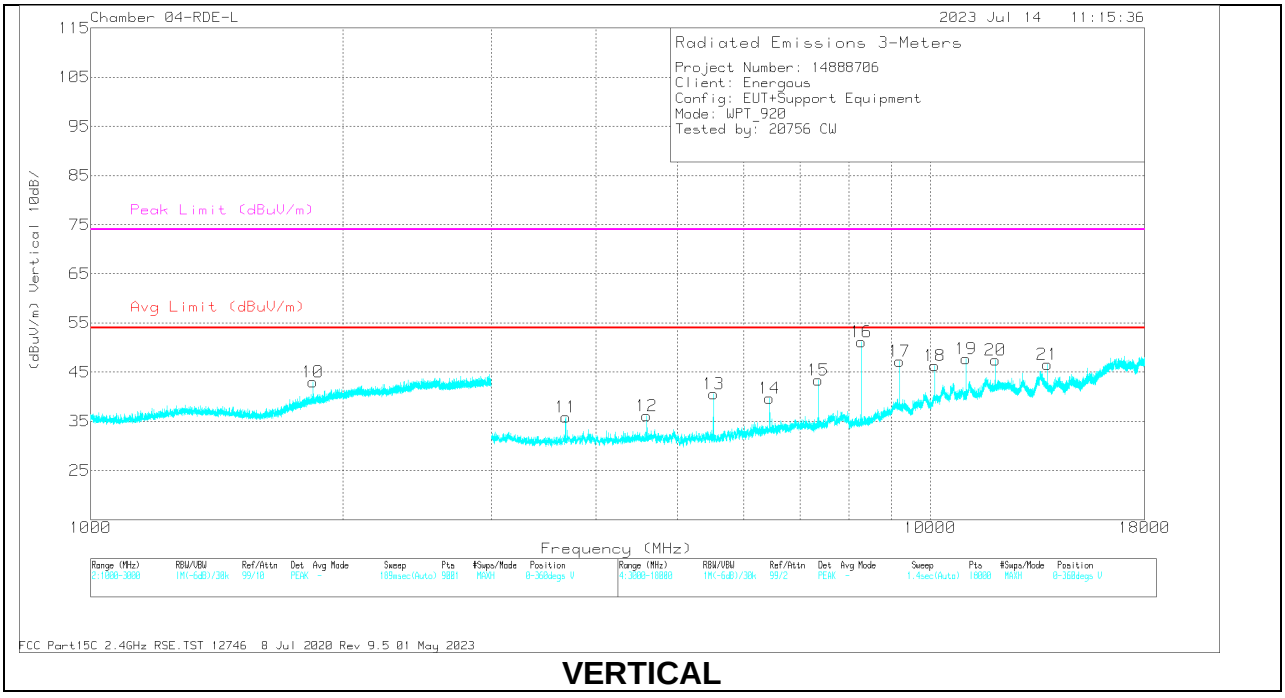
HIGH CHANNEL RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	206806 ACF (dB) 3mH	AMP/CBL	152043 HPF	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
4	* 4600.02	37.7	PKFH	34.1	-25.7	0.45	46.55	-	-	74	-27.45	355	295	H
	* 4600.055	32.82	VA1T	34.1	-25.7	0.45	41.67	54	-12.33	-	-	355	295	H
7	* 7360.162	30.61	PKFH	35.6	-21.1	0.41	45.52	-	-	74	-28.48	317	271	H
	* 7360.116	20.51	VA1T	35.6	-21.1	0.41	35.42	54	-18.58	-	-	317	271	H
8	* 8280.141	32.43	PKFH	35.7	-20	0.42	48.55	-	-	74	-25.45	249	165	H
	* 8280.107	27.58	VA1T	35.7	-20	0.42	43.7	54	-10.3	-	-	249	165	H
16	* 8280.082	37.52	PKFH	35.7	-20	0.42	53.64	-	-	74	-20.36	27	285	V
	* 8280.126	35.17	VA1T	35.7	-20	0.42	51.29	54	-2.71	-	-	27	285	V
19	* 11040.322	30.96	PKFH	37.8	-16.8	0.62	52.58	-	-	74	-21.42	21	110	V
	* 11040.114	24.53	VA1T	37.8	-16.8	0.62	46.15	54	-7.85	-	-	21	110	V
20	* 11960.082	30.84	PKFH	38.6	-16	1.45	54.89	-	-	74	-19.11	18	108	V
	* 11960.17	23.64	VA1T	38.6	-16	1.45	47.69	54	-6.31	-	-	18	108	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PKFH FHSS/BT RB=100k for Frequencies<1GHz / RB=1MHz for Frequencies>1GHz, VB=3 x RB, Peak
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

Marker 2 is BLE fundamental signal.
Markers 1, 5, 6, 10, 13, 14, 18, 21 are under non restricted bands.
Markers 4, 7, 8, 16, 19, 20 are chosen as the worst 6 worst markers.

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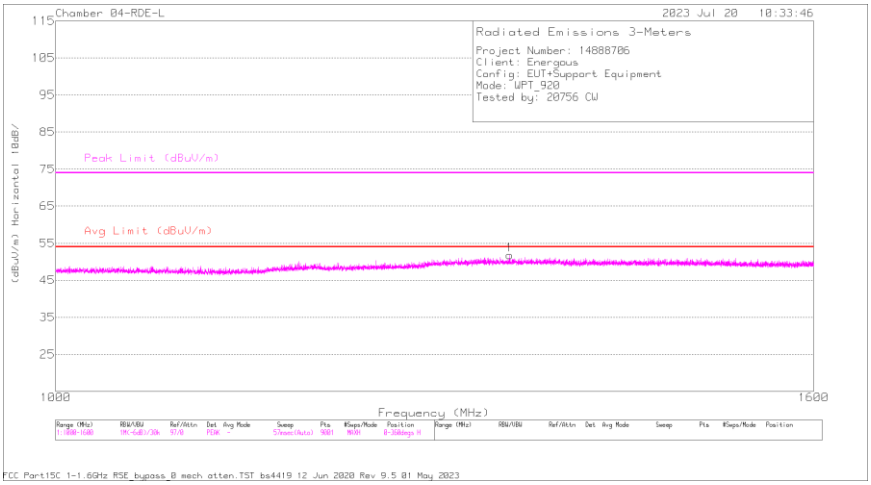
Spurious Emissions 1GHz – 1.6GHz without a Band Reject Filter, without 1.2 GHz HPF, and without amplifier

Horizontal



DATA

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	206806 ACF (dB) 3mH	Cbl (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1323.456	22.69	PKFH	28.8	6.7	58.19	-	-	74	-15.81	309	220	H
	* 1324.702	9.79	VA1T	28.8	6.7	45.29	54	-8.71	-	-	309	220	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PKFH FHSS/BT RB=100k for Frequencies<1GHz / RB=1MHz for Frequencies>1GHz, VB=3 x RB, Peak
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration
Note:

- Test was performed @ 3 meter distance.

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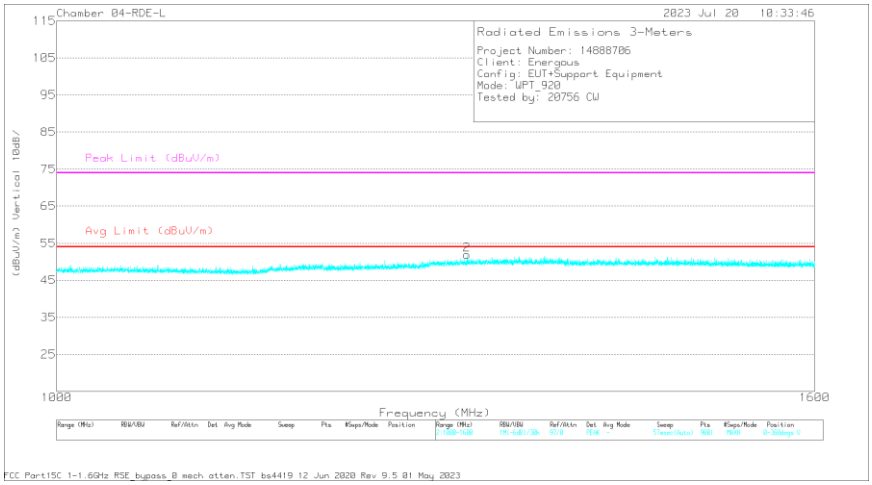
Vertical



DATA

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	206806 ACF (dB) 3mH	Cbl (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	* 1289.962	22.4	PKFH	28.8	6.5	57.7	-	-	74	-16.3	54	113	V
	* 1290.478	9.65	VA1T	28.8	6.5	44.95	54	-9.05	-	-	54	113	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PKFH FHSS/BT RB=100k for Frequencies<1GHz / RB=1MHz for Frequencies>1GHz, VB=3 x RB, Peak
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration
Note:

- Test was performed @ 3 meter distance.

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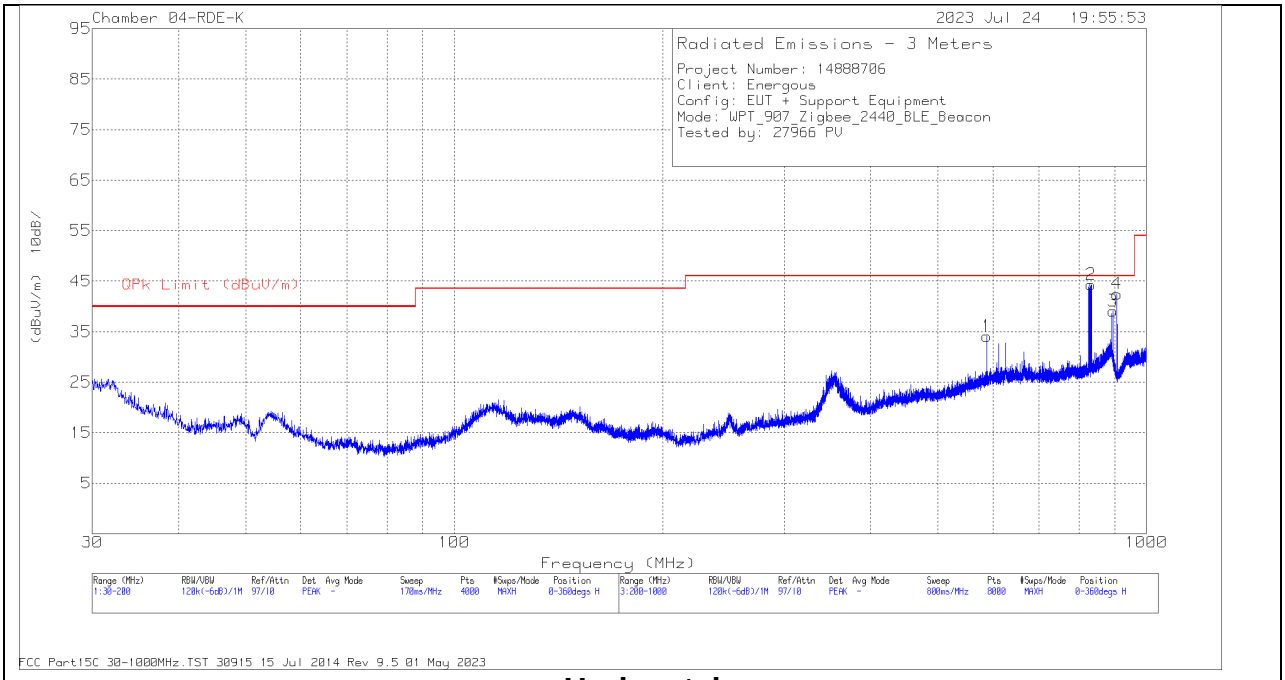
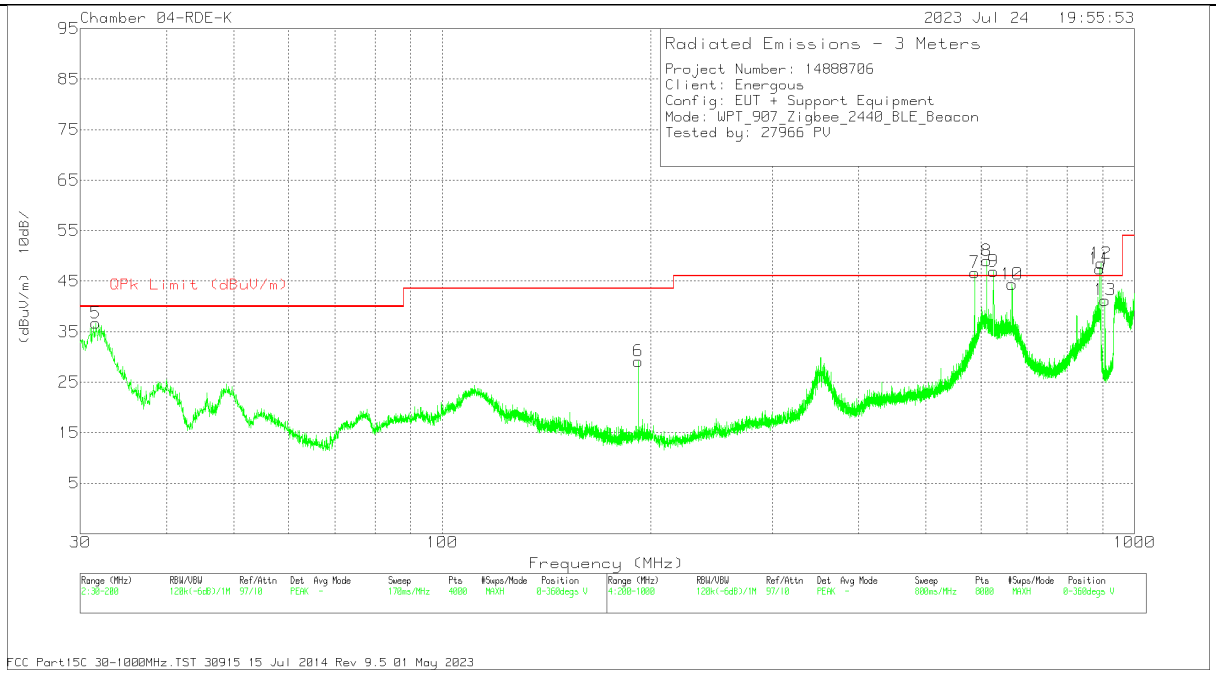
10.3. WORST CASE COLACATION BELOW 1G

SPURIOUS EMISSIONS 30 MHz-1000MHz (WORST-CASE CONFIGURATION)



Horizontal



Vertical

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Radiated Emissions

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	232075 ACF (dB) 10m H	Amp/Cbl (dB)	156483 BRF	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	587.95	38.3	Pk	24.2	-28.4	0.1	34.2	46.02	-11.82	0-360	299	H
2	831.797	20.13	Qp	27.4	-27.3	0.5	20.73	46.02	-25.29	188	393	H
5	31.5826	35.13	Qp	25.4	-31.4	0.0	29.13	40	-10.87	119	113	V
6	192.052	41.67	Pk	17.5	-30	0.1	29.27	43.52	-14.25	0-360	100	V
7	587.943	47.19	Qp	24.2	-28.4	0.1	43.09	46.02	-2.93	227	104	V
8	* 611.945	48.42	Qp	24.7	-28.3	0.4	45.22	46.02	-0.8	87	192	V
9	625.956	40.98	Qp	25.1	-28.3	0.3	38.08	46.02	-7.94	48	202	V
10	665.939	41.7	Qp	25.5	-27.9	0.4	39.7	46.02	-6.32	9	132	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
Qp - Quasi-Peak detector

NOTE: Markers 4 and 13 are the WPT fundamental. Markers 11 and 12 are the BRF band-edge and weren't maximized.
Marker 3 please refer to zoom result as below Marker 3 (-20 dBc BANDEDGE WITHOUT NOTCH FILTER AND PRE-AMPLIFIER (LOW CHANNEL)

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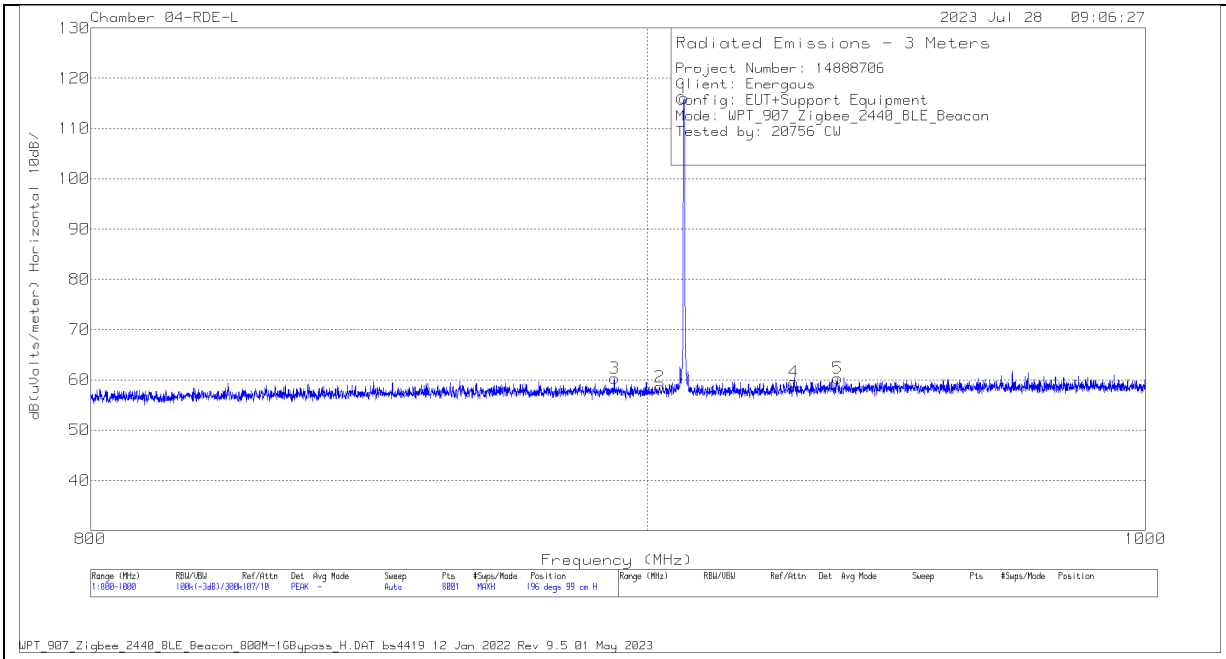
-20 dBc BANDEDGE WITHOUT NOTCH FILTER AND PRE-AMPLIFIER (LOW CHANNEL)

HORIZONTAL RESULT



Radiated Emissions

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	174374 ANSI ACF 10 m H UL_	Gain/Loss (dB)	Corrected Reading dB(uVolts/meter)	Azimuth (Degs)	Height (cm)	Polarity
1	907	83.5	Pk	28.2	4.3	116	196	99	H
2	902.325	26.24	Pk	28	4.3	58.54	196	99	H
3	893.75	28.23	Pk	27.9	4.2	60.33	196	99	H
4	928.275	26.93	Pk	28.3	4.3	59.53	196	99	H
5	936.95	27.6	Pk	28.5	4.2	60.3	196	99	H

Pk - Peak detector

M3 and M5 are not under restricted bands. With 20dBc from M1 116 dBuV/m= 96 dBuV/m as limit, M3 and M5 are passing.

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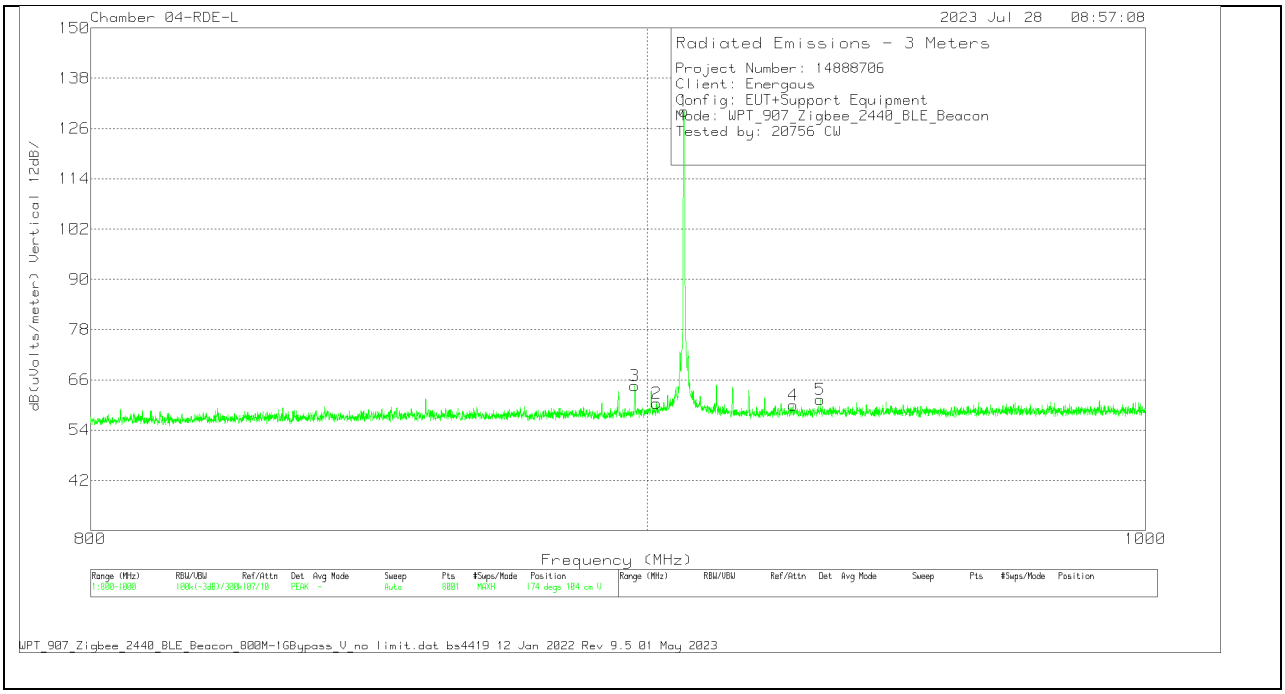
VERTICAL RESULT



Radiated Emissions

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	174374 ANSI ACF 10 m H UL_	Gain/Loss (dB)	Corrected Reading dB(uVolts/meter)	Azimuth (Degs)	Height (cm)	Polarity
1	907	97.57	Pk	28.2	4.3	130.07	174	104	V
2	901.75	28.15	Pk	28	4.3	60.45	174	104	V
3	897.625	32.39	Pk	28	4.2	64.59	174	104	V
4	928.15	27.39	Pk	28.3	4.3	59.99	174	104	V
5	933.5	28.68	Pk	28.4	4.2	61.28	174	104	V

Pk - Peak detector

M3 and M5 are not under restricted bands. With 20dBc from M1 130.07 dBuV/m= 110.07dBuV/m as limit, M3 and M5 are passing.

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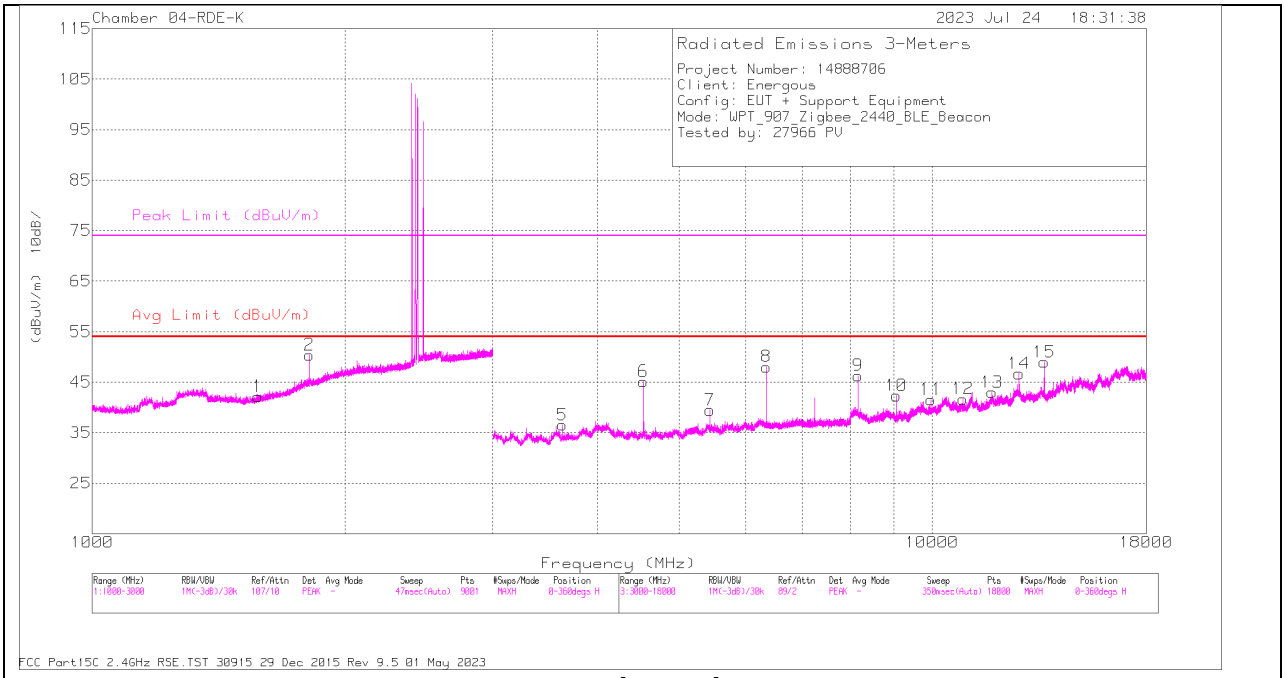
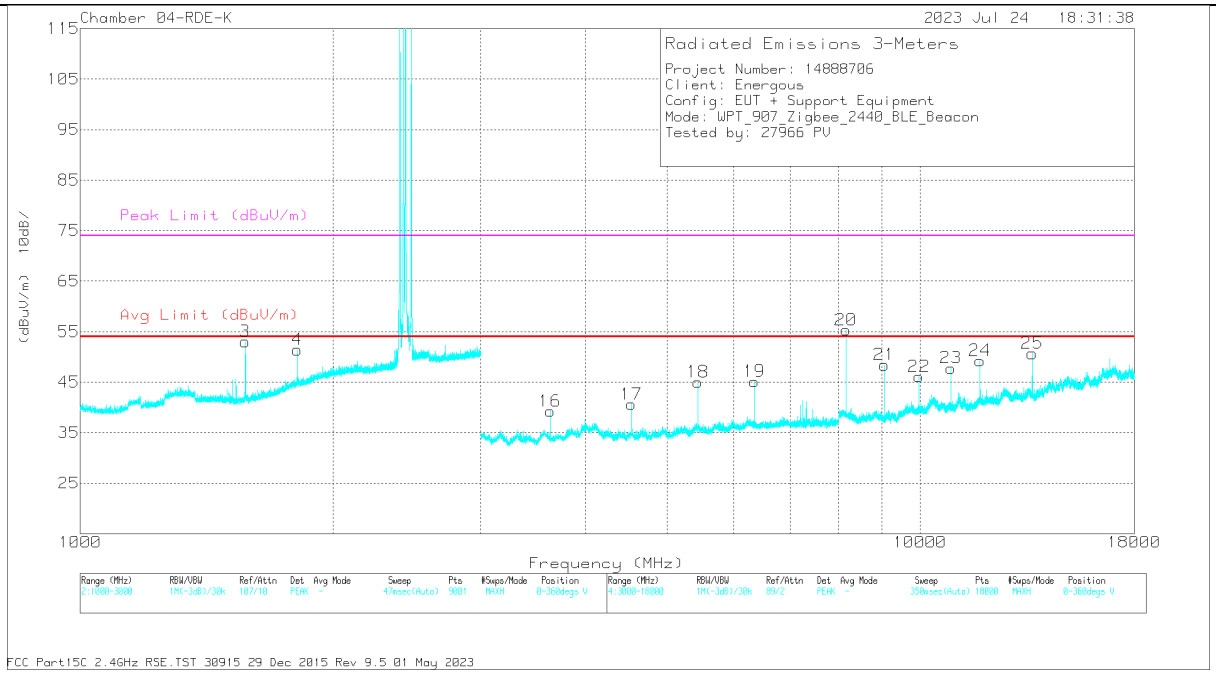
10.4. WORST CASE COLOCATION ABOVE 1G

SPURIOUS EMISSIONS Above 1GHz (COLOCATION WORST-CASE CONFIGURATION)



Horizontal



Vertical

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Radiated Emissions

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	223083 ACF (dB) 3mH	Cbl/Amp (dB)	152043 HPF	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1579.144	37.29	PK2	27.9	-12.8	0.68	53.07	-	-	74	-20.93	309	272	H
	* 1577.067	25.31	MAv1	27.9	-12.7	0.67	41.18	54	-12.82	-	-	309	272	H
8	* 8163.204	53.59	PK2	35.9	-36.9	0.43	53.02	-	-	74	-20.98	235	104	H
	* 8163.111	46.65	MAv1	35.9	-36.9	0.43	46.08	54	-7.92	-	-	235	104	H
13	* 11790.772	47.66	PK2	38.3	-33.9	1.3	53.36	-	-	74	-20.64	225	277	H
	* 11790.969	36.32	MAv1	38.3	-33.9	1.3	42.02	54	-11.98	-	-	225	277	H
3	* 1572.897	41.75	PK2	27.9	-12.7	0.67	57.62	-	-	74	-16.38	19	119	V
	* 1573.019	28.22	MAv1	27.9	-12.7	0.66	44.08	54	-9.92	-	-	19	119	V
20	* 8162.967	57.44	PK2	35.9	-36.9	0.43	56.87	-	-	74	-17.13	325	101	V
	* 8163.052	53.59	MAv1	35.9	-36.9	0.43	53.02	54	-0.98	-	-	325	101	V
24	* 11791.271	50.39	PK2	38.3	-33.9	1.3	56.09	-	-	74	-17.91	320	105	V
	* 11791.185	43.01	MAv1	38.3	-33.9	1.3	48.71	54	-5.29	-	-	320	105	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PK2 - KDB558074 Method: Maximum Peak
MAv1 - KDB558074 Option 1 Maximum RMS Average

Markers 2, 4,11, 15, 19, 22, 25 are under non restricted bands.
Markers 1, 8, 13, 3, 20, 24 are chosen as the worst 6 worst markers.

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