CLASS II PERMISSIVE CHANGE TEST REPORT

FCC PART 15.247 & ISED CANADA RSS-247, ISSUE 2

for the

BEARTOOTH MK II

FCC ID: 2AJY7-011

IC ID: 22043-011

WLL REPORT# 17619-01 REV 2

Prepared for:

BEARTOOTH RADIO, INC.

45 DISCOVERY DRIVE

BOZEMAN, MONTANA 59718

Prepared By:

WASHINGTON LABORATORIES, LTD.

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FREDERICK, MARYLAND 21703

Class II Permissive Change Test Report
FCC Part 15.247 & ISED Canada Rss-247, Issue 2

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Beartooth Radio, Inc.
Beartooth MK II

FCC ID: 2AJY7-011
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WLL Report# 17619-01 Rev 2

May 23, 2022

Prepared by:

Ryan Mascaro
RF Test Engineer

Reviewed by:

Steven D. Koster
President

Abstract

This report has been prepared on behalf of Beartooth Radio, Inc. to document the compliance test results for the requirements of a Class II Permissive Change, in accordance with FCC Part 15.247 of the Federal Communication Commission (FCC) Rules and Regulations and Telecommunications Policy RSS-247, Issue 2 of Innovation, Science and Economic Development (ISED) Canada. The information provided within this report is only applicable to devices herein documented as the EUT.

The radiated portion of the testing was performed in the Free-space Anechoic Chamber Test-site (FACT) 3m Chamber of Washington Laboratories, Ltd., located at 4840 Winchester Boulevard, Suite #5. Frederick, MD 21703.

Washington Laboratories, Ltd. has been accepted by the FCC and approved by ANAB under Testing Certificate AT-1448 as an independent FCC test laboratory. The Washington Laboratories, Ltd. ISED Canada number is 3035A.

Washington Laboratories, Ltd. has been accepted by the FCC and approved by ANAB under Testing Certificate AT-1448 as an independent FCC test laboratory. These tests are accredited and meet the requirements of ISO/IEC 17025 as verified by the ANAB scope of accreditation. The ISED Canada number for Washington Laboratories, Ltd. is 3035A.

The Beartooth Radio, Inc., Beartooth MK II (FCC ID: 2AJY7-011) complies with the requirements for a for a Dual-Transmitter Intentional Radiator, under Part 15.247 of the FCC rules, and with the requirements of ISED Canada RSS-247, Issue 2.

Revision History	Description of Change	Date
Rev 0	Initial Release	May 23, 2022
Rev 1	ACB Comments Dated: 10/24/2022	November 2, 2022
Rev 2	ACB Comments Dated: 1/1/2023. Added output power graphs	January 30, 2023

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1 Introduction

1.1 Compliance Statement

The Beartooth Radio, Inc., Beartooth MK II (FCC ID: 2AJY7-011) complies with the requirements for a for a Dual-Transmitter Intentional Radiator, under Part 15.247 of the FCC rules, and with the requirements of ISED Canada RSS-247, Issue 2.

1.2 Test Scope

Tests for radiated and AC conducted emissions were performed. All measurements were performed in accordance with the 2014 version of ANSI C63.4. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 Contract Information

Customer:	Beartooth Radio, Inc.
Purchase Order Number:	Deposit Terms; 50%
Quotation Number:	73154B

1.4 Test and Support Personnel

Washington Laboratories, LTD:	Ryan Mascaro
Customer Representative:	Michael Monaghan

1.5 Testing Algorithm

The Beartooth MK II was powered by a +3.7 VDC battery, which can be charged via a USB wall-wart, when connected to a public mains 120 VAC, 60 Hz supply. The EUT was configured in a powered-on, steady state, with the 900 MHz and the 2.4 GHz radio transmitters always enabled. The EUT can transmit while plugged into the public mains supply. Worst-case emissions are provided throughout this report.

1.6 Test Location

All measurements herein were performed at Washington Laboratories, Ltd. test center in Frederick, MD. Site description and site attenuation data are currently being reported to the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by ANAB under Testing Certificate AT-1448 as an independent FCC test laboratory.

2 Equipment Under Test

2.1 EUT Identification & Description

The results obtained relate only to the item(s) tested.

Table 1: Device Summary

Manufacturer:	Beartooth Radio, Inc.	
FCC ID:	2AJY7-011	
IC ID:	22043-011	
Model Name:	Beartooth MK II	
IC HVIN:	BT MK II	
Rule Part:	FCC	§15.247
	ISED	RSS-247
TX Frequency Range:	900 MHz	902.5 MHz – 927.5 MHz
	2.4 GHz	2402 MHz – 2480 MHz
Pre-Certified Modules:	900 MHz	FCC ID: 2AJY7-011
	2.4 GHz	FCC ID: 2AJY7-012
Modulation:	900 MHz	FSK & GFSK
	2.4 GHz	GFSK
Firmware/Software Version:	900 MHz	Test Mode via Smart Phone App.
	2.4 GHz	Normal Production
Power Source & Voltage:	+3.7 VDC 3,000 mAh Battery	
Test Dates:	5/17/2022 – 5/18/2022	

The Beartooth Radio, Inc., Beartooth MK II is an ultra-lightweight self-forming mesh radio built for tactical teams that connects with a smartphone to send push-to-talk voice, text, and locations. It enables robust, secure communications when cellular connectivity is unavailable or compromised. The Beartooth MK II transmits TAK data in both a server-less and server-based environment. The EUT is battery powered; however, it can transmit a CW while plugged into an AC mains source.

2.2 Test Configuration

The Beartooth MK II was provided to the test laboratory, in one sample configuration for testing. The 900 MHz radio was controlled via connectivity to a smart phone; where the low, center, and high transmit channels could be tuned, in a CW mode only. The BLE radio was paired to a smart phone companion during each test. The EUT was arranged on the test site to produce the worst-case emissions. Overall, pre-certified modules were set to a transmit enabled mode, which was verified before and after each test. The EUT is capable of dual-transmitter, simultaneous transmission. Figure 1 provides a block-diagram image of the EUT.

Figure 1: EUT Profile and Dimensions

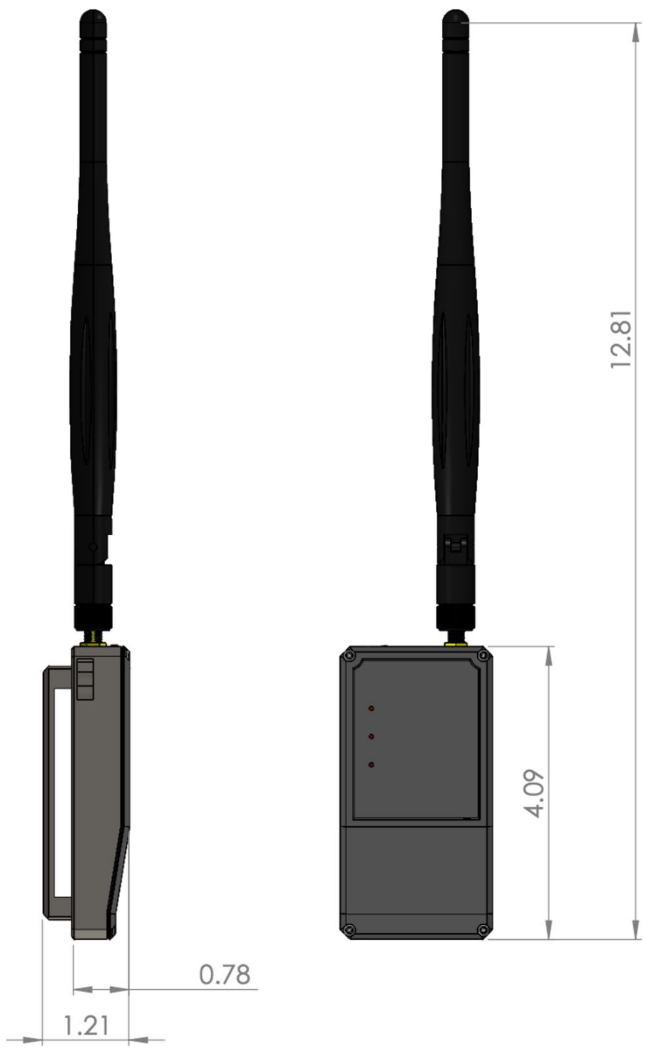


Table 2: EUT System Configuration List

Name / Description	Model Number	Part Number	Serial Number	Rev. #
Beartooth MK II	N/A	N/A	N/A	N/A
USB Wall-Wart	N/A	N/A	N/A	N/A

Table 3: Support Equipment (for testing)

Name / Description	Manufacturer	Model Number	Customer Supplied Calibration Data
Smart Phone	N/A	N/A	N/A

Table 4: Cable Configuration

Ref.	Port on EUT	Cable Description	Qty.	Length	Shielded	Termination
1	USB-C	USB	1	N/A	N/A	AC Mains

2.3 Measurements

2.3.1 References

ANSI C63.2 (Jan-2016) Specifications for Electromagnetic Noise and Field Strength Instrumentation

ANSI C63.4 (Jan 2014) American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GH

2.4 Measurement Uncertainty

All results reported herein relate only to the equipment tested. The basis for uncertainty calculation uses ANSI/NCSL Z540-2-1997 (R2002) with a type B evaluation of the standard uncertainty. Elements contributing to the standard uncertainty are combined using the method described in Equation 1 to arrive at the total standard uncertainty. The standard uncertainty is multiplied by the coverage factor to determine the expanded uncertainty which is generally accepted for use in commercial, industrial, and regulatory applications and when health and safety are concerned (see Equation 2). A coverage factor was selected to yield a 95% confidence in the uncertainty estimation.

Equation 1: Standard Uncertainty

$$u_c = \pm\sqrt{\frac{a^2}{{div_a}^2} + \frac{b^2}{{div_b}^2} + \frac{c^2}{{div_c}^2} + \ldots\ldots}$$

Where:

uc	= standard uncertainty
a, b, c	= individual uncertainty elements
Diva, b, c	= the individual uncertainty element divisor based on the probability distribution
Divisor	= 1.732 for rectangular distribution
Divisor	= 2 for normal distribution
Divisor	= 1.414 for trapezoid distribution

Equation 2: Expanded Uncertainty

$$U = ku_c$$

Where

U = expanded uncertainty
k = coverage factor
k ≤ 2 for 95% coverage (ANSI/NCSL Z540-2 Annex G)
uc = standard uncertainty

The measurement uncertainty complies with the maximum allowed uncertainty from CISPR 16-4-2. Measurement uncertainty is not used to adjust the measurements to determine compliance. The expanded uncertainty values for the various scopes in the WLL accreditation are provided in Table 5 below.

Table 5: Expanded Uncertainty List

Scope	**Standard(s)**	**Expanded Uncertainty**
Conducted Emissions	CISPR11, CISPR22, CISPR32, CISPR14, FCC Part 15	± 2.63 dB
Radiated Emissions	CISPR11, CISPR22, CISPR32, CISPR14, FCC Part 15	± 4.55 dB

3 Test Results

3.1 Peak Transmitter Output Power

To measure the output power of the transmitter, the hopping sequence was stopped while the CW dwelled on the low, center, and high channels. The output from the transmitter was connected to an attenuator and then to the input of a Spectrum Analyzer. The analyzer offset was adjusted to compensate for the attenuator and other losses in the system. Please note that only the 900 MHz radio was evaluated for conducted peak output power, as the BLE radio does not have a conducted antenna port.

3.1.1 Measurement Method:

This test was performed as specified in ANSI C63.10, Section 11.9.1., "Maximum peak conducted output power".

Table 6: Peak Output Power Test Results

Frequency	Level (dBm)	Granted Power	Results
(MHz)	(dBm)	(dBm)	(Pass/Fail)
902.75 MHz	21.165	30.0	Pass
915.25 MHz	21.044	30.0	Pass
927.25 MHz	20.787	30.0	Pass

Table 7: Peak Output Power Test Results. Max Power

Frequency	Level (dBm)	Granted Power	Results
(MHz)	(dBm)	(dBm)	(Pass/Fail)
902.75 MHz	29.1	30.0	Pass
915.25 MHz	28.6	30.0	Pass
927.25 MHz	28.1	30.0	Pass

* embedded module granted power is based on the equipment authorization for FCC ID: MCQ-XBPSX, dated: 12/22/2015

Figure 2: RF Peak Power, Low Channel

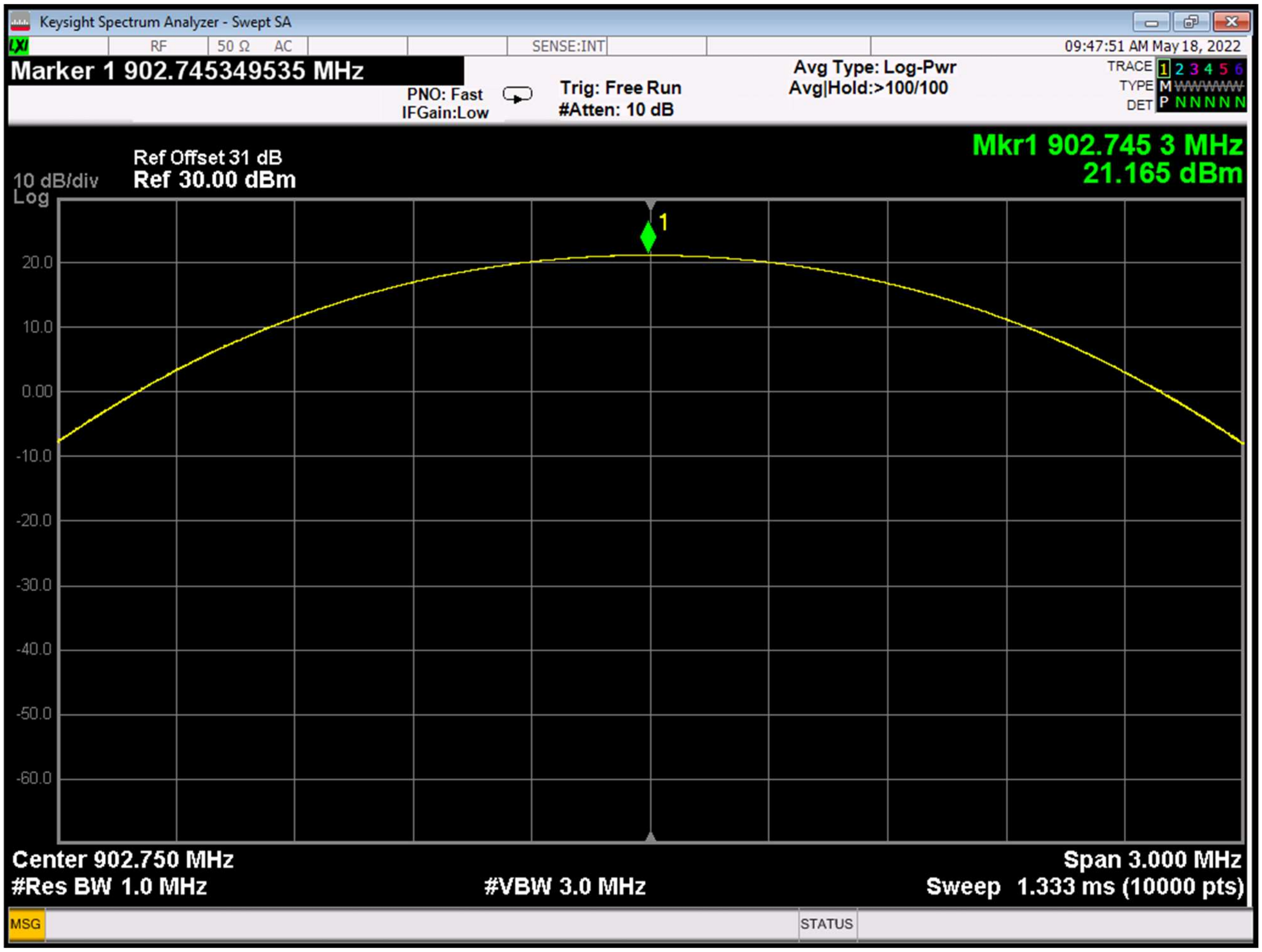


Figure 3: RF Peak Power, Mid Channel

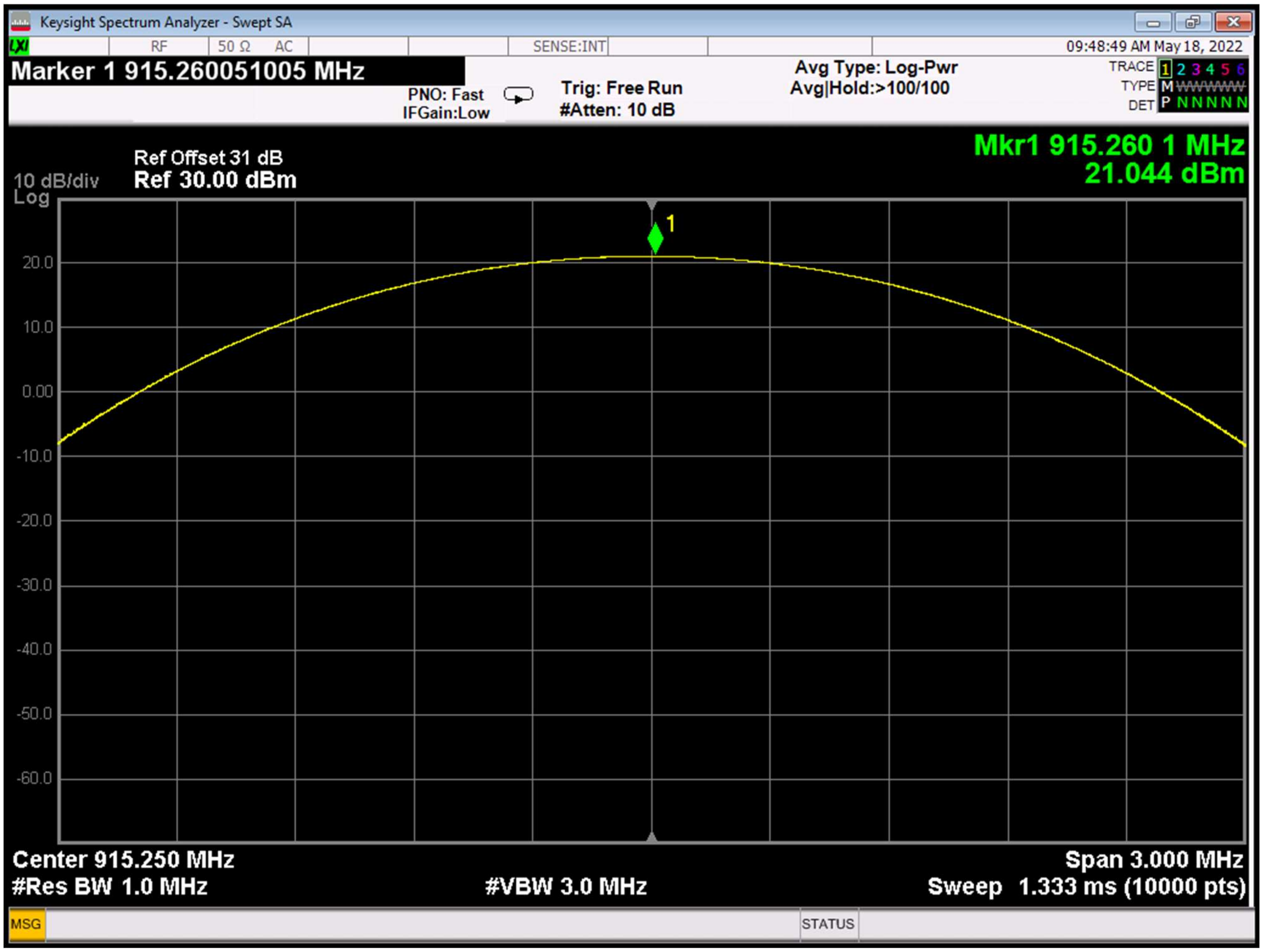
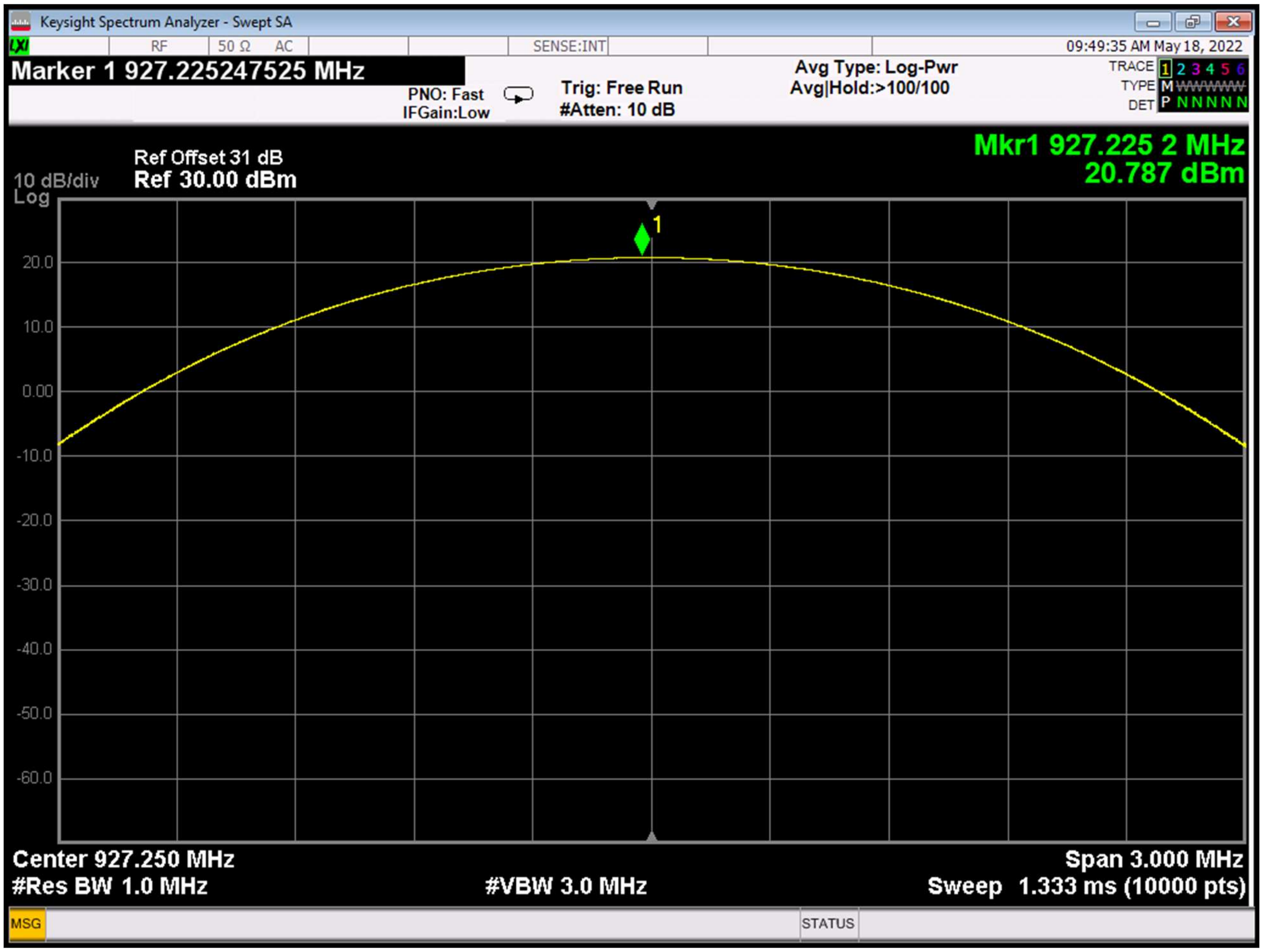


Figure 4: RF Peak Power, High Channel



A separate sample was evaluated to determine the peak output (conducted) power. Test software was provided by the applicant (Beartothh-fcc-1-30.apk) and the conducted output power was tested at the low, middle and high channels. The following plots display the output power and conducted spurious emissions.

Figure 5: RF Peak Power, Low Channel

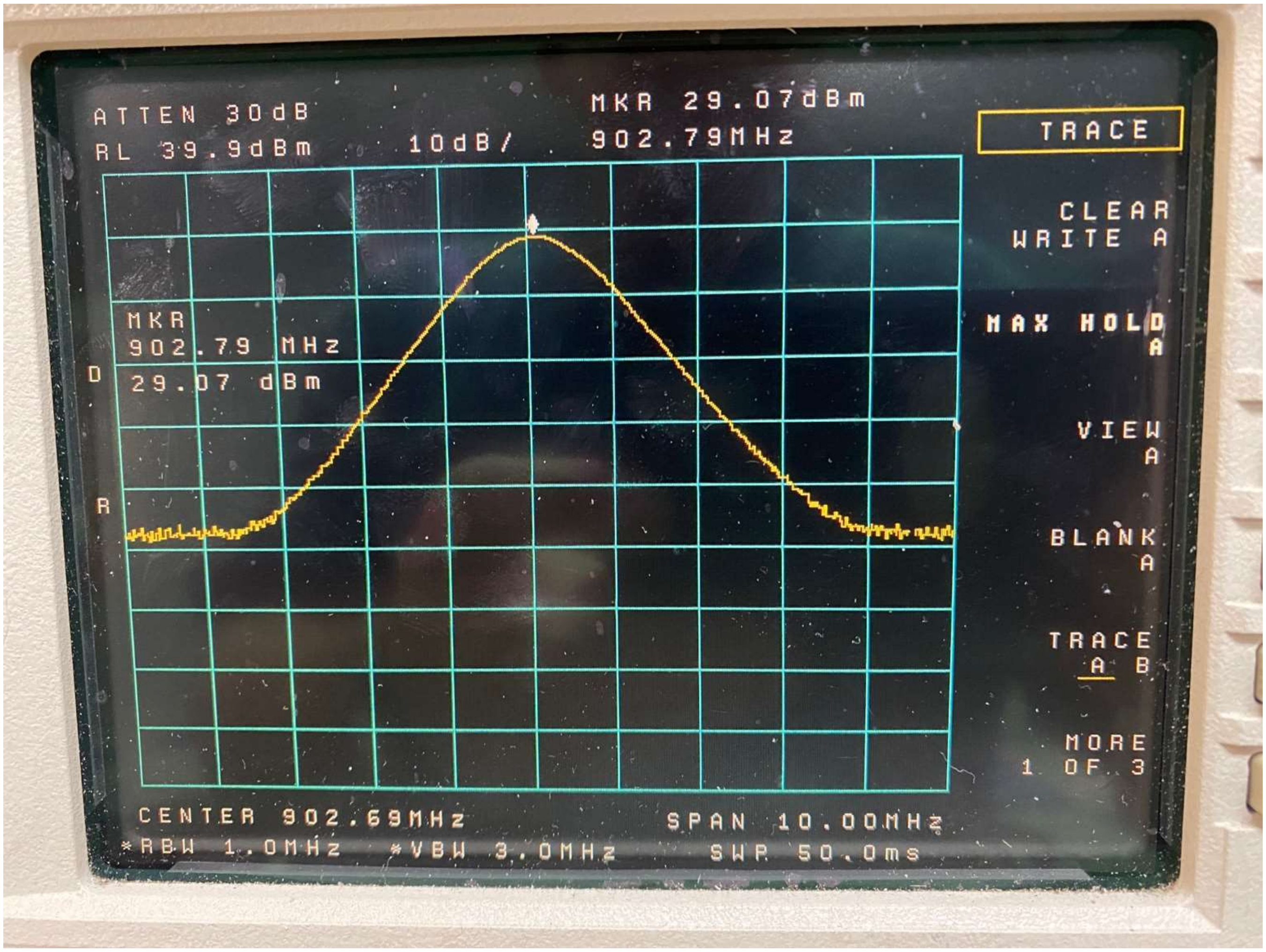


Figure 6: RF Peak Power, Mid Channel

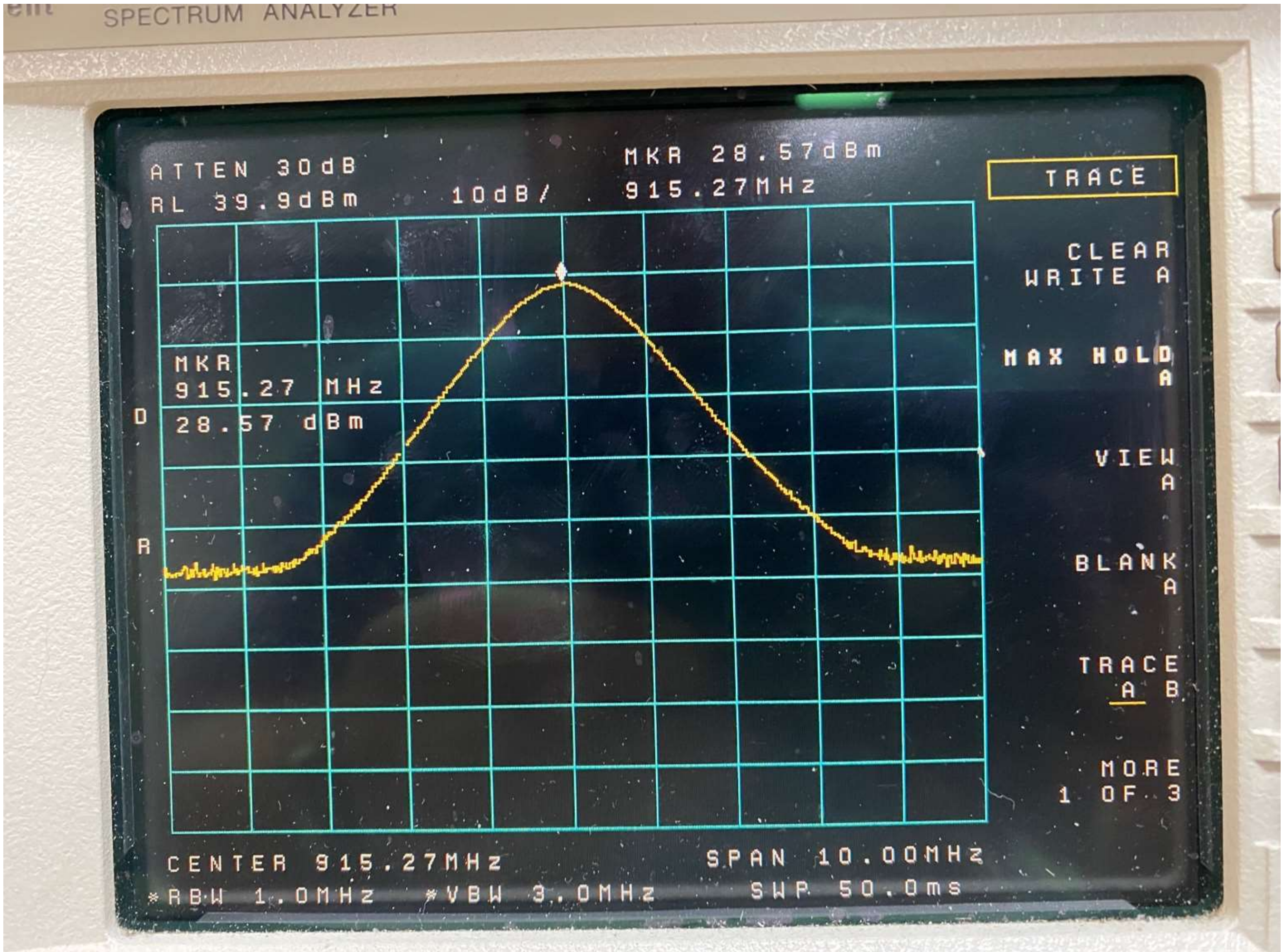


Figure 7: RF Peak Power, High Channel

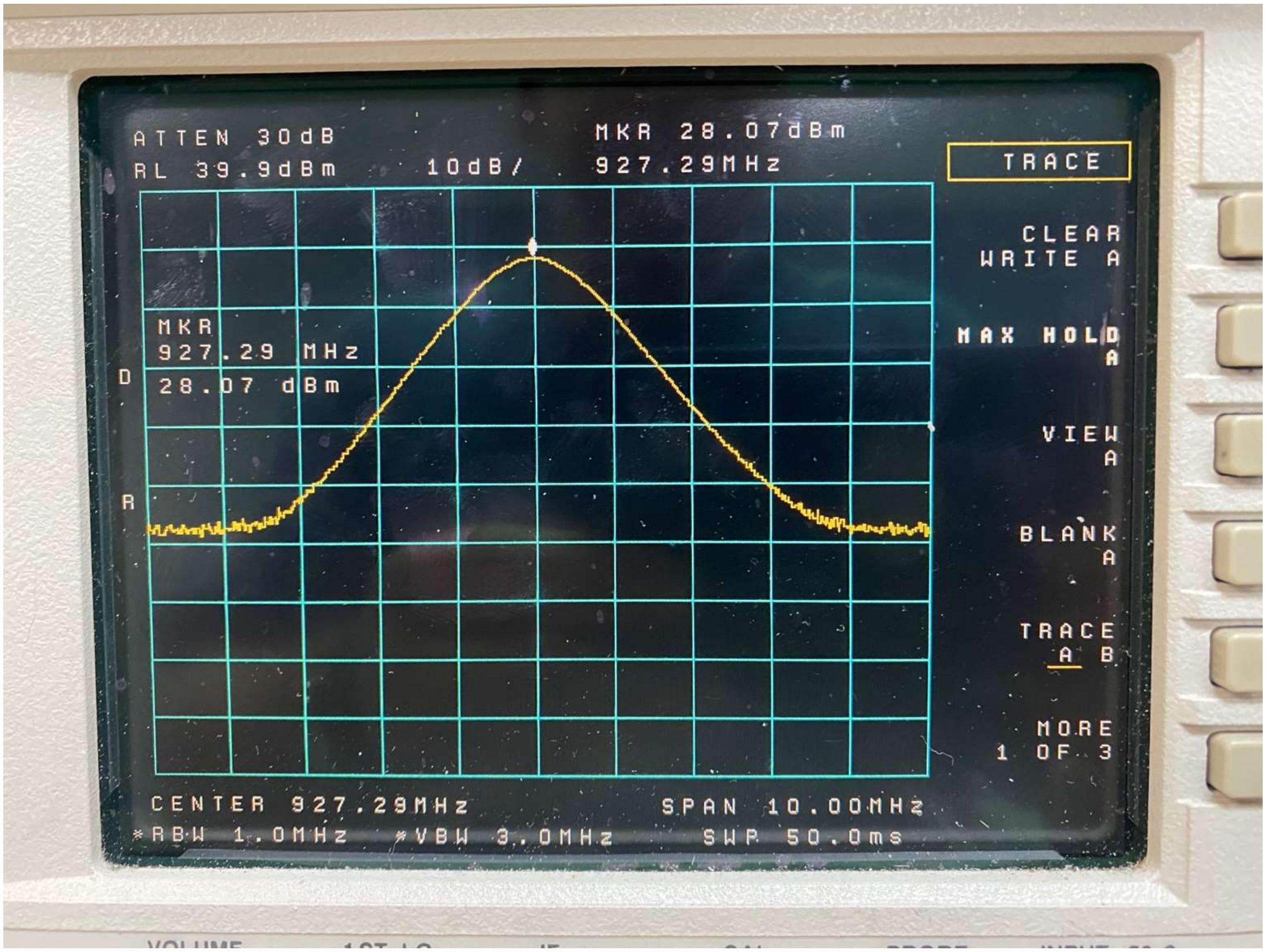


Figure 8: Spurious Emissions, Low Channel

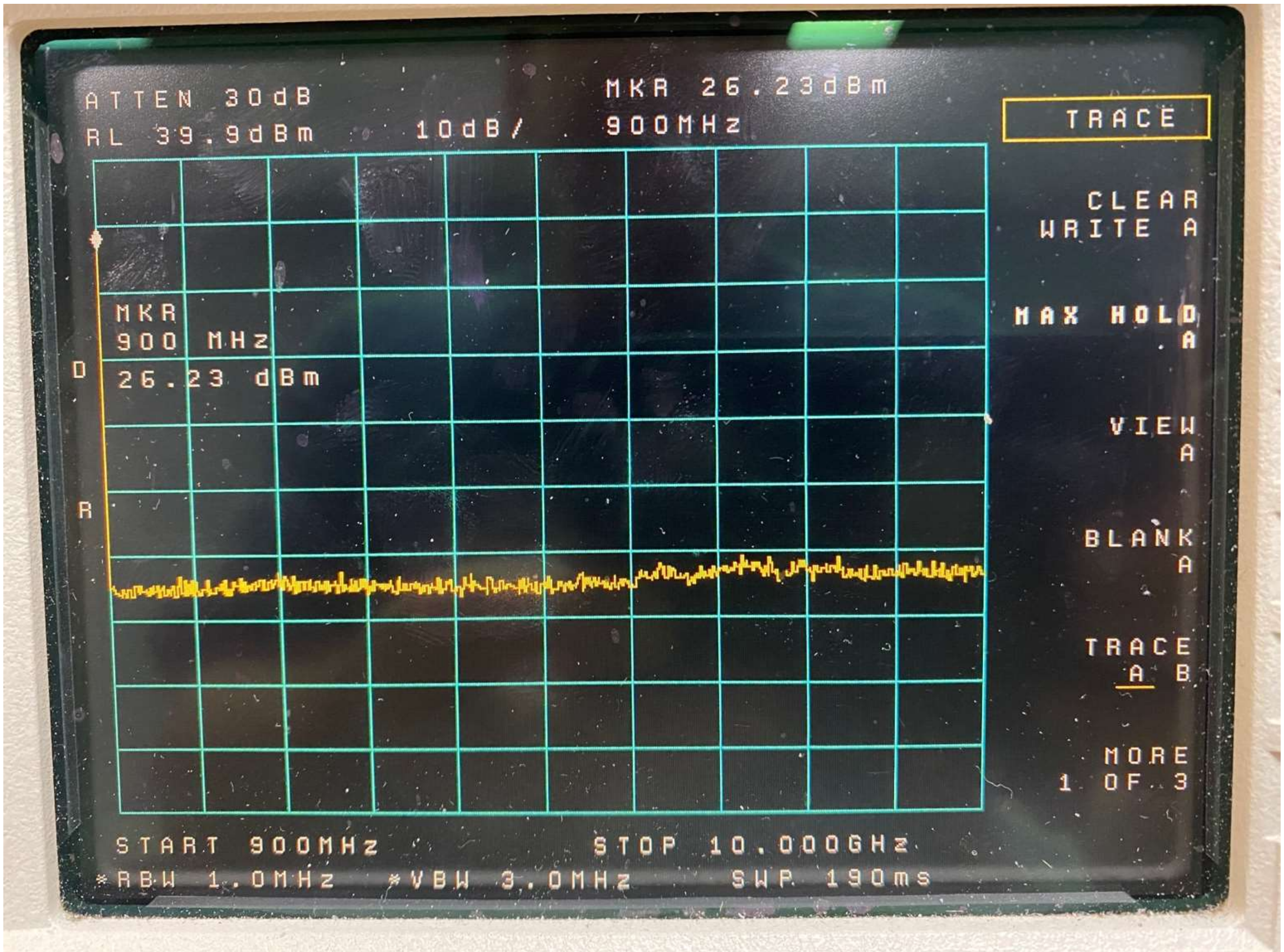


Figure 9: Spurious Emissions, Mid Channel

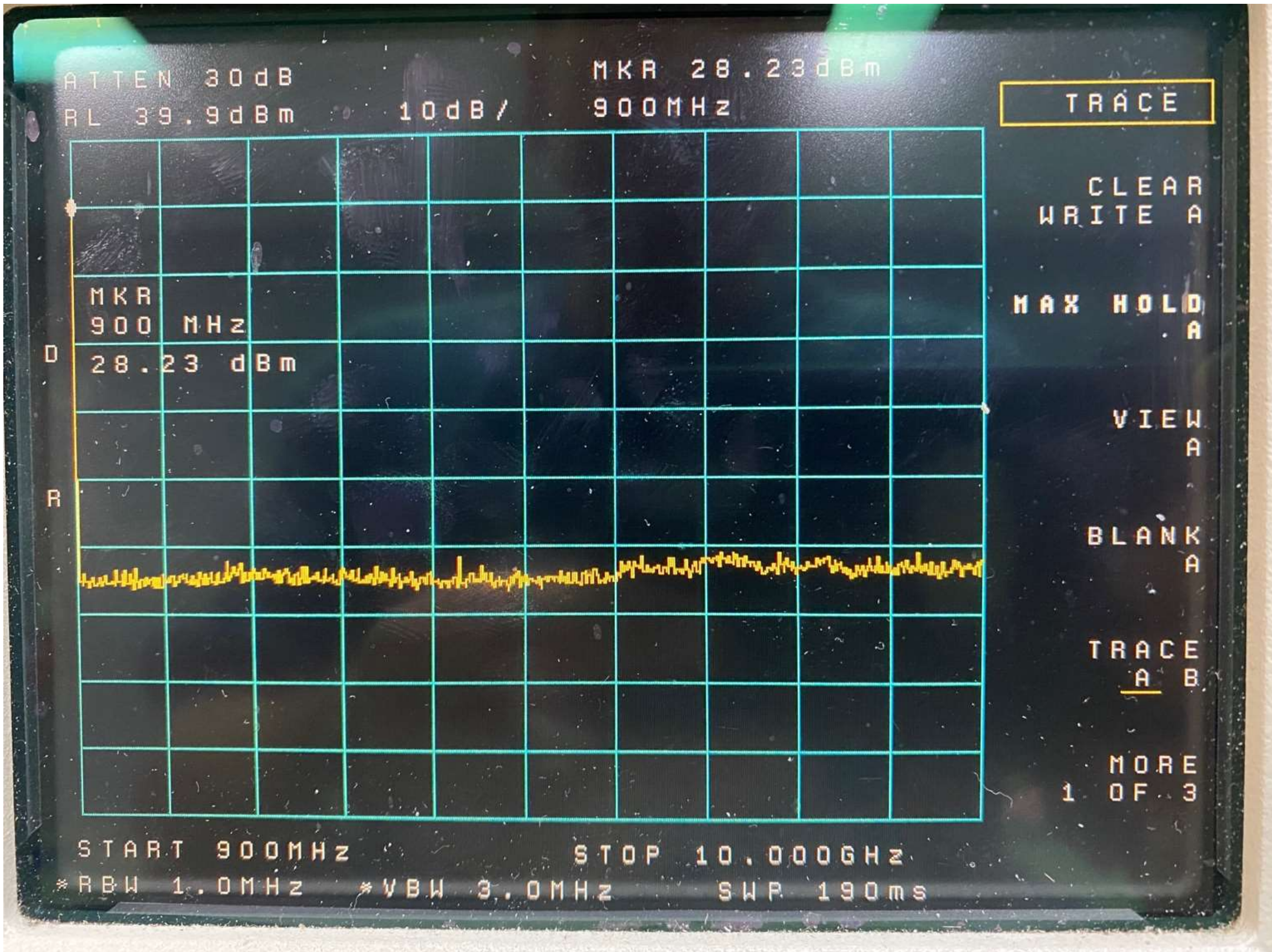
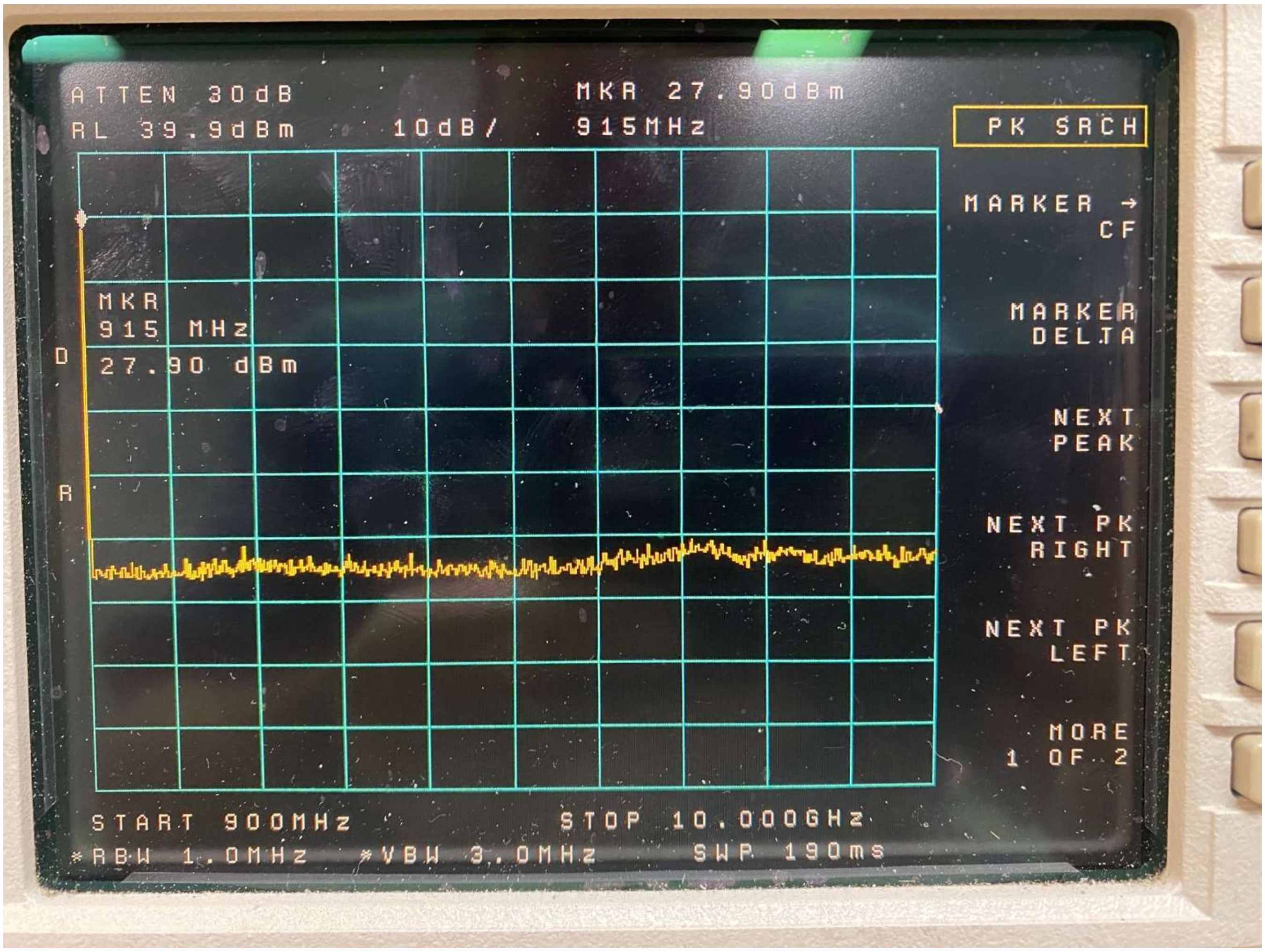


Figure 10: Spurious Emissions, High Channel



3.2 Radiated Emissions

3.2.1 Requirements

Compliance Standard: FCC Part 15.209

FCC Compliance Limits		
Frequency Range	**3m Limit**	
30 – 88 MHz	100 µV/m (QP)	
88 – 216 MHz	150 µV/m (QP)	
216 – 960 MHz	200 µV/m (QP)	
> 960 MHz	500 µV/m (AVG)	5000 µV/m (Peak)

3.2.2 Test Procedure

The requirements of this test call for the EUT to be placed on an 80cm high, 1m X 1.5m non-conductive motorized turntable for radiated testing at a 3m test site. All radiated emissions measured during this testing, were performed at a distance of 3-meters.

An initial pre-scan of the EUT was performed to identify any emissions that exceed, or come within 6dB of, the applicable limit. This pre-scan was performed a with the employment of a spectrum analyzer peak detector function. The highest amplitude (worst-case) emissions noted during the pre-scan were selected for final compliance measurements.

The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Broadband log periodic and double-ridged horn antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters. The output of the antenna was connected to the input of the spectrum analyzer and the emissions in the frequency range of 30 MHz to 25 GHz were evaluated. The EUT peripherals were placed on the table in accordance with ANSI C63.4. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

The detector function was set to quasi-peak for measurements below 1 GHz. The measurement bandwidth of the spectrum analyzer system was set to at least 120 kHz, with all post-detector filtering no less than 10 times the measurement bandwidth. For measurements above 1 GHz, the average levels are recorded, using a measurement bandwidth of 1 MHz with a video bandwidth setting of 10 Hz, in the case of video averaging. Otherwise, an EMI AVG detector shall be employed.

Environmental Conditions During Radiated Emissions Testing

Ambient Temperature:	20.6 °C
Relative Humidity:	41 %

3.2.3 Radiated Data Reduction and Reporting

To convert the raw spectrum analyzer radiated data into a form that can be compared with the FCC limits, it is necessary to account for various calibration factors that are supplied with the antenna(s) and other measurement equipment. These factors include the antenna factor ((AF)(in dB/m)), cable loss factors ((CF)(in dB)), and the pre-amplifier gain [if applicable] ((G)(in dB)). These correction values are algebraically added to the raw Spectrum Analyzer Voltage (in dBµV) to obtain the corrected radiated electric field, which shall be the final corrected logarithm amplitude ((Corr. Meas.)(in dBµV/m)). This logarithm amplitude is then compared to the FCC limit, which has been converted to a unit of log in dBµV/m, as denoted in Table 8.

<u>Example:</u>

Spectrum Analyzer Voltage:	VdBµV (SA)
Antenna Correction Factor:	AFdB/m
Cable Correction Factor:	CFdB
Pre-Amplifier Gain (if applicable):	GdB
Electric Field:	EdBµV/m = V dBµV (SA) + AFdB/m + CFdB - GdB
To convert from linear units of measure:	dBuV/m = 20LOG(uV/m)
To convert FCC limits, based on $D_{Measure}$:	3m Limit = 10m Limit + 20LOG(10/3)

3.2.4 Test Data

The EUT complies with the Class B Radiated Emissions requirements.

The EUT was scanned from 30 MHz to 25 GHz, to cove the tenth harmonic of the each transmitter.

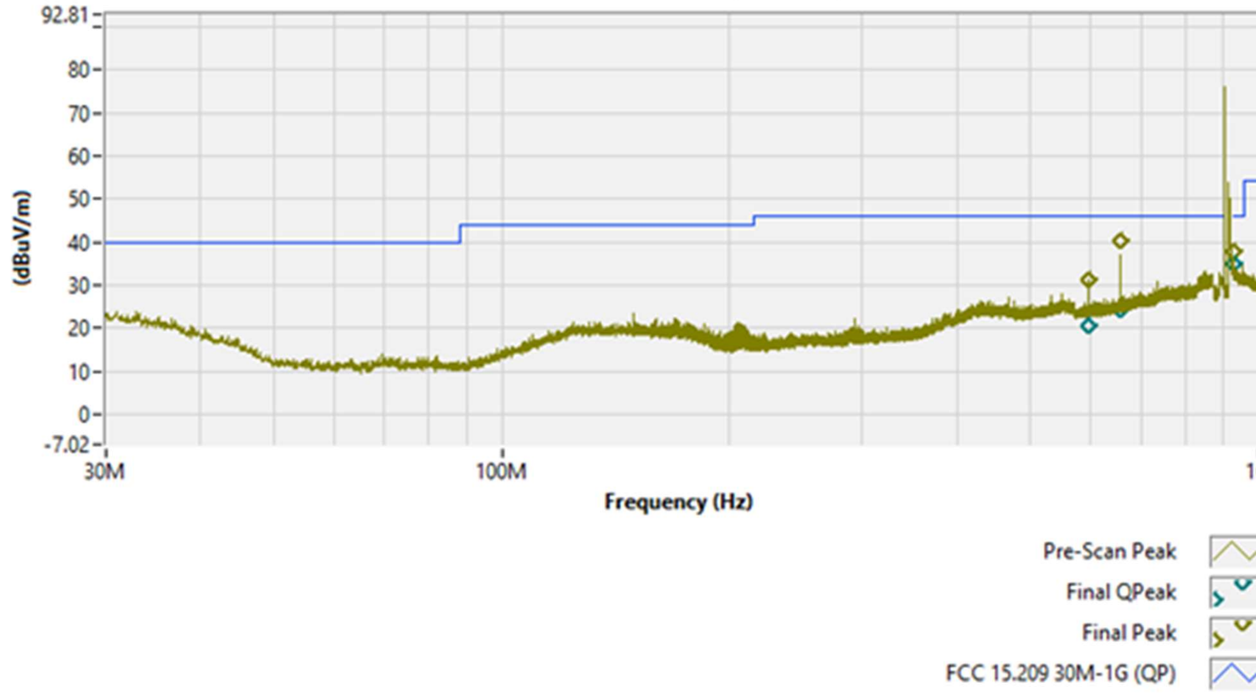
There were no EUT emissions detected above 6.5 GHz.

The radiated emissions test data is provided below.

The worst-case emissions are reported.

Figure 11: Radiated Emissions Test Data (30 MHz – 1 GHz)

Pre-scan and Final Data (Vertical)



Pre-scan and Final Data (Horizontal)

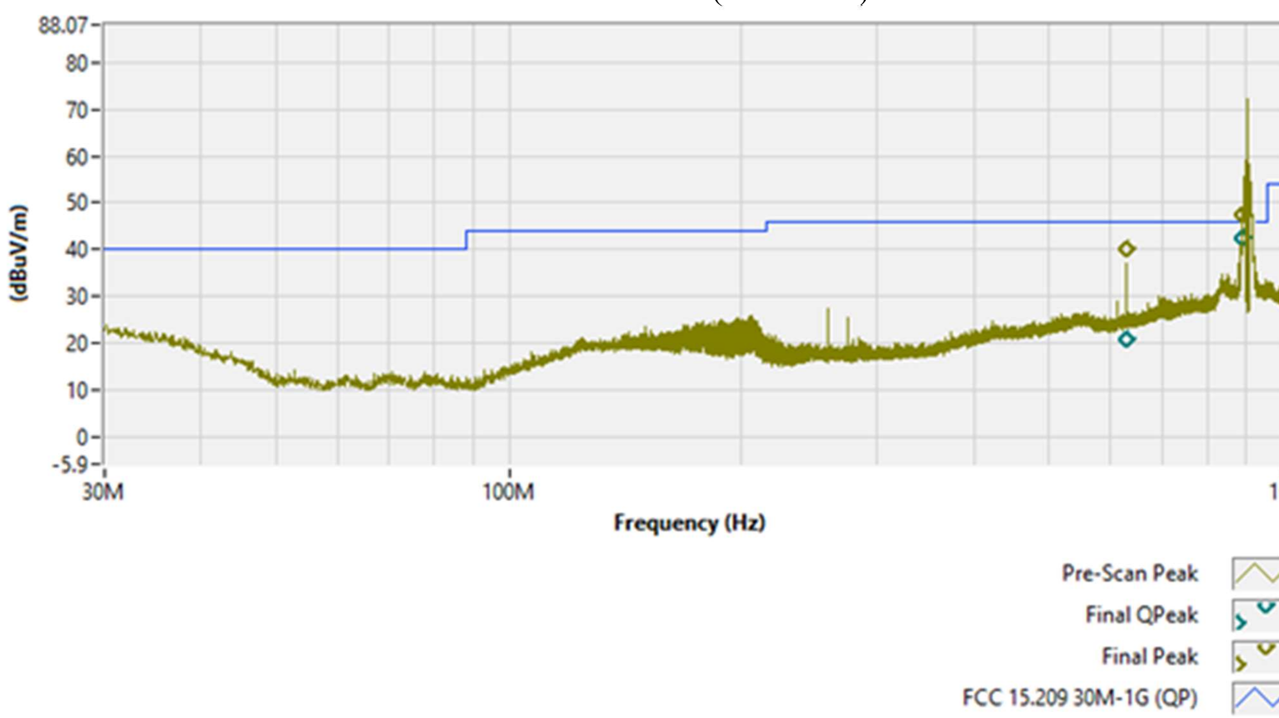


Table 8: Radiated Emission Test Data (30 MHz – 1 GHz)

Frequency (MHz)	Detector	Corr. Meas. (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Turn Table (deg)	Antenna (cm)
596.726	Peak	31.275	--	--	20	Vert, 135
	QP	20.395	46	-25.605	90	Vert, 180
630.720	Peak	40.08	--	--	180	Horiz, 135
	QP	20.636	46	-25.364	90	Horiz, 200
656.366	Peak	40.26	--	--	0	Vert, 135
	QP	24.27	46	-21.73	20	Vert, 135
889.440	Peak	47.644	--	--	20	Horiz, 250
	QP	42.504	46	-3.496	20	Horiz, 235
902.000	Peak	28.733	--	--	90	Vert, 180
	QP	23.008	46	-22.992	90	Vert, 180
928.000	Peak	37.768	--	--	270	Vert, 120
	QP	34.962	46	-11.038	180	Vert, 235

Please note that the amplitude of the 900 MHz radio fundamental was not measured during this test. Nevertheless, it was necessary to utilize appropriate waveguide notch filters, when measuring the unwanted emissions in frequencies above 1800 MHz. The use of band-pass notch filters allows for an accurate evaluation of the radio transmitter harmonics. The notch filters prevent the RF pre-amplifier from becoming saturated.

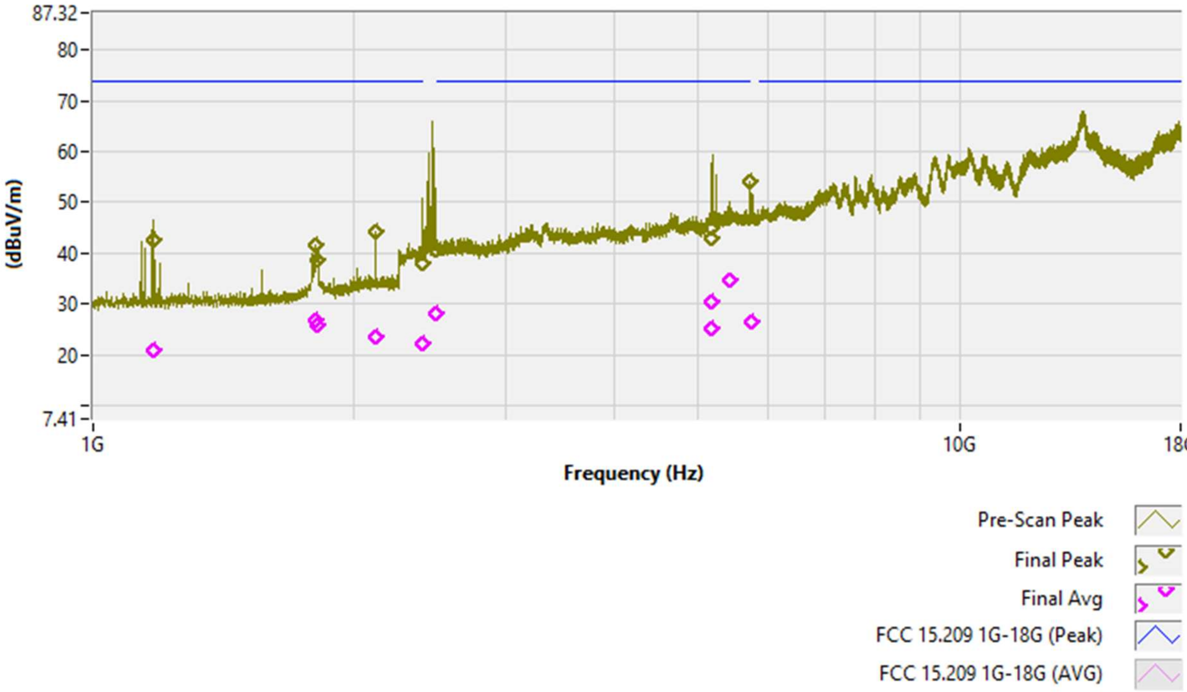
Moreover, the EUT was evaluated for co-location radio intermodulation products. In addition to the data provided in Figure 5 and Figure 6, he EUT was scanned for case radiated emissions at specific frequencies that are known to be products associated with co-location.

(i.e., F_1-F_2 | F_1+F_2 | $2F_1$-$2F_2$ | $2F_1$+$2F_2$ | F_1-$2F_2$ | F_1+$2F_2$)

The Bandedge at 902.0 MHz and 928.0 MHz was evaluated for compliance. A zero-span measurement was made to ensure that any detectable energy met the requirements of §15.205 and §15.247.

Figure 12: Radiated Emissions Test Data (1 GHz – 18 GHz)

Pre-scan and Final Data (Vertical)



Pre-scan and Final Data (Horizontal)

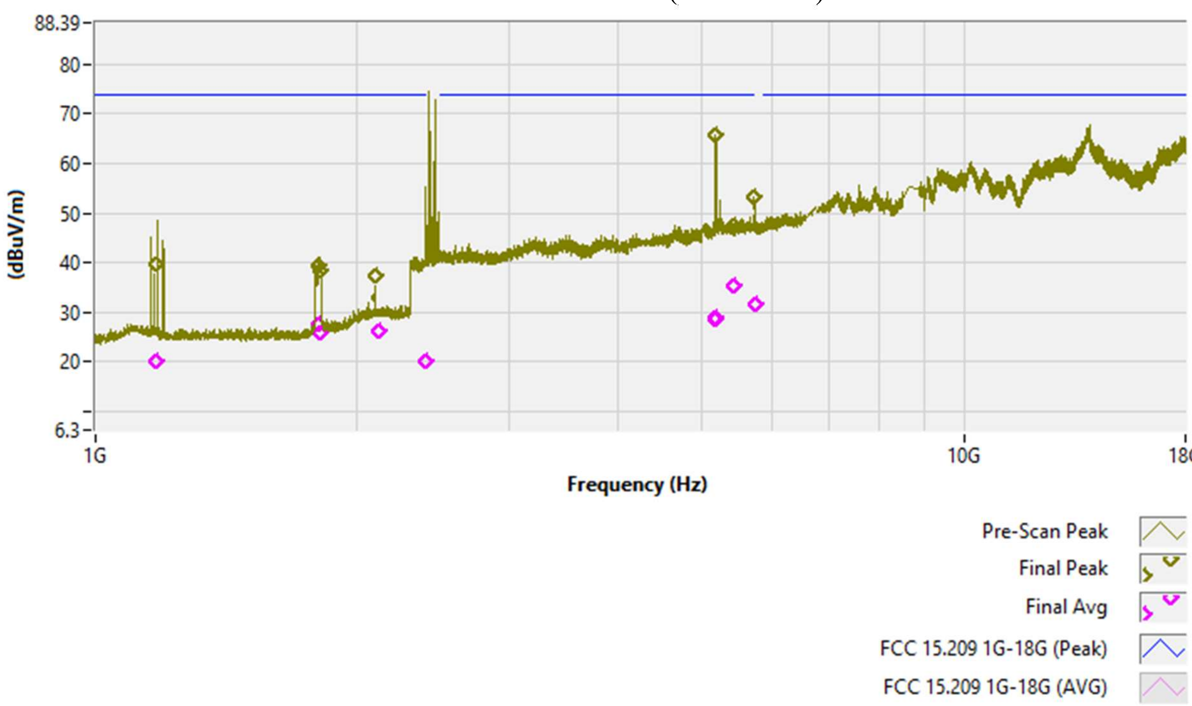


Table 9: Radiated Emission Test Data (1 GHz – 18 GHz)

Frequency (GHz)	Detector	Corr. Meas. (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Turn Table (deg)	Antenna (cm)
1.173	Peak	42.673	74	-31.327	20	Vert, 160
	AVG	20.728	54	-33.272	20	Vert, 160
1.806	Peak	45.866	74	-28.134	140	Vert, 160
	AVG	31.771	54	-22.229	20	Horiz, 160
1.810	Peak	38.545	74	-35.455	20	Horiz, 160
	AVG	25.854	54	-28.146	20	Vert, 160
2.115	Peak	44.405	74	-29.595	140	Vert, 160
	AVG	26.106	54	-27.894	0	Horiz, 160
2.400	Peak	38.043	74	-35.957	90	Vert, 160
	AVG	22.242	54	-31.758	90	Vert, 160
2.4835	Peak	40.581	74	-33.419	0	Vert, 160
	AVG	28.083	54	-25.917	0	Vert, 160
5.179	Peak	65.743	74	-8.257	140	Horiz, 160
	AVG	28.999	54	-25.001	140	Horiz, 160
5.180	Peak	42.835	74	-31.165	0	Horiz, 160
	AVG	30.359	54	-23.641	0	Vert, 160
5.417	Peak	47.579	74	-26.421	0	Horiz, 160
	AVG	35.249	54	-18.751	0	Horiz, 160
5.740	Peak	40.262	74	-33.738	180	Horiz, 160
	AVG	31.551	54	-22.449	180	Horiz, 160

Please note that the amplitude of the BLE radio fundamental was not measured during this test. Nevertheless, it was necessary to utilize appropriate waveguide notch filters, when measuring the unwanted emissions in frequencies above 4800 MHz. The use of band-pass notch filters allows for an accurate evaluation of the radio transmitter harmonics. The notch filters prevent the RF pre-amplifier from becoming saturated.

Moreover, the EUT was evaluated for co-location radio intermodulation products. In addition to the data provided in Figure 5 and Figure 6, he EUT was scanned for case radiated emissions at specific frequencies that are known to be products associated with co-location.
(i.e., F_1-F_2 | F_1+F_2 | $2F_1$-$2F_2$ | $2F_1$+$2F_2$ | F_1-$2F_2$ | F_1+$2F_2$)

The Bandedge at 2400 MHz and 2483.5 MHz was evaluated for compliance. A zero-span measurement was made to ensure that any detectable energy met the requirements of §15.205 and §15.247.

3.3 AC Conducted Emissions

3.3.1 Requirements

Compliance Standard: FCC Part 15.107, Class B

FCC Compliance Limits				
Frequency Range	Class A Digital Device		Class B Digital Device	
	Quasi-peak	Average	Quasi-peak	Average
0.15 – 0.5 MHz	79 dBµV	66 dBµV	66 to 56 dBµV	56 to 46 dBµV
0.5 – 5 MHz	79 dBµV	66 dBµV	56 dBµV	46 dBµV
0.5 – 30 MHz	73 dBµV	60 dBµV	60 dBµV	50 dBµV

3.3.2 Test Procedure

The requirements of FCC Part 15 and ICES-003 call for the EUT to be placed on an 80cm-high 1 X 1.5-meter non-conductive table above a ground plane. Power to the EUT was provided through a Solar Corporation 50 Ω/50 µH Line Impedance Stabilization Network bonded to a 3 X 2-meter ground plane. The LISN has its AC input supplied from a filtered AC power source. Power was supplied to the peripherals through a second LISN. The peripherals were placed on the table in accordance with ANSI C63.4. Power and data cables were moved about to obtain maximum emissions.

The 50 Ω output of the LISN was connected to the input of the spectrum analyzer and the emissions in the frequency range of 150 kHz to 30 MHz were measured. The detector function was set to quasi-peak, peak, or average as appropriate, and the resolution bandwidth during testing was at least 9 kHz, with all post-detector filtering no less than 10 times the resolution bandwidth. For average measurements, the post-detector filter was set to 10 Hz.

These emissions must meet the limits specified in §15.107 for quasi-peak and average measurements.

Environmental Conditions During Conducted Emissions Testing

Ambient Temperature:	20.7 °C
Relative Humidity:	41 %

3.3.3 Conducted Data Reduction and Reporting

The comparison between the Conducted emissions level and the FCC limit is calculated as shown in the following example:

Spectrum Analyzer Voltage: VdBμV(raw)
LISN Correction Factor: LISN dB
Cable Correction Factor: CF dB
Voltage: VdBμV = V dBμV (raw) + LISN dB + CF dB

3.3.4 Test Data

The EUT complies with the Class B Conducted Emissions requirements.

The EUT was set to a transmit enabled mode for this test.

The Conducted Emissions test data is provided in the table below.

Please note that the EUT can transmit a CW while it is plugged into a public mains network.

Table 10: AC Power Conducted Emissions Test Data

NEUTRAL										
Frequency (MHz)	**Level QP (dBµV)**	**Level AVG (dBµV)**	**Cable Loss (dB)**	**LISN Corr (dB)**	**Level QP Corr (dBµV)**	**Level Avg Corr (dBµV)**	**Limit QP (dBµV)**	**Limit AVG (dBµV)**	**Margin QP (dB)**	**Margin AVG (dB)**
0.234	32.1	20.0	9.9	0.4	42.5	30.4	62.3	52.3	-19.8	-18.9
0.394	19.9	12.0	9.9	0.3	30.2	22.3	58.0	48.0	-27.8	-25.7
0.616	27.3	17.9	9.9	0.3	37.5	28.1	56.0	46.0	-18.5	-17.9
1.254	17.1	9.9	10.0	0.3	27.3	20.1	56.0	46.0	-28.7	-25.9
1.871	10.3	5.5	10.1	0.3	20.6	15.8	56.0	46.0	-35.4	-30.2
8.083	26.7	16.8	10.5	0.6	37.8	27.9	60.0	50.0	-22.2	-22.1
14.017	19.0	10.4	10.7	0.9	30.6	22.0	60.0	50.0	-29.4	-28.0
29.900	21.0	9.0	10.9	3.2	35.2	23.2	60.0	50.0	-24.8	-26.8
PHASE / L1										
Frequency (MHz)	**Level QP (dBµV)**	**Level AVG (dBµV)**	**Cable Loss (dB)**	**LISN Corr (dB)**	**Level QP Corr (dBµV)**	**Level Avg Corr (dBµV)**	**Limit QP (dBµV)**	**Limit AVG (dBµV)**	**Margin QP (dB)**	**Margin AVG (dB)**
0.151	34.7	20.7	9.9	0.5	45.1	31.1	65.9	55.9	-20.8	-24.8
0.215	25.7	13.3	9.9	0.3	35.9	23.6	63.0	53.0	-27.1	-29.4
0.412	24.0	12.6	9.9	0.3	34.2	22.8	57.6	47.6	-23.4	-24.8
0.610	30.1	14.0	9.9	0.3	40.3	24.2	56.0	46.0	-15.7	-21.8
8.226	26.8	17.1	10.5	0.6	37.9	28.2	60.0	50.0	-22.1	-21.8
10.283	19.5	9.3	10.6	0.6	30.7	20.5	60.0	50.0	-29.3	-29.5
29.560	20.4	9.9	10.9	2.8	34.2	23.7	60.0	50.0	-25.8	-26.3

3.4 Fundamental Transmitter Field Strength

3.4.1 Test Procedure

The test laboratory wanted to ensure that all efforts were taken to adequately evaluate the radio transmitters embedded within this device.

As a means to determine the worst-case orientation that produced the highest fundamental field strength, the EUT was investigated in three orthogonal axes (x, y, and z). When the EUT was positioned in each of the respective orientations, the polarity of the measurement antenna was varied in both the vertical and horizontal planes.

Based on these exploratory measurements, the position that produced the worst-case emissions was used for the radiated emissions testing in section 3.2 of this report.

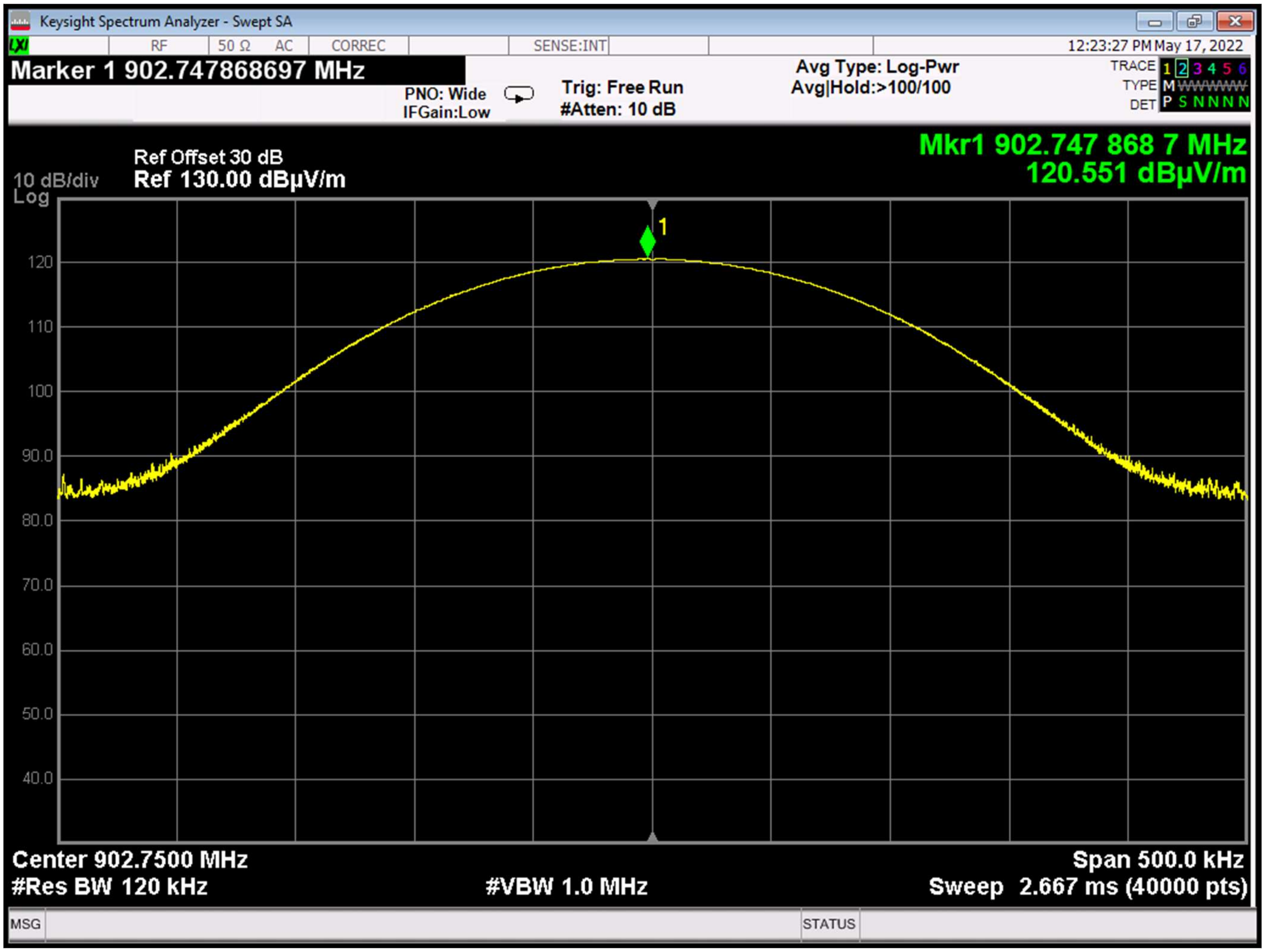
3.4.2 Test Data

The 900 MHz transmitter was set to a CW mode and was evaluated at the low, center, and high channels. The worst-case (highest amplitude) filed strength test data is provided in Figure 7.

The 2.4 GHz BLE radio was set to a normal production mode, as the EUT was paired over-the-air with a smart phone companion device. The worst-case (highest amplitude) filed strength test data is provided in Figure 8.

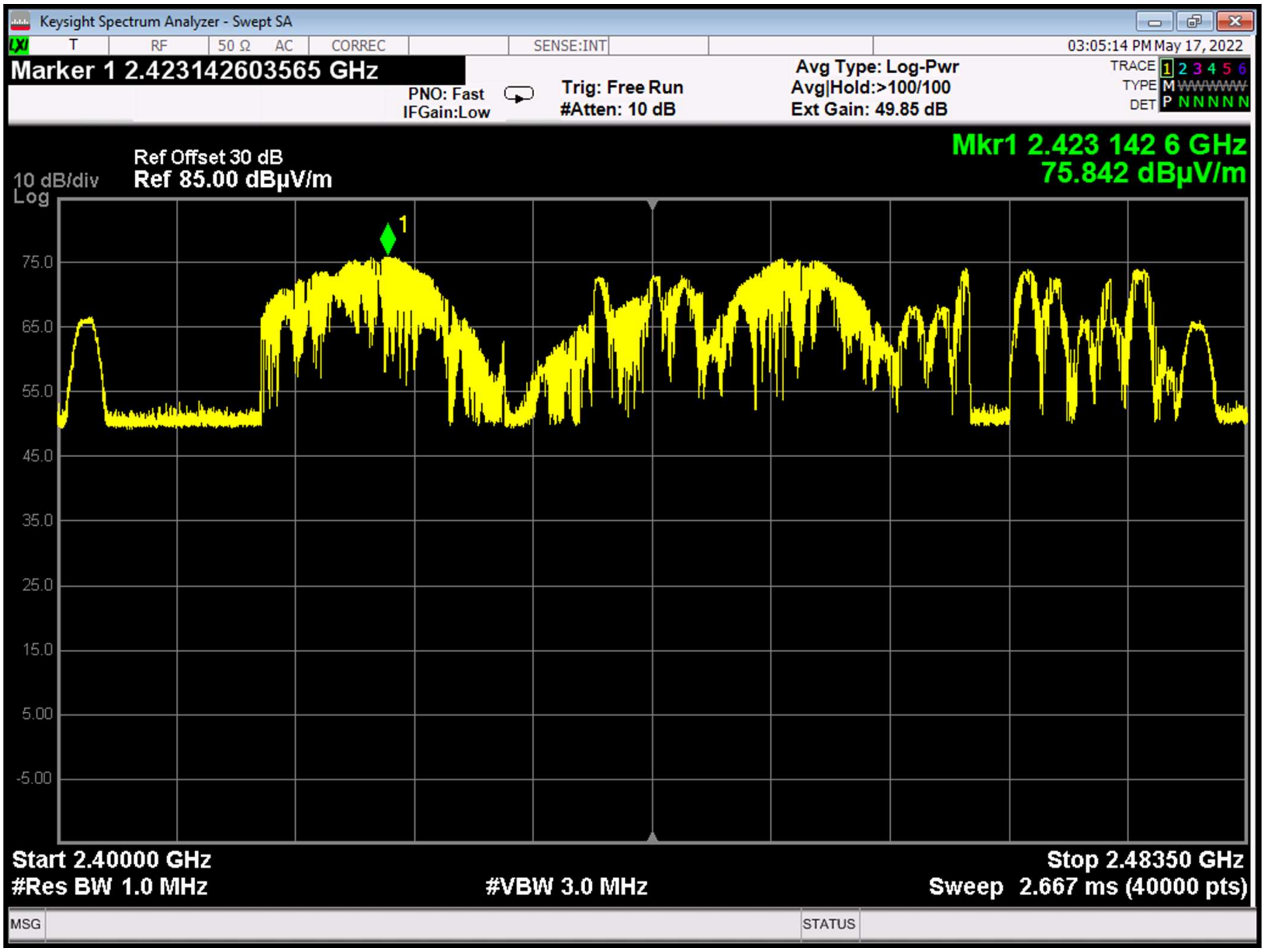
The 3-meter field strength test data provided in the plots below, are corrected values. The measurement antenna factor and cable loss have been introduced into the spectrum analyzer as a correction factor. The attenuator value has been entered as a reference level offset. When applicable, the gain of the RF pre-amplifier was entered as an external factor. (i.e., Figure 8).

Figure 13: 900 MHz Radio (CW) Low Channel – Corrected Field Strength at 3m



120.551 dBuV/m + 20LOG(3) – 104.7 = 25.4 dBm EIRP

Figure 14: BLE Radio (Normal Mode) – Corrected Field Strength at 3m



75.842 dBuV/m + 20LOG(3) – 104.7 = -19.3 dBm EIRP

This field strength is collaborated by Figure 6 of this report. The 2.4 GHz BLE signal was ~ 75 dBuV/m during the Horizontal, 3m RE scans.

4 Test Equipment

Table 11 shows a list of the test equipment used for data measurements along with the calibration information.

Table 11: Test Equipment List

Test Name: **AC Mains Conducted Emissions**		Test Date:	**5/18/2022**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
00125	SOLAR, 8028-50-TS-24-BNC	LISN	9/14/2022
00126	SOLAR, 8028-50-TS-24-BNC	LISN	9/14/2022
00895	HP, 11947A	TRANSIENT LIMITER	2/21/2023
00942	AGILENT, MXA	SPECTRUM ANALYZER	9/29/2022
00330	WLL, CE CABLE	BNC, RF COAXIAL CABLE	5/6/2023
Test Name: **Radio Emissions, Bench**		Test Dates:	**5/18/2022 & 1/30/2023**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
00942	AGILENT, MXA	SPECTRUM ANALYZER	9/29/2022
00948	Agilent, 8564EC	SPECTRUM ANALYZER	1/17/2024
Test Name: **3m Radiated Emissions**		Test Date:	**5/17/2022**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
00942	AGILENT, MXA	SPECTRUM ANALYZER	9/29/2022
00644	SUNOL SCIENCES CORP.	ANTENNA, LOGPERIOD	11/9/2022
00626	ARA, DRG-118/A	ANTENNA, HORN	8/20/2023
00627	AGILENT, 8449B	RF PRE-AMPLIFIER	5/6/2023
00276	ELECTRO-METRICS, BPA-1000	RF PRE-AMPLIFIER	5/6/2023
00806	MINI-CIRCUITS, 3061	HIGH FREQUENCY CABLE, SMA	5/6/2023
00977	JUNKOSHA, USA MX-322	6M COAXIAL CABLE, SMA/N	1/3/2023