



Bluetooth LE

FCC Test Report

FOR:
Pearl Automation Inc.

Model Name: / Model Number:

RearVision Camera Frame / P110

Product Description:

RearVision consists of 2 main components. The "Car Adapter", which is an accessory that connects to the vehicle's OBD-II diagnostic port, and the "Camera Frame" which is an accessory that is mounted at the license plate of the vehicle. The "Car Adapter" will relay information from the "Camera Frame" and vehicle environmental and state information over Bluetooth/WiFi, and that information will be relayed to the phone over Bluetooth/WiFi and displayed to the driver via the phone app.

FCC ID: 2AG6M-P110

47 CFR Part 15.247 [DTS]

TEST REPORT #: EMC-PEARL-004-16001-15.247-P110-DTS-BTLE

DATE: 2016-09-30



FCC Recognized

A2LA Accredited

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1 Assessment

The following device was evaluated against the applicable criteria specified in FCC rules Parts 15.247 of Title 47 of the Code of Federal Regulations and no deviations were ascertained during the course of the tests performed.

Company	Description	Model #
Pearl Automation Inc.	RearVision Camera Frame	P110

Responsible for Testing Laboratory:

Franz Engert

2016-09-30 Compliance (Compliance Manager)

Date	Section	Name	Signature
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Responsible for the Report:

James Donnellan

2016-09-30 Compliance (Sr. EMC Engineer)

Date	Section	Name	Signature
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The test results of this test report relate exclusively to the test item specified in Section3.

CETECOM Inc. USA does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM Inc. USA.

2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the Test Report

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Telephone:	+1 (408) 586 6200
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Compliance Manager:	Franz Engert
Responsible Project Leader:	James Donnellan

2.2 Identification of the Client

Applicant's Name:	Pearl Automation Inc.
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City/Zip Code	Scotts Valley, CA 95066
Country	USA
Contact Person:	Erturk Kocalar / Hagan O'Connor
Phone No.	+1 408 655-3319 (Hagan) / +1 408 410-0144 (Erturk)
e-mail:	hagan@pearlauto.com / erturk@pearlauto.com.

2.3 Identification of the Manufacturer

Manufacturer's Name:	Dongguan Primax Electronic & Telecommunications Products Co., Ltd
Manufacturers Address:	Liu Wu District, Shek Kit Town,
City/Zip Code	DongGuan City, Guang Dong,
Country	China

3 Equipment under Test (EUT)

3.1 Specification of the Equipment under Test

Model No:	P110
HW Version :	DVT1B
SW Version :	001.668
FCC-ID:	2AG6M-P110
Product Description:	RearVision Camera Frame
Technology / Type(s) of Modulation:	Bluetooth v4.0 LE / GFSK
Operating Frequency Ranges (MHz) / Channels:	Nominal band: 2400 – 2483.5; Center to center: 2402(ch 0) – 2480(ch 39), 40 channels
Antenna info:	1 Custom internal PCB Trace Antenna. For RF conducted measurements, a temporary connection was made from measurement equipment to the 50Ohm UFL port of the EUT.
Max. Declared Antenna Gain:	Documented antenna gain(2.4GHz) = 5 dBi
Max. Output Power:	10 dBm per spec (10 mw to antenna port)
Rated Operating Voltage Range / Power Supply:	Vmin: 2.8 V DC - Vmax: 4.2V DC USB 4.4 VDC - 5.25 VDC
Rated Operating Temperature Range:	Tlow: -20° C -- Tmax: 45° C
Other Radios included in the device:	5G WLAN 2.4G WLAN
EUT status	Prototype

3.2 Identification of the Equipment under Test (EUT)

EUT #	Serial Number	HW Version	SW Version	Notes/Comments
1	A2A6170576	DVT1B	001.668	Radiated Sample
2	A2A61008K4	DVT1B	001.668	Conducted Sample

3.3 Identification of Ancillary equipment

AE #	Type	Manufacturer	Model	Serial Number	Notes/Comments
1	12W USB Power Adapter	A143	Apple	-	Used to charge internal battery when needed
2	MacBook Air	A1465	Apple	C2QQ606&G4FY	Used to setup channel modes prior to test.

3.4 EUT Sample Configuration

EUT Set-Up #	Combination of AE used for test set up	Comments
1	EUT#1 (AE1/AE2)	The radio of the EUT was stimulated directly in a test mode not accessible by the end user. The internal antenna was connected. AE1 and AE2 used as needed for charging.
2	EUT#2 +AE2	The radio of the EUT was stimulated directly in a test mode not accessible by the end user. The measurement equipment was connected to the 50Ohm UFL port of the EUT.

3.5 Test mode of operation:

The EUT was set low, mid and high channels with a Max Duty Cycle and GFSK modulation using special software that is not available to the end user.

4 Subject Of Investigation

The objective of the evaluation documented in this report was to assess if the performance of the EUT meets the relevant requirements specified in FCC rules Part 15.247 of Title 47 of the Code of Federal Regulations.

This test report is to support a request for new equipment authorization under the FCC ID: 2AG6M-P110

All testing was performed on the product referred to in Section 3 as the EUT.

During the testing process the EUT was tested with transmitter sets on low, mid and high channels. For radiated measurements, all data in this report shows the worst case between horizontal and vertical antenna polarizations and for all orientations of the EUT.

Testing procedures are based on FCC KDB 558074 D01 v03r05, "GUIDANCE FOR PERFORMING COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEMS (DTS) OPERATING UNDER §15.247" and ANSI C63.10:2013 for DTS devices.

5 Summary of Measurement Results

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	Fail	NA	NP	Result
§15.247(e) RSS-247 5.2(1)	Power Spectral Density	Nominal	Bluetooth LE	■	□	□	□	Complies
§15.247(a)(1) RSS-247 5.2(2)	Emission Bandwidth	Nominal	Bluetooth LE	■	□	□	□	Complies
§15.247(b)(1) RSS-247 5.4(4)	Maximum Conducted Output Power and EIRP	Nominal	Bluetooth LE	■	□	□	□	Complies
§15.247(d) RSS-247 5.5	Band edge compliance- Unrestricted Band Edges	Nominal	Bluetooth LE	■	□	□	□	Complies
§15.247/15.209/15.205 RSS-Gen 8.9/ 8.10	Band edge compliance- Restricted Band Edges	Nominal	Bluetooth LE	■	□	□	□	Complies
§15.247(d) §15.209	TX Spurious emissions- Conducted	Nominal	Bluetooth LE	□	□	□	■	See Note 1
§15.247(d) §15.209 RSS-Gen 6.13	TX Spurious emissions- Radiated	Nominal	Bluetooth LE	■	□	□	□	Complies
§15.207(a) RSS Gen 8.8	AC Conducted Emissions	Nominal	Bluetooth LE	□	□	□	■	-

Note: NA= Not Applicable; NP= Not Performed.

Note 1: Conducted unwanted emissions testing against non-restricted band limits is not performed, except at the authorized band edge section, since radiated spurious emissions against more stringent restricted band limits over the complete range (9 kHz to 26 GHz) has passed.

6 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus, with 95% confidence interval (in dB delta to result), based on a coverage factor k=1.

	Uncertainty in dB radiated <30MHz	Uncertainty in dB radiated 30MHz - 1GHz	Uncertainty in dB radiated > 1GHz	Uncertainty in dB Conducted measurement
standard deviation k=1	2.48	1.94	2.16	0.64
95% confidence interval in dB	4.86	3.79	4.24	1.25
95% confidence interval in dB in delta to Result (rounded up to next decimal point)	+/- 2.5 dB	+/- 2.0 dB	+/- 2.3dB	+/- 0.7dB

7 Environmental Conditions During Testing:

The following environmental conditions were maintained during the course of testing:

- Ambient Temperature: 20-25°C
- Relative humidity: 40-60%

8 Dates of Testing:

April 2016 – June 2016

9 Measurement Procedures.

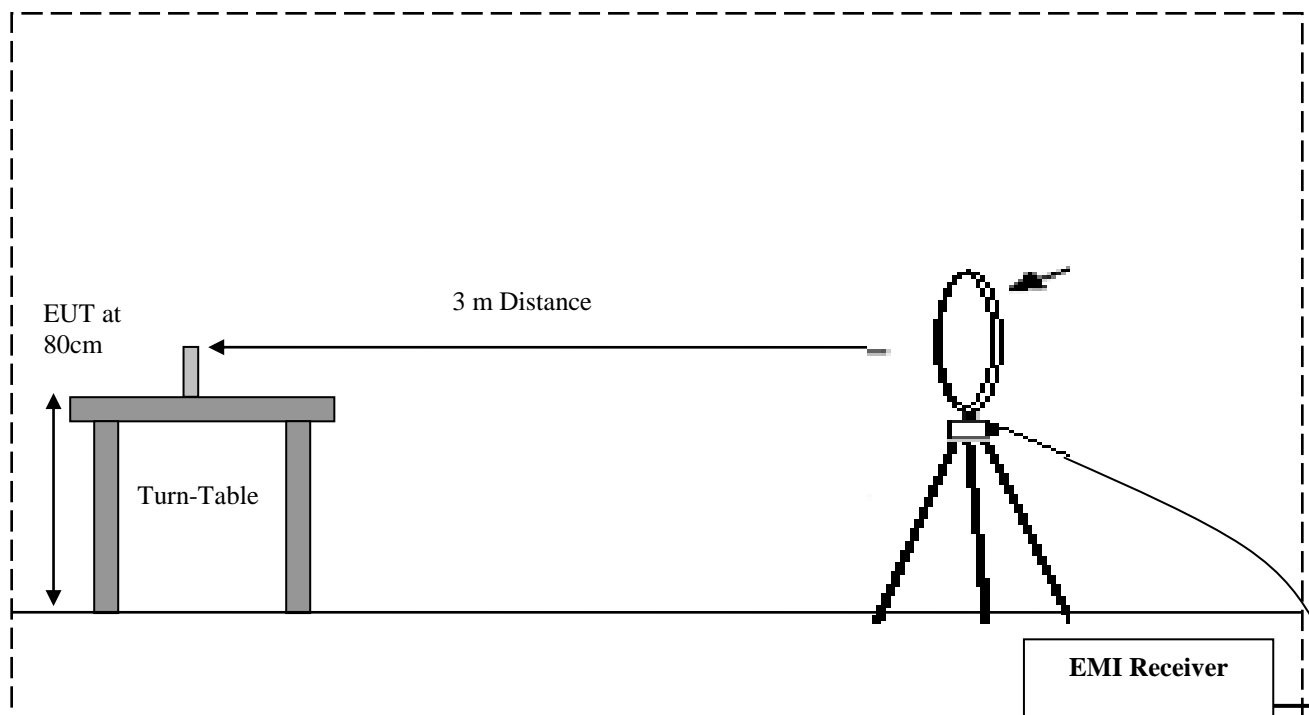
9.1 Radiated Measurement

The radiated measurement is performed according to:

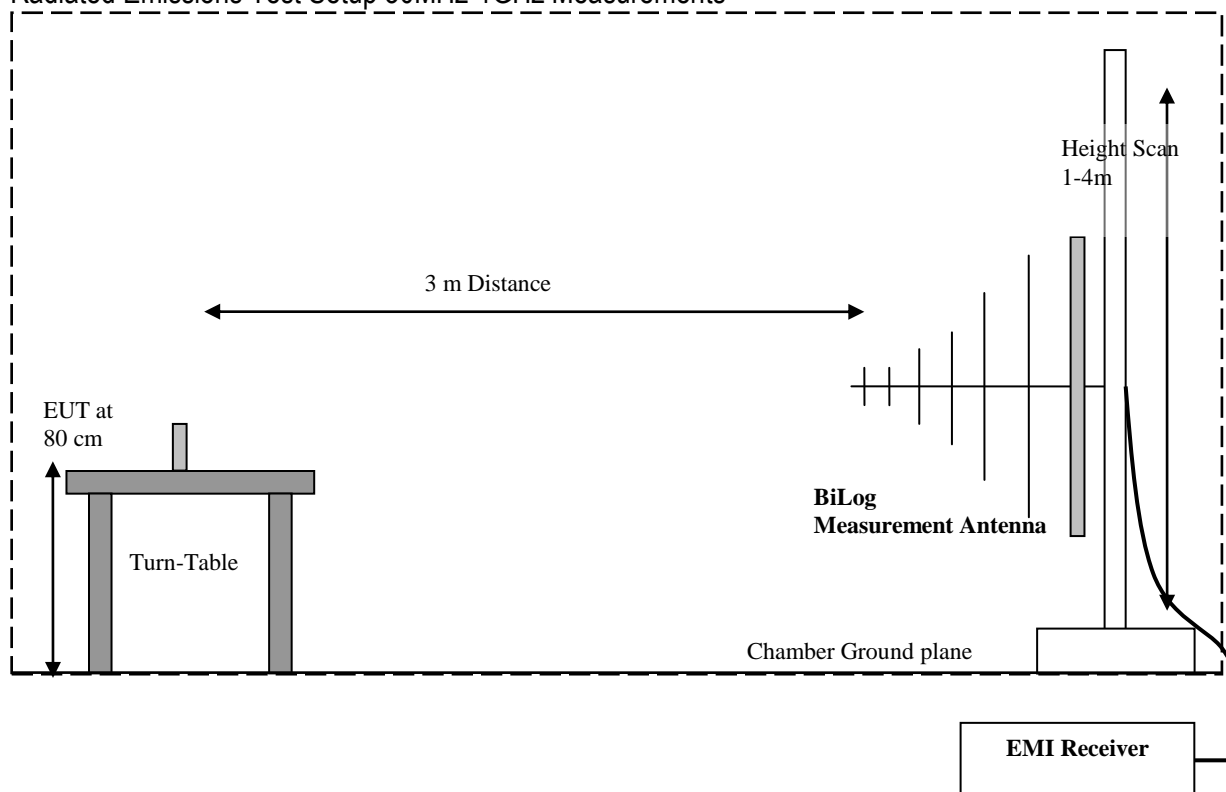
ANSI C63.10 (2013)

- The exploratory measurement is accomplished by running sweeps at 1 and 4m antenna heights over the required frequency range with R&S Test-SW EMC32 for both antenna polarizations. During each frequency scan the turntable rotates by no more than 10deg.
- The 10 highest emissions are selected with an automatic algorithm of EMC32 searching for peaks in the noise floor and ensuring that broadband signals are not selected multiple times.
- The maxima are then again maximized through a fine search in frequency domain, maximized in the 360deg range of the turntable, and maximized over antenna height between 1m and 4m and for positioning of the EUT.
- The above procedure is repeated for transmission low mid and high channel.
- In case there are no emissions above noise floor level only the maximum trace is reported as described above.
- The results are split up into up to 4 frequency ranges due to antenna bandwidth restrictions. A magnetic loop is used from 9 kHz to 30 MHz, a Biconilog antenna is used from 30 MHz to 1 GHz, and two different horn antennas are used to cover frequencies up to 40 GHz.

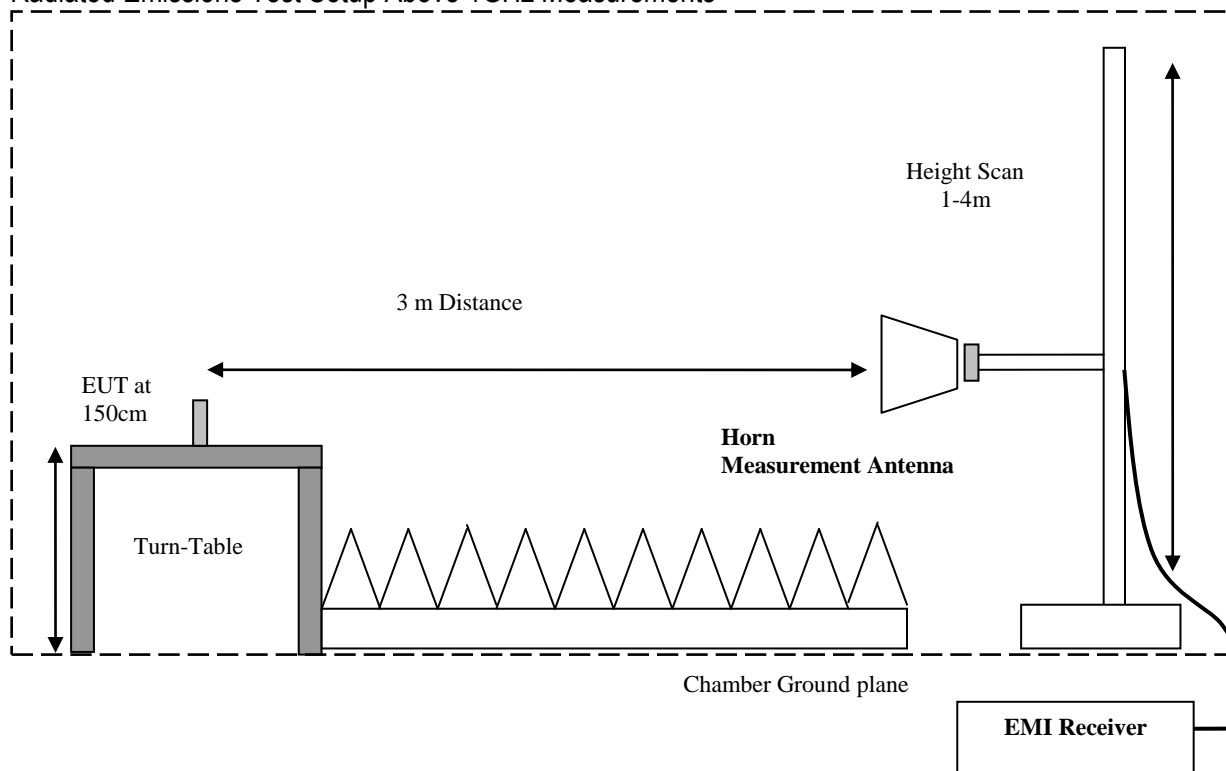
Radiated Emissions Test Setup Below 30MHz Measurements



Radiated Emissions Test Setup 30MHz-1GHz Measurements



Radiated Emissions Test Setup Above 1GHz Measurements



9.2 Sample Calculations for Field Strength Measurements

Field Strength is calculated from the Spectrum Analyzer/ Receiver readings, taking into account the following parameters:

1. Measured reading in dB μ V
2. Cable Loss between the receiving antenna and SA in dB and
3. Antenna Factor in dB/m

All radiated measurement plots in this report are taken from a test SW that calculates the Field Strength based on the following equation:

$$FS \text{ (dB}\mu\text{V/m)} = \text{Measured Value on SA (dB}\mu\text{V)} - \text{Cable Loss (dB)} + \text{Antenna Factor (dB/m)}$$

Example:

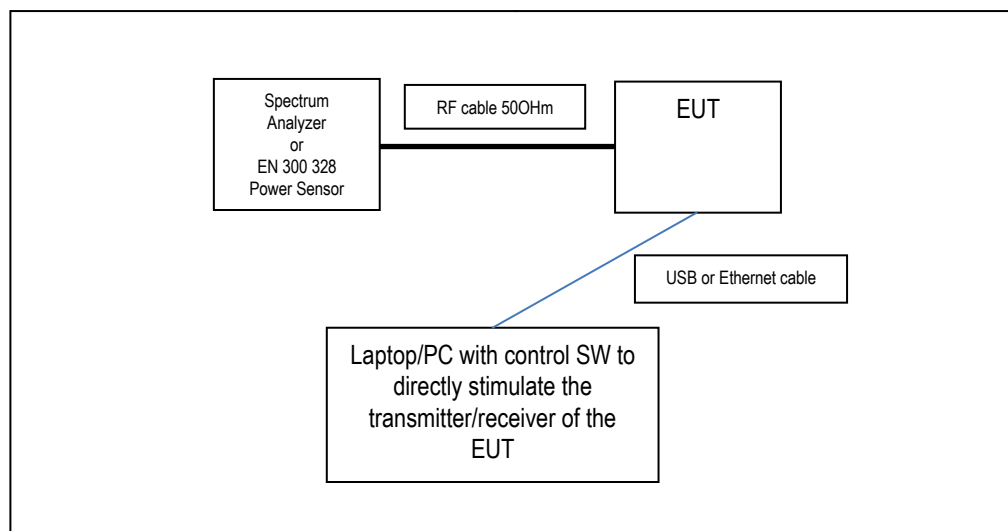
Frequency (MHz)	Measured SA (dB μ V)	Cable Loss (dB)	Antenna Factor Correction (dB)	Field Strength Result (dB μ V/m)
1000	80.5	3.5	14	98.0

9.3 Power Line Conducted Measurement Procedure

AC Power Line conducted emissions measurements performed according to: ANSI C63.4 (2014)

9.4 RF Conducted Measurement Procedure

9.4.1 Conducted Measurement Setup.



10 Measurements and Results

10.1 Maximum Conducted (Average) Output Power and EIRP

10.1.1 Limits:

Maximum Peak Output Power:

FCC §15.247 (b) (3): 1W

10.1.2 Test Conditions:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
22 ° C	2	Tx	Battery

EUT set to Transmit with 100% Duty Cycle

10.1.3 Test Procedure

Duty cycle measurement according to FCC KDB 558074 D01 v03r05 section 6.0 b)

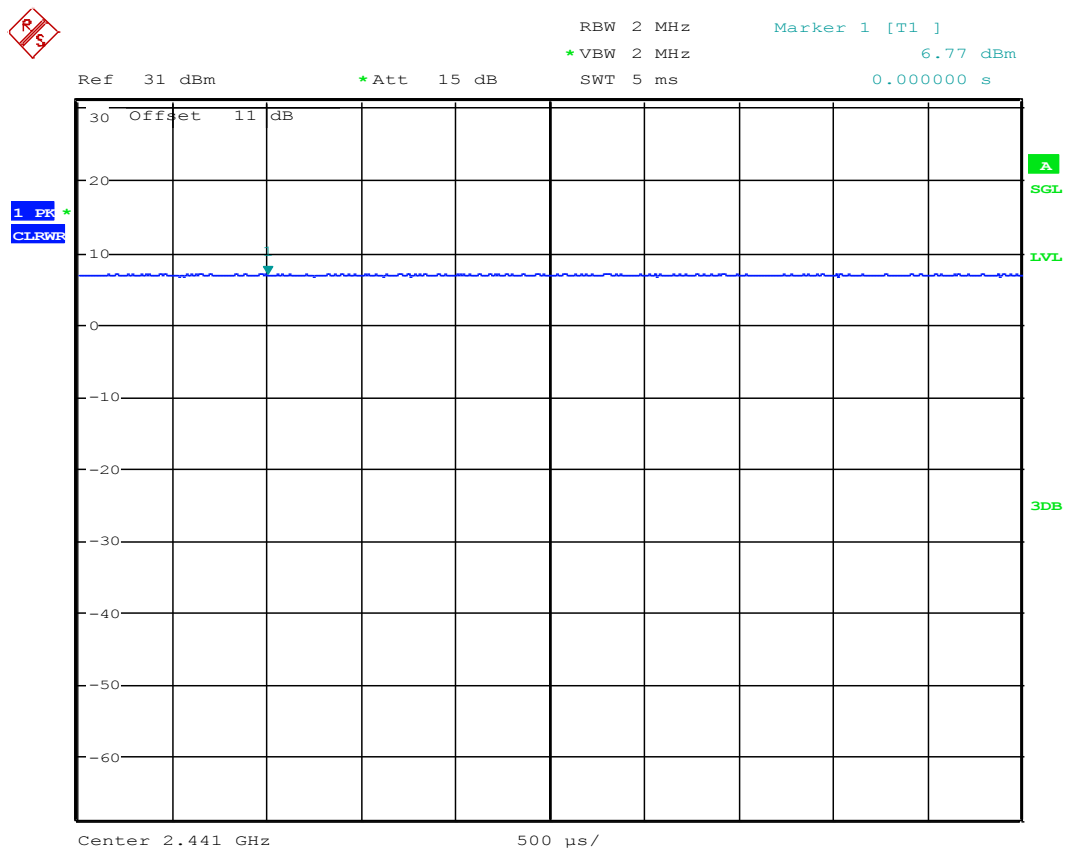
Power measurement according to FCC KDB 558074 D01 v03r05 section 9.2.2.2

9.2.2.2 Method AVGSA-1 (trace averaging with the EUT transmitting at full power throughout each sweep)

- Set span to at least 1.5 times the OBW.
- Set RBW = 1-5% of the OBW, not to exceed 1 MHz.
- Set VBW $\geq 3 \times$ RBW.
- Number of points in sweep $\geq 2 \times$ span / RBW. (This gives bin-to-bin spacing \leq RBW/2, so that narrowband signals are not lost between frequency bins.)
- Sweep time = auto.
- Detector = RMS (*i.e.*, power averaging), if available. Otherwise, use sample detector mode.
- If transmit duty cycle $< 98 \%$, use a sweep trigger with the level set to enable triggering only on full power pulses. The transmitter shall operate at maximum power control level for the entire duration of every sweep. If the EUT transmits continuously (*i.e.*, with no off intervals) or at duty cycle $\geq 98 \%$, and if each transmission is entirely at the maximum power control level, then the trigger shall be set to “free run”.
- Trace average at least 100 traces in power averaging (*i.e.*, RMS) mode.
- Compute power by integrating the spectrum across the OBW of the signal using the instrument’s band power measurement function, with band limits set equal to the OBW band edges. If the instrument does not have a band power function, sum the spectrum levels (in power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.

10.1.4 Test Data

Duty Cycle Measurement:



Duty Cycle = 100%

10.1.5 Maximum Conducted (Average) Output Power

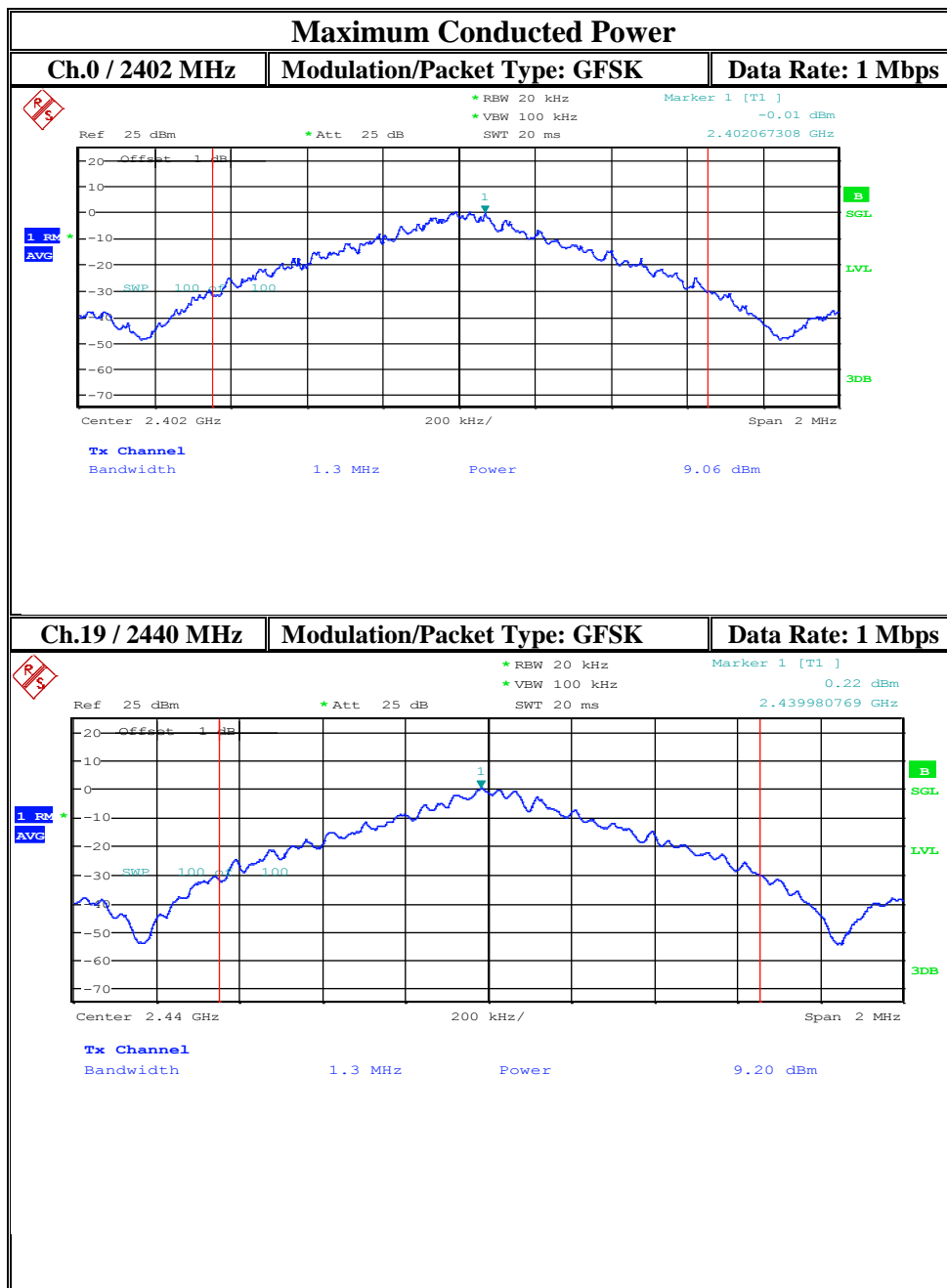
Maximum Conducted (Average) Output Power (dBm)				
Limit = 30 dBm		Frequency (MHz)		
		2402 Channel 0	2440 Channel 19	2480 Channel 39
Bluetooth LE		9.06	9.20	8.78
Calculated Radiated Output Power EIRP (dBm)				
Limit = 36 dBm		Frequency (MHz)		
Mode	Antenna Gain (dBi)	2402 Channel 0	2440 Channel 19	2480 Channel 39
Bluetooth LE	5.0	14.06	14.20	13.78

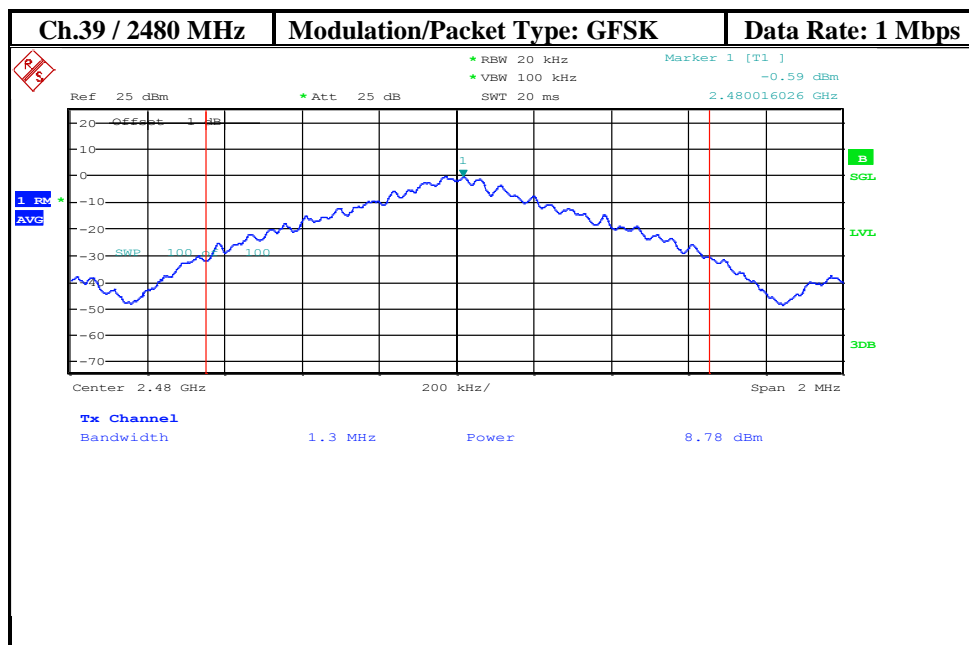
Declared Antenna Gain in the 2.4GHz band: 5.0 dBi.

10.1.6 Measurement Result

Pass.

10.1.7 Measurement Plots:





10.2 Power Spectral Density

10.2.1 Limits:

§ 15.247 (e) & RSS-247 Section 5.2 (2)

For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

10.2.2 Test Conditions:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
22.2 ° C	2	Tx	Battery

10.2.3 Measurement procedure

Measurement according to FCC KDB 558074 D01 V03R05 section 10.3

10.3 Method AVGPSD-1 (trace averaging with EUT transmitting at full power throughout each sweep)

This procedure may be used when the maximum (average) conducted output power was used to demonstrate compliance to the output power limit. This is the baseline method for determining the maximum (average) conducted PSD level. If the instrument has an RMS power averaging detector, it must be used; otherwise, use the sample detector. The EUT must be configured to transmit continuously (duty cycle $\geq 98\%$); otherwise sweep triggering/signal gating must be implemented to ensure that measurements are made only when the EUT is transmitting at its maximum power control level (no transmitter off time is to be considered).

- Set instrument center frequency to DTS channel center frequency.
- Set span to at least 1.5 times the OBW.
- Set RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- Set VBW $\geq 3 \times \text{RBW}$.
- Detector = power averaging (RMS) or sample detector (when RMS not available).
- Ensure that the number of measurement points in the sweep $\geq 2 \times \text{span/RBW}$.
- Sweep time = auto couple.
- Employ trace averaging (RMS) mode over a minimum of 100 traces.
- Use the peak marker function to determine the maximum amplitude level.
- If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat (note that this may require zooming in on the emission of interest and reducing the span in order to meet the minimum measurement point requirement as the RBW is reduced).

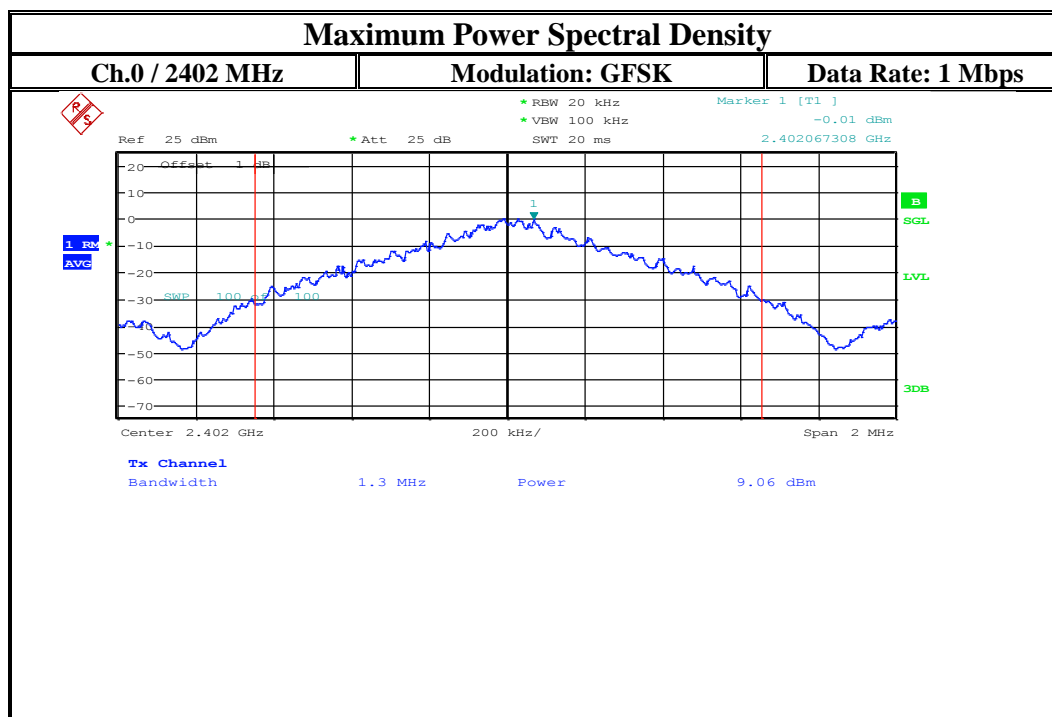
10.2.4 Test Data Results:

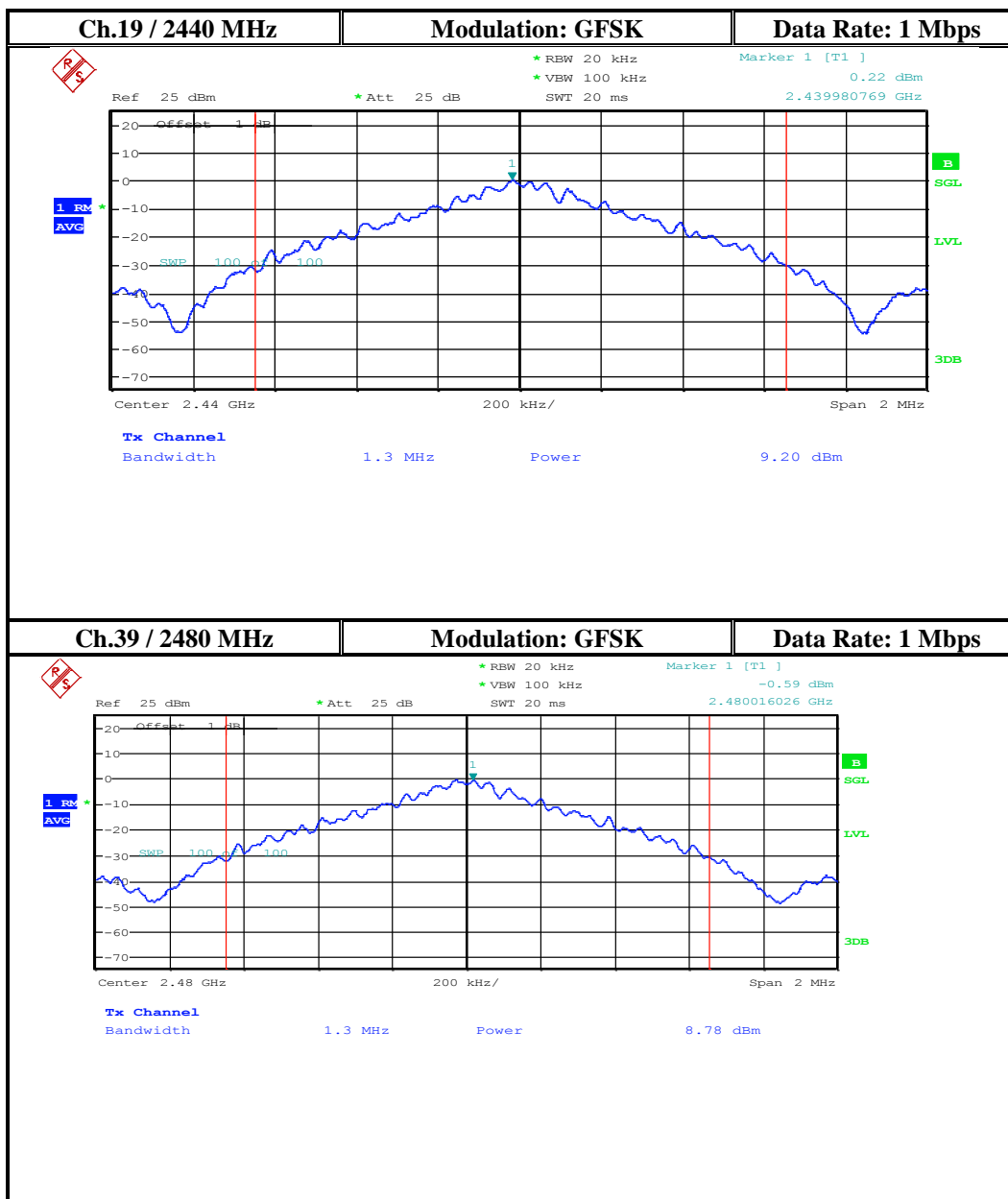
Maximum Power Spectral Density (dBm)			
Limit = 8 dBm in any 3 KHz band	Frequency (MHz)		
	2402 Channel 0	2440 Channel 19	2480 Channel 39
Bluetooth LE	-0.01	0.22	-0.59

10.2.5 Measurement Result

Pass.

10.2.6 Measurement Plots:





10.3 Band Edge Compliance – Unrestricted Band Edges**10.3.1 Limits: § FCC15.247 (d)****FCC15.247 (d)**

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a).

10.3.2 Test Conditions:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
21.5 ° C	2	Tx	Battery

10.3.3 Measurement Procedure:

Conducted Measurement according to FCC KDB 558074 D01 v03r05 section 11.3

For Non Restricted Band Edge measurement

Max measurements are made using a Peak detector and RBW=100 KHz.

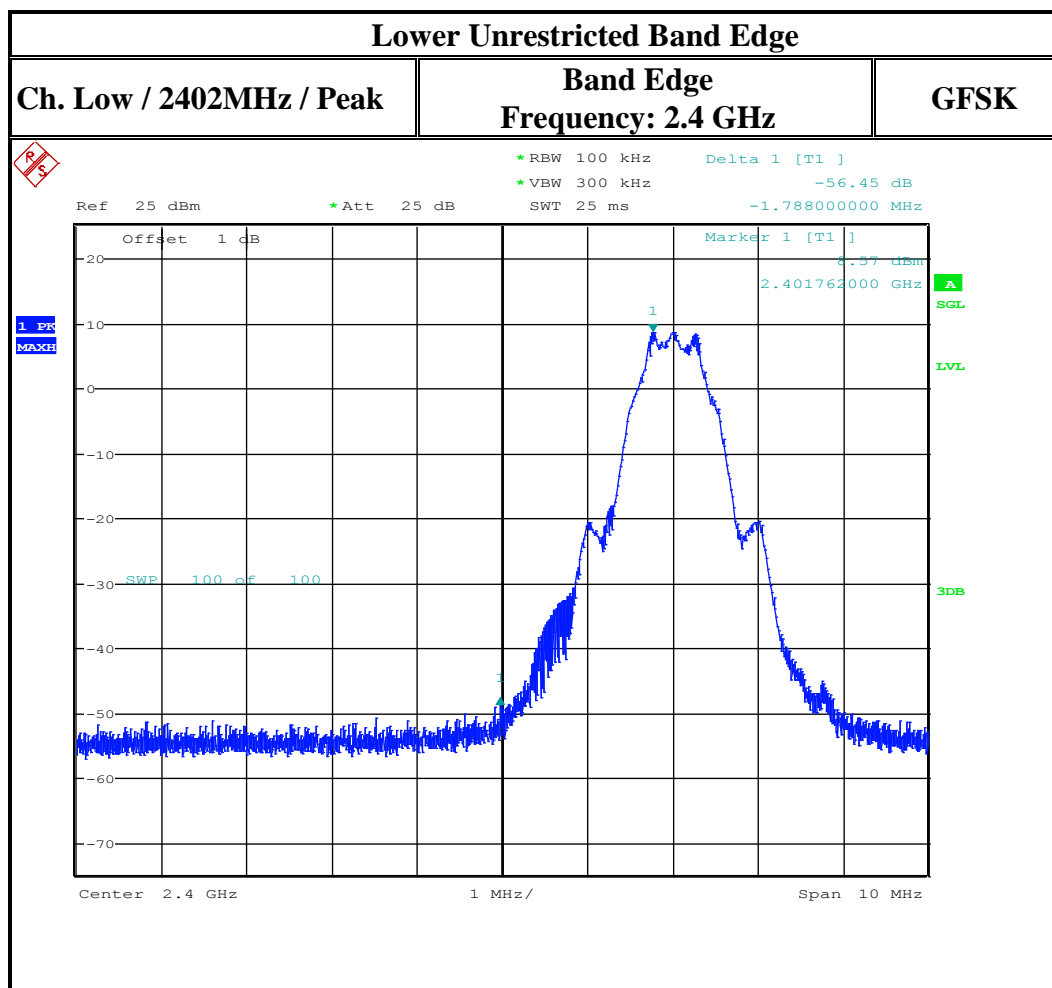
*PEAK LIMIT= 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

10.3.4 Measurement Result

Pass.

Note Peak measurement complies with the Avg limit of -30dBc

10.3.5 Measurement Plots:



10.4 Band Edge Compliance – Restricted Band Edges

10.4.1 Limits: §15.247/15.209/15.205

Only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	(²)
13.36 - 13.41			

§15.205(b)

Except as provided in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in § 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in § 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in § 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in § 15.35 apply to these measurements.

FCC15.247 (d)

Radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a).

At 3 meter distance radiated limits are:

*PEAK LIMIT= 74dB μ V/m

*AVG. LIMIT= 54dB μ V/m

For conducted measurements at the antenna port:

*PEAK LIMIT= -21.2 dBm EIRP

*AVG. LIMIT= -41.2 dBm EIRP

10.4.2 Test Conditions:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
22 ° C	2	Tx	Battery

10.4.3 Measurement Procedure:

Conducted Measurements were performed according to FCC KDB 558074 D01 V03R05 section 12.2, 12.2.4, and 12.2.5.1

Per 12.2.4 Peak power measurement procedure.

Peak emission levels are measured by setting the instrument as follows:

- RBW = as specified in Table 1.
- $VBW \geq 3 \times RBW$.
- Detector = Peak.
- Sweep time = auto.
- Trace mode = max hold.
- Allow sweeps to continue until the trace stabilizes. (Note that the required measurement time may be longer for low duty cycle applications).

Table 1 —RBW as a function of frequency.

Frequency	RBW
9-150 kHz	200-300 Hz
0.15-30 MHz	9-10 kHz
30-1000 MHz	100-120 kHz
> 1000 MHz	1 MHz

If the peak-detected amplitude can be shown to comply with the average limit, then it is not necessary to perform a separate average measurement.

Per 12.2.5.1 Trace averaging with continuous EUT transmission at full power

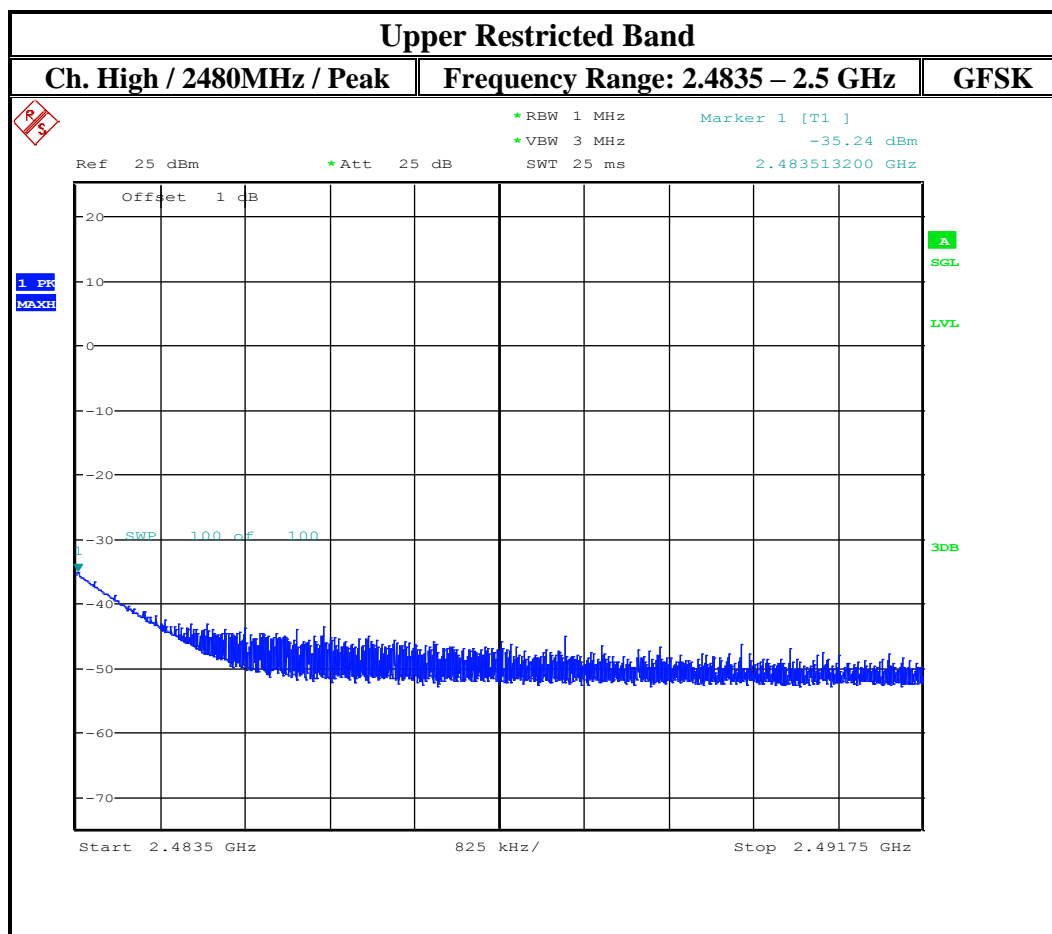
If the EUT can be configured or modified to transmit continuously (duty cycle ≥ 98 percent then the average emission levels shall be measured using the following method (with EUT transmitting continuously).

- RBW = 1 MHz (unless otherwise specified).
- $VBW \geq 3 \times RBW$.
- Detector = RMS, if $\text{span}/(\# \text{ of points in sweep}) \leq (RBW/2)$. Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If this condition cannot be satisfied, then the detector mode shall be set to peak.
- Averaging type = power (i.e., RMS).
 - As an alternative, the detector and averaging type may be set for linear voltage averaging.
 - Some instruments require linear display mode in order to use linear voltage averaging. Log or dB averaging shall not be used.
- Sweep time = auto.
- Perform a trace average of at least 100 traces.

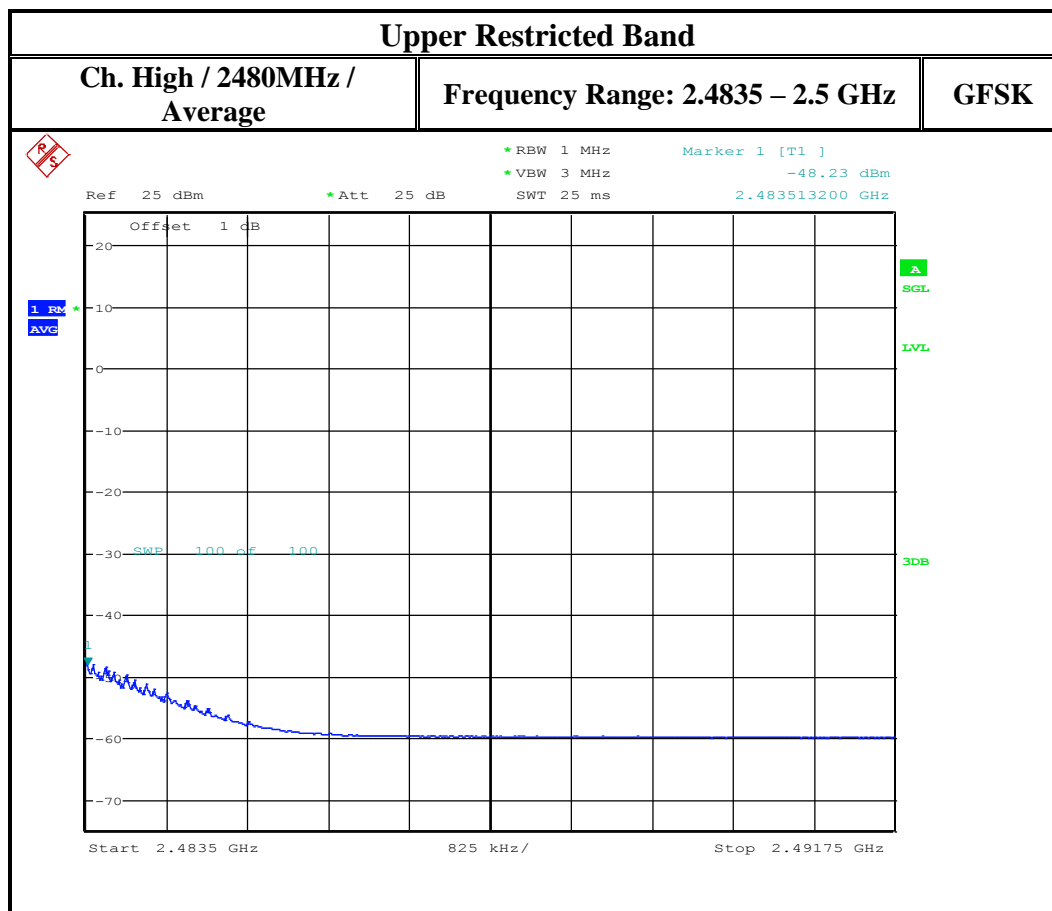
10.4.4 Measurement Result

Plot #	EUT operating mode	Band Edge	Measured value	Corrected by Duty Cycle Correction Factor (dBm)	Corrected by Antenna Gain (dBi)	Limit (dBm)	Result
1	BTLE	Upper restricted average	-48.23	-48.23	-43.23	-41.2 avg	Pass
2	BTLE	Upper restricted peak	-35.24	-35.24	-30.24	-21.2 Peak	Pass

10.4.5 Measurement Plots:



Note: Antenna gain is not in the offset.



Note: Antenna gain is not in the offset.

10.5 Occupied Bandwidth (6dB and 99% Bandwidth)**10.5.1 Limits:****10.5.1.1 §15.247 (a)(2)**

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

10.5.2 Test Conditions:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
21 ° C	2	Tx	Battery

10.5.3 Test Procedure

Measurement according to FCC KDB 558074 D01 v03r05 section 8.1

For 6 dB bandwidth:**Spectrum Analyzer settings:**

Span= Wide enough to capture the entire emission bandwidth

RBW= 100 KHz

VBW≥ 3xRBW

Detector: Peak-

Sweep Time: Auto

Trace = Max Hold

Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the peak level measured in the fundamental emission.

For 99% bandwidth:

Use the occupied bandwidth in the measurement function of the spectrum analyzer with power bandwidth setting at 99%

10.5.4 Test Data Results:

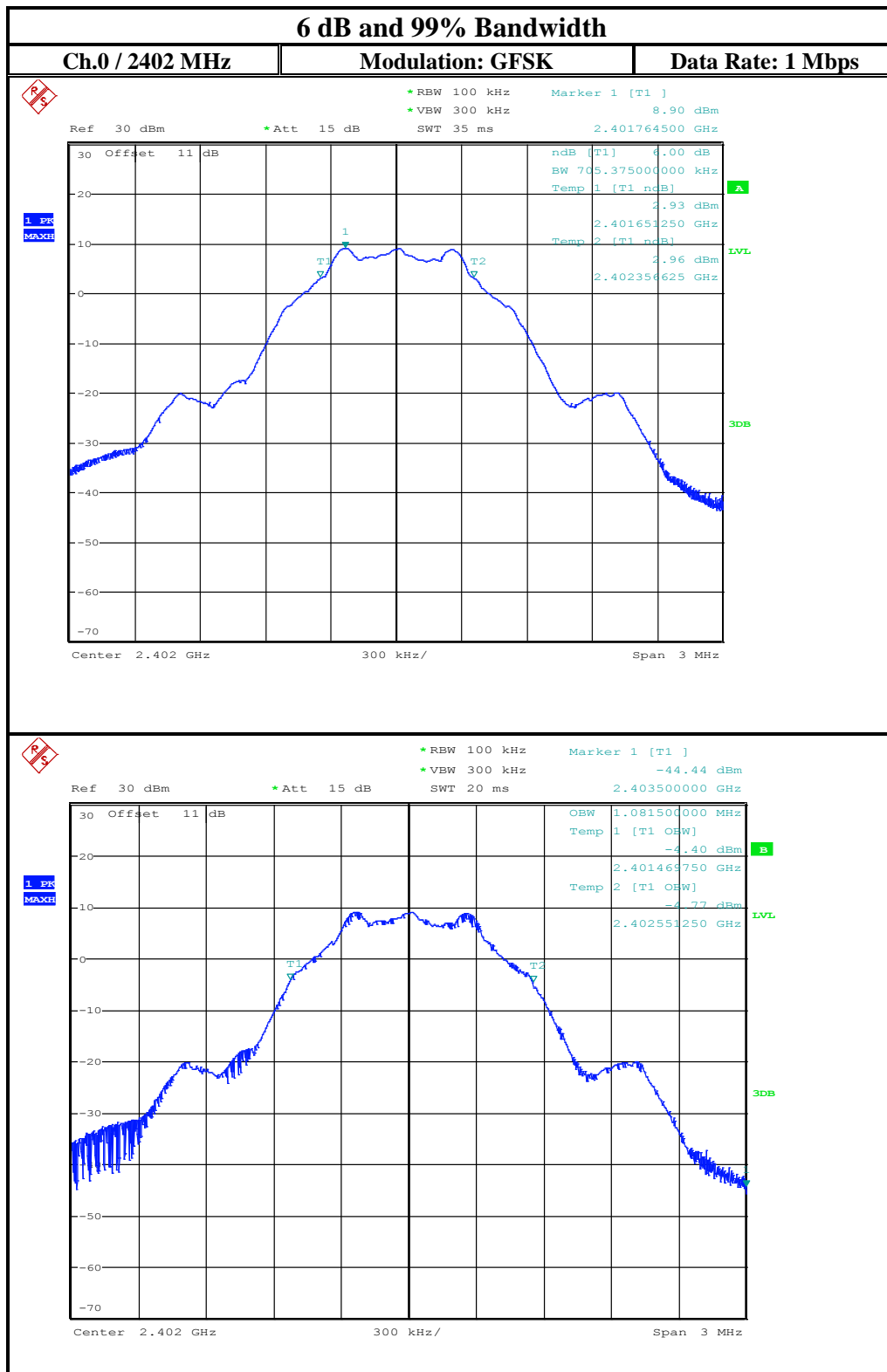
2.4 GHz Band

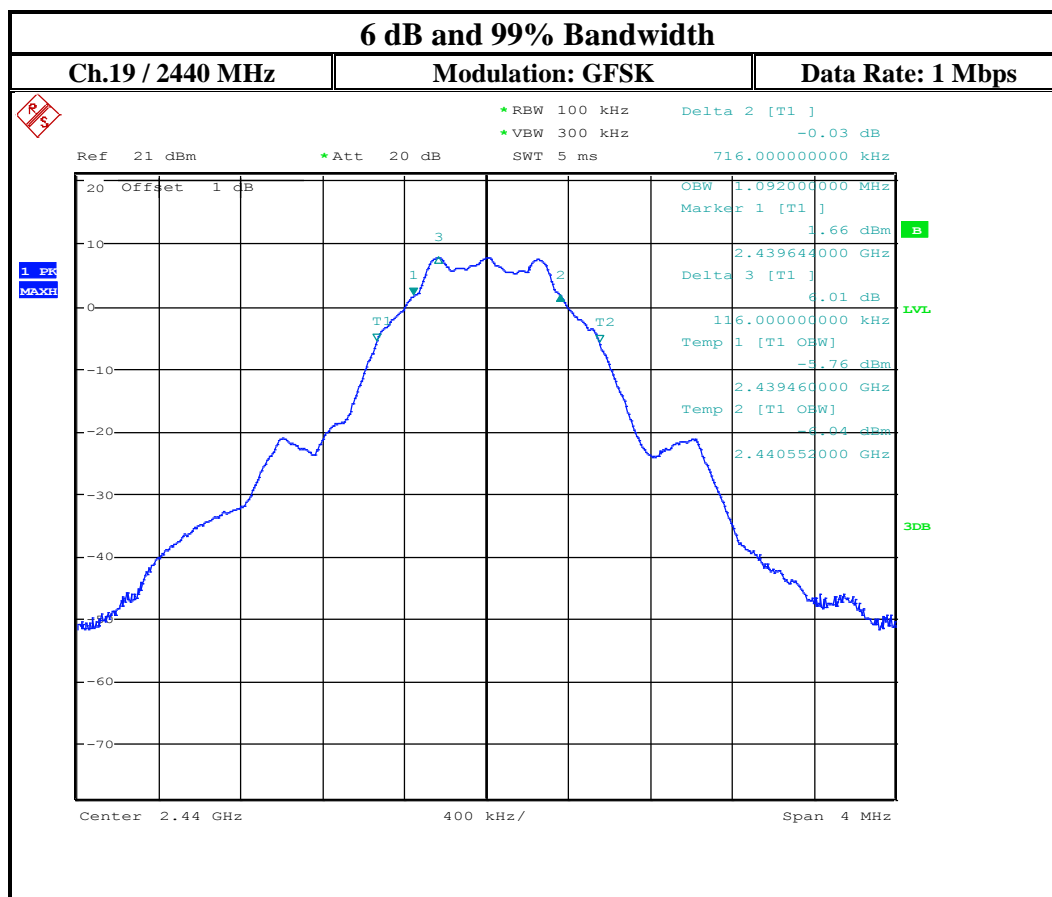
Occupied Bandwidth (MHz)						
Mode	Frequency (MHz)					
	2402 Channel 0		2440 Channel 19		2480 Channel 39	
	6dB (KHz)	99% (MHz)	6dB (KHz)	99% (MHz)	6dB (KHz)	99% (MHz)
Bluetooth LE	705.0	1.082	716	1.092	720	1.088

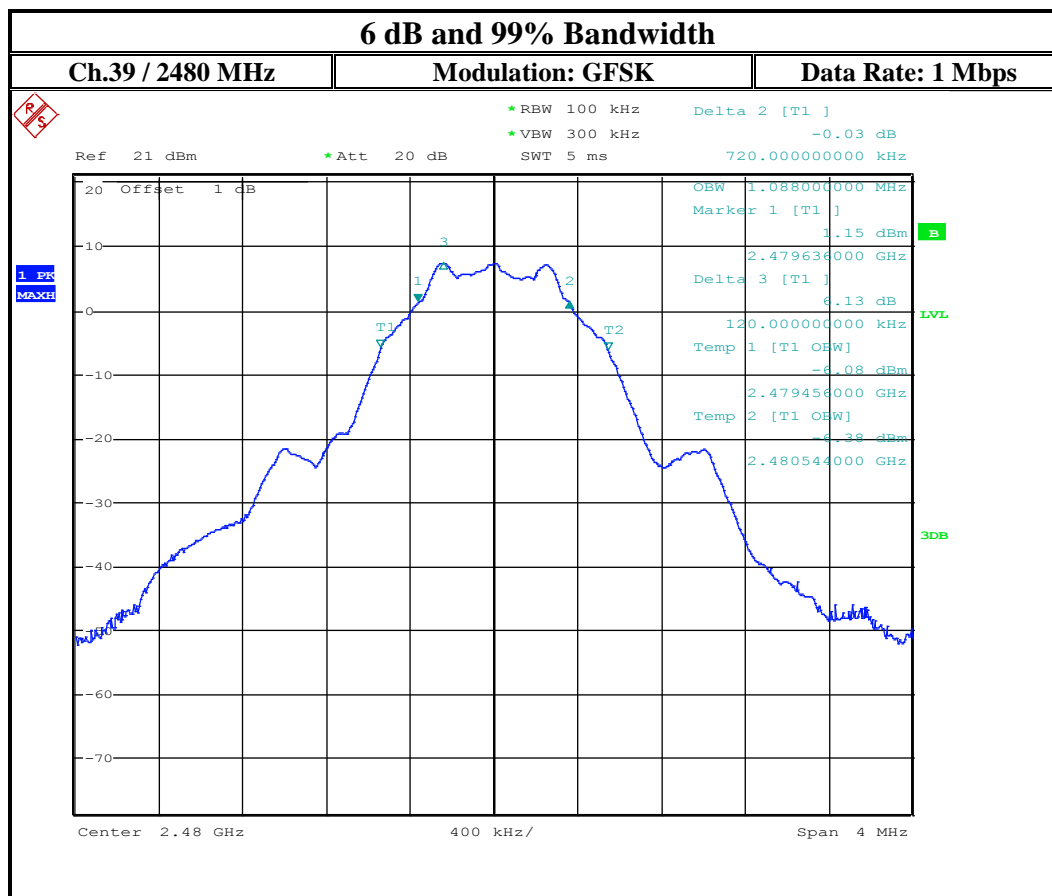
10.5.5 Measurement Result

Pass.

10.5.6 Measurement Plots:







10.6 Radiated Transmitter Spurious Emissions - Restricted Bands

10.6.1 Limits:

§15.247/15.205/15.209 & RSS-Gen 8.9/ 8.10 (restricted bands)

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
¹ 0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	(²)
13.36 - 13.41			

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

*PEAK LIMIT= 74dB μ V/m

*AVG. LIMIT= 54dB μ V/m

Table 1: Field strength limits table above 30 MHz

Frequency of emission (MHz)	Field strength (μ V/m)
30–88	100 (40dB μ V/m)
88–216	150 (43.5 dB μ V/m)
216–960	200 (46 dB μ V/m)
Above 960	500 (54 dB μ V/m)

Table 2: Field strength limits table below 30 MHz

Frequency of emission (MHz)	Field strength ($\mu\text{V/m}$)	Measurement Distance (m)
0.009–0.490	2400/F(kHz)	300
0.490–1.705	24000/F(kHz)	30
1.705–30.0	30	30

Radiated spurious emissions shall be measured for the transmit frequencies, transmit power, and data rate for the lowest, middle and highest channel in each frequency band of operation and for the highest gain antenna for each antenna type, and using the appropriate parameters and test requirements described in 5.4.

The highest (or worst-case) data rate shall be recorded for each measurement.

10.6.2 Test Conditions:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
23 ° C	1	Tx	Battery

10.6.3 Measurement procedure:

Measurement according to:

ANSI C63.10 (2013)

Analyzer Settings:

From 9 KHz – 30 MHz

RBW = 9 KHz

Detector: Peak

From 30 MHz – 1 GHz

Detector = Peak / Quasi-Peak

RBW=120 KHz (<1GHz)

Above 1 GHz

Detector = Peak / Average

RBW= 1MHz

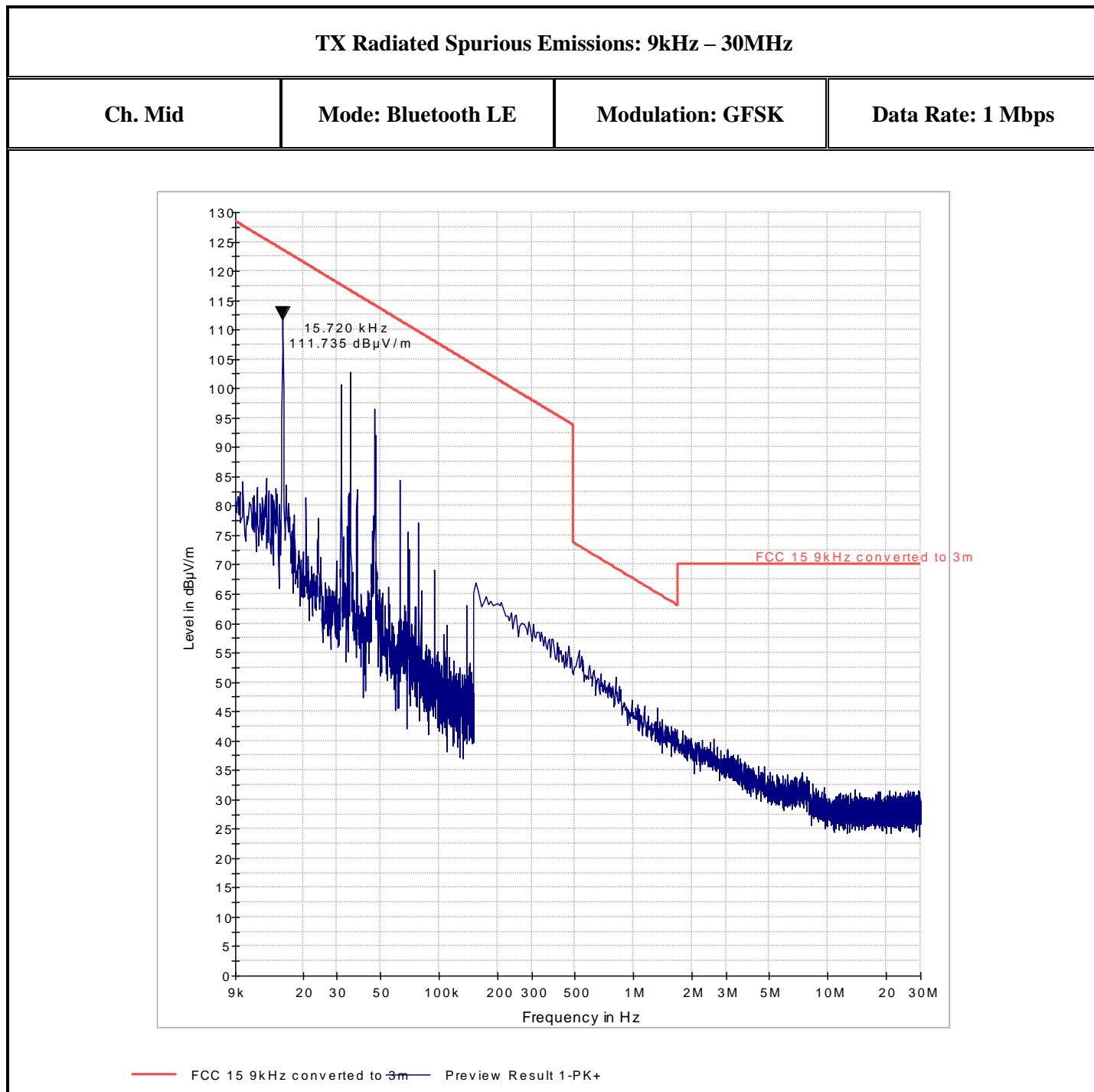
Test mode: *Modulation:* GFSK

Plots in this report represent the worst case emissions for horizontal and vertical antenna polarizations and for orientations of the EUT.

10.6.4 Measurement Result

Pass.

10.6.5 Measurement Plots:



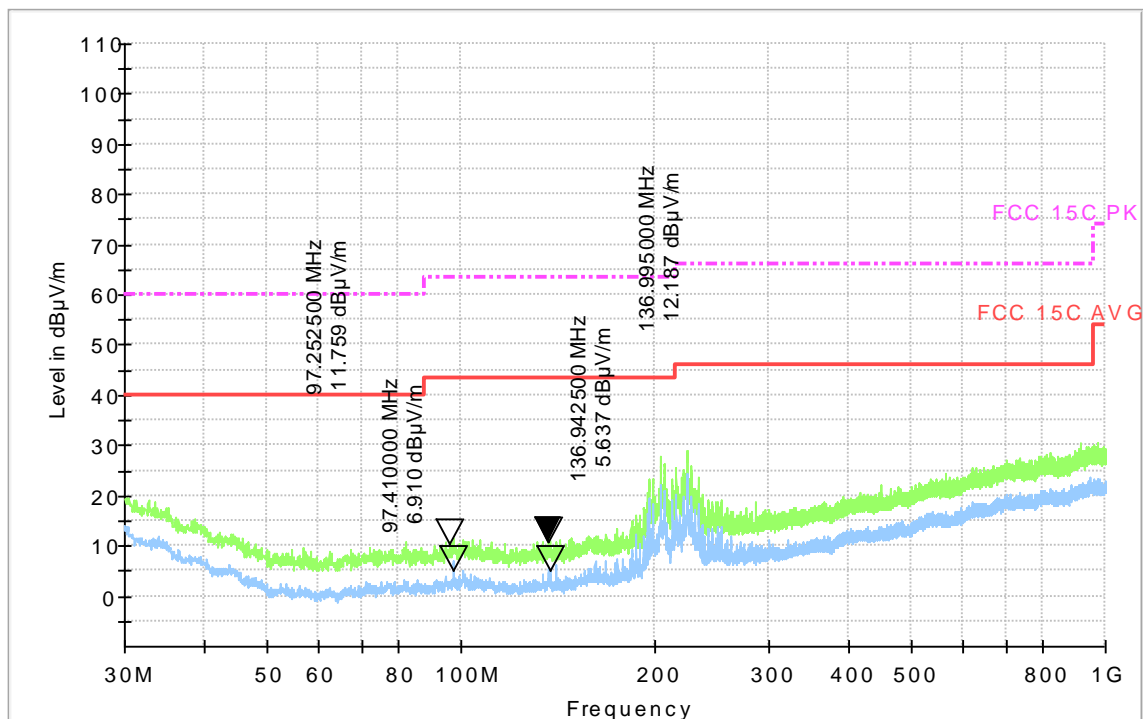
TX Radiated Spurious Emission: 30 MHz – 1GHz

Ch. Low

Mode: Bluetooth LE

Modulation: GFSK

Data Rate: 1 Mbps



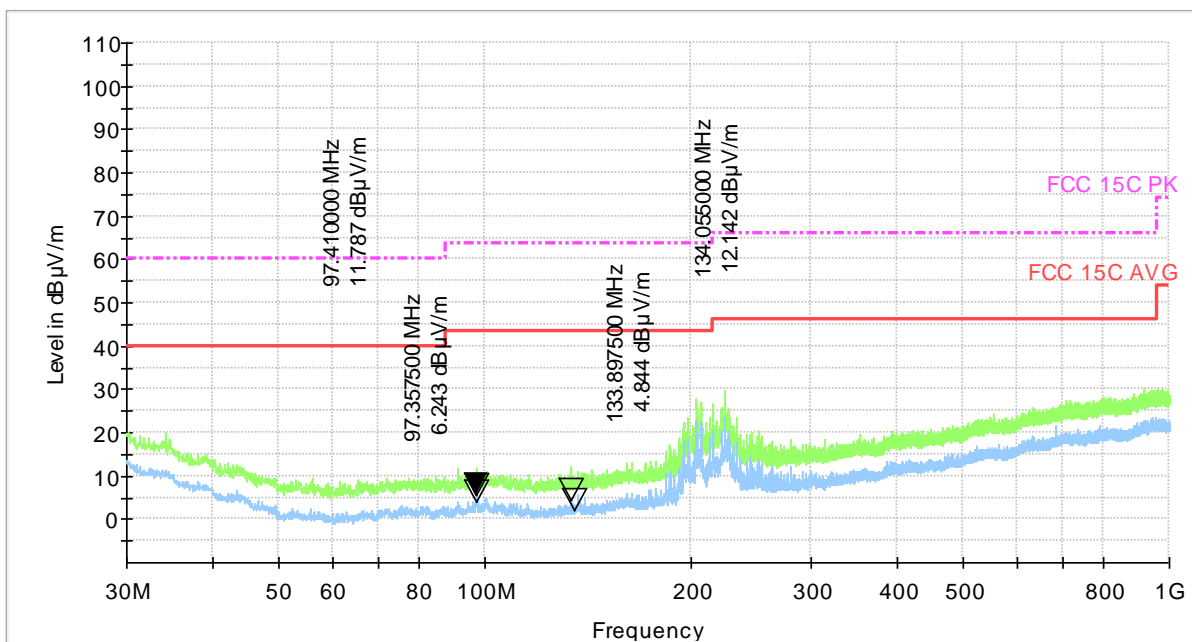
TX Radiated Spurious Emission: 30 MHz – 1GHz

Ch. Mid

Mode: Bluetooth LE

Modulation: GFSK

Data Rate: 1 Mbps



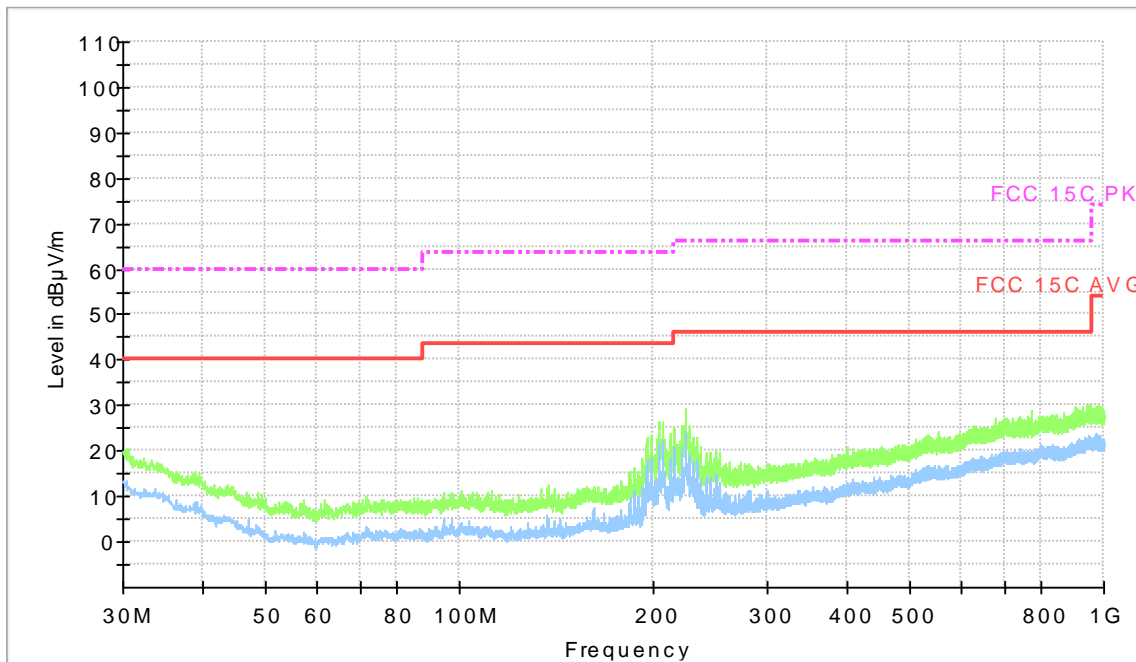
TX Radiated Spurious Emission: 30 MHz – 1GHz

Ch. High

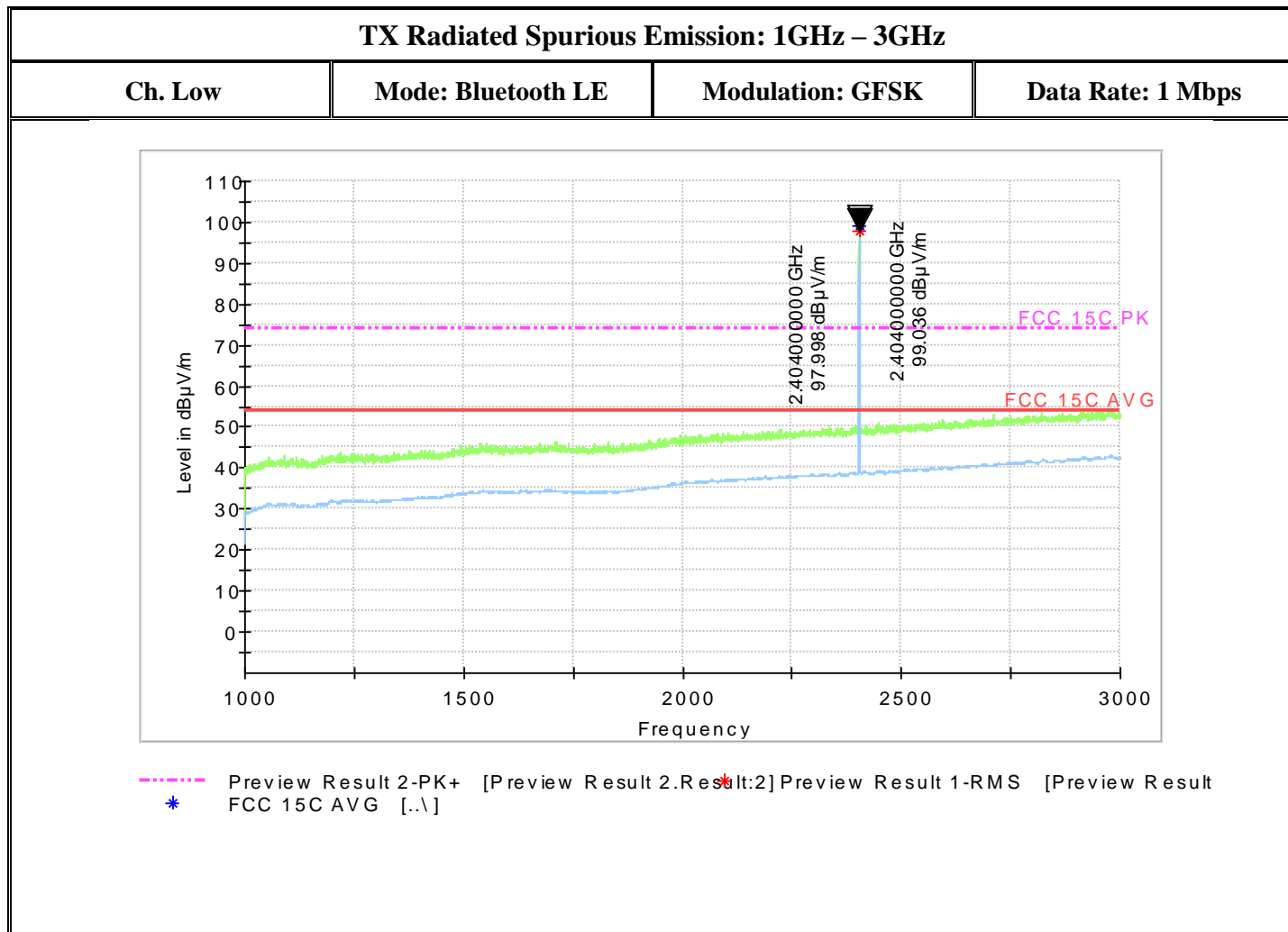
Mode: Bluetooth LE

Modulation: GFSK

Data Rate: 1 Mbps



Preview Result 2-PK+ [Preview Result 2.Result:2] Preview Result 1-RMS [Preview Result
 * FCC 15C AVG [..]



Note: The peak signal above is the Tx Low channel.

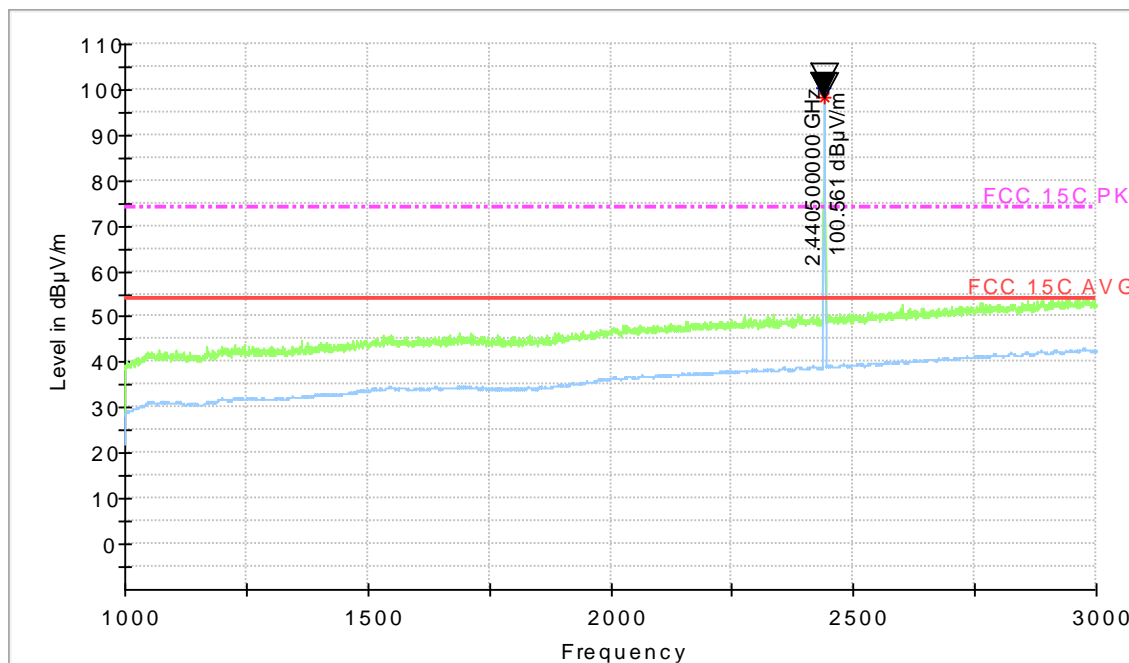
TX Radiated Spurious Emission: 1GHz – 3GHz

Ch. Mid

Mode: Bluetooth LE

Modulation: GFSK

Data Rate: 1 Mbps



----- Preview Result 2-PK+ [Preview Result 2.Result:2] Preview Result 1-RMS [Preview Result
* FCC 15C AVG [.\.]

Note: The peak signal above is the Tx Mid channel.

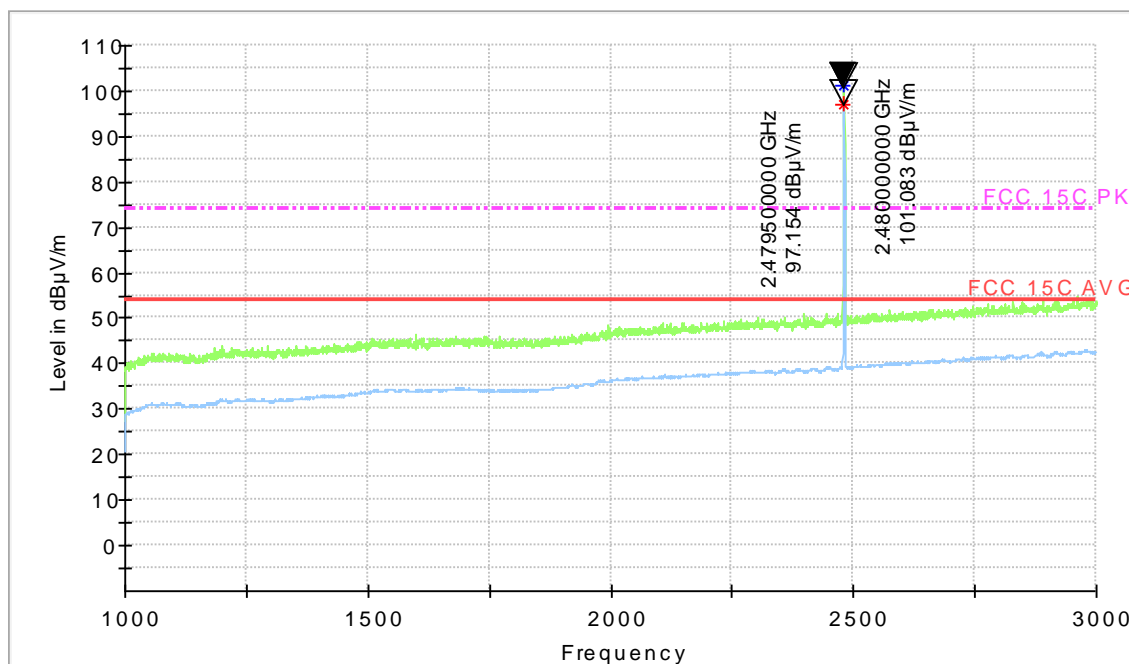
TX Radiated Spurious Emission: 1GHz – 3GHz

Ch. High

Mode: Bluetooth LE

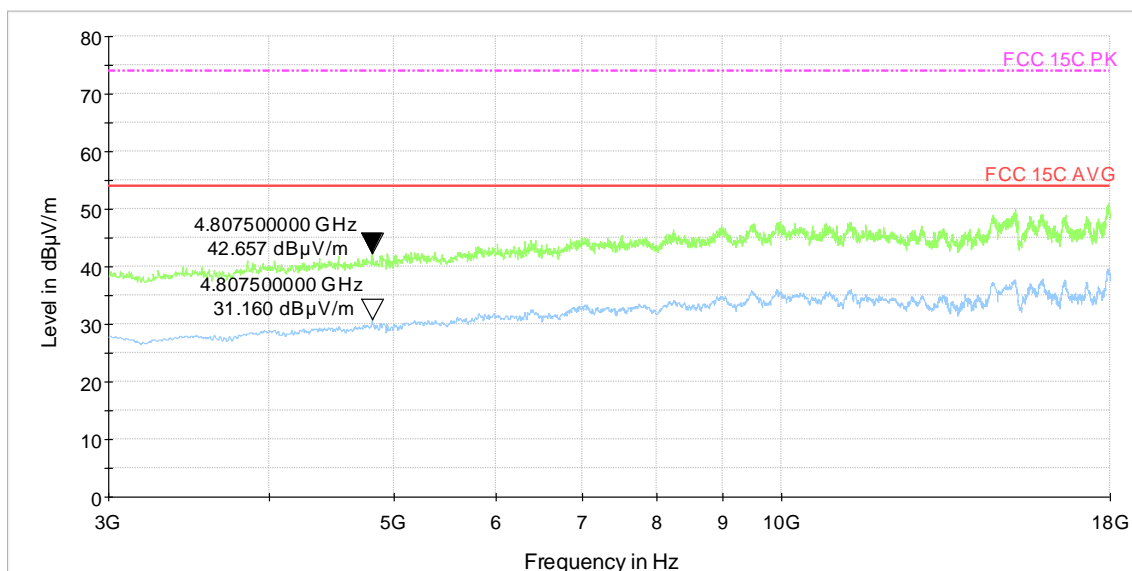
Modulation: GFSK

Data Rate: 1 Mbps



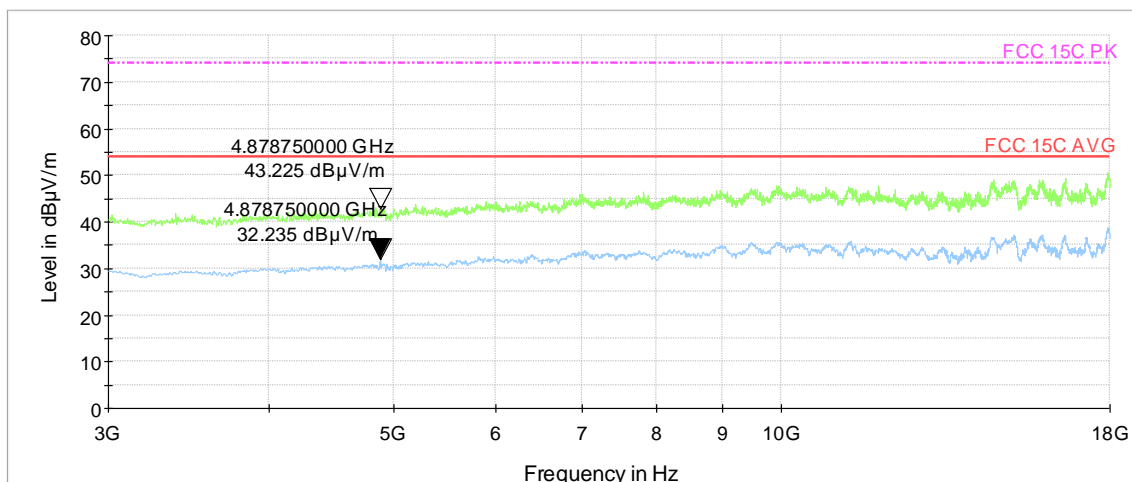
Preview Result 2-PK+ [Preview Result 2.Result:2] Preview Result 1-RMS [Preview Result
 * FCC 15C AVG [..]

Note: The peak signal above is the Tx High channel.

TX Radiated Spurious Emission: 3 GHz – 18 GHz
Ch. Low
Mode: Bluetooth LE
Modulation: GFSK
Data Rate: 1 Mbps

Preview Result 2-PK+
FCC 15C PK

Preview Result 1-RMS
RMS-RMS

FCC 15C AVG
MaxPeak-PK+

TX Radiated Spurious Emission: 3 GHz – 18 GHz
Ch. Mid
Mode: Bluetooth LE
Modulation: GFSK
Data Rate: 1 Mbps

Preview Result 2-PK+
FCC 15C PK

Preview Result 1-RMS
RMS-RMS

FCC 15C AVG
MaxPeak-PK+

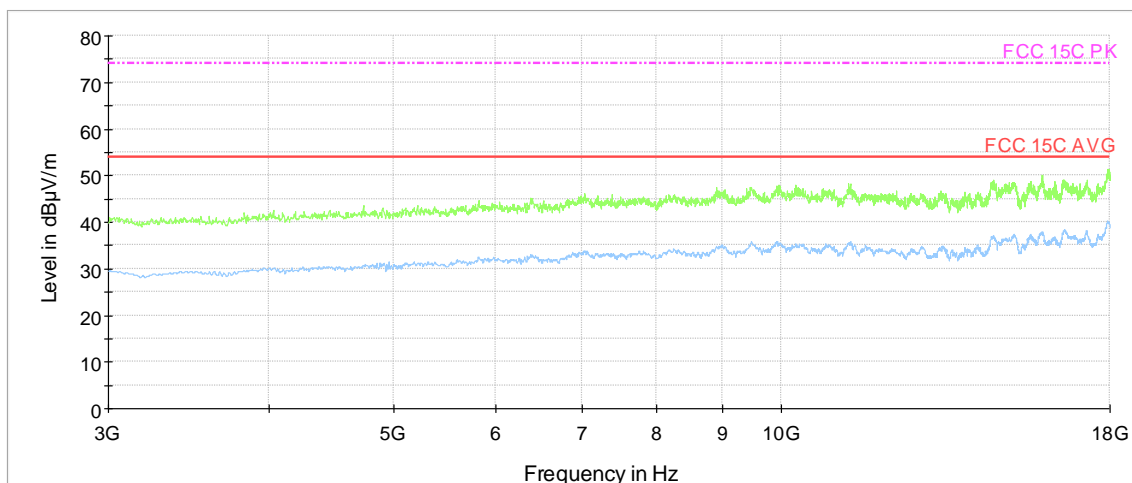
TX Radiated Spurious Emission: 3 GHz – 18 GHz

Ch. High

Mode: Bluetooth LE

Modulation: GFSK

Data Rate: 1 Mbps



Preview Result 2-PK+
FCC 15C PK

Preview Result 1-RMS
RMS-RMS

FCC 15C AVG
MaxPeak-PK+

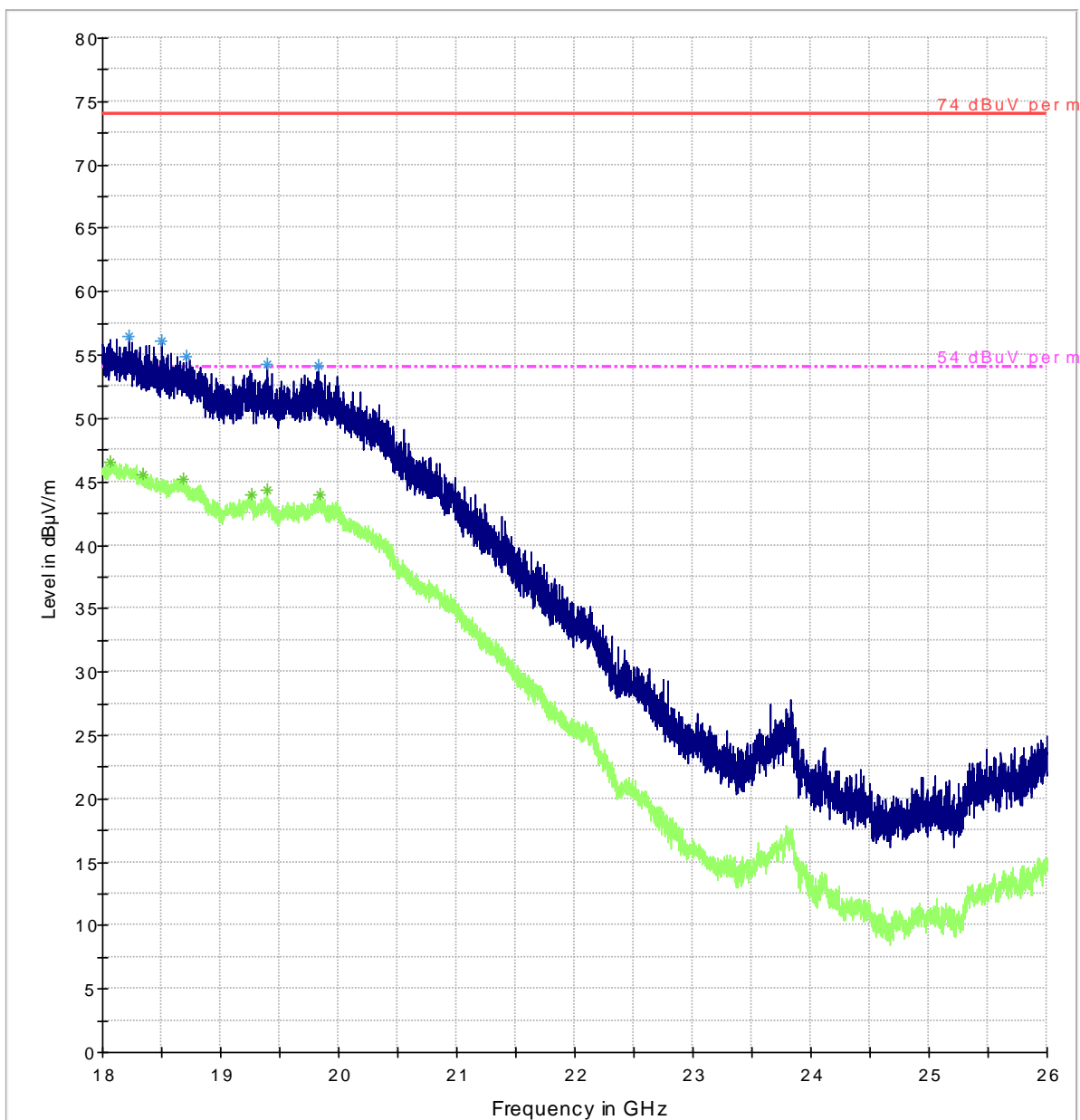
TX Radiated Spurious Emission: 18 GHz -26 GHz

Ch. Mid

Mode: Bluetooth LE

Modulation: GFSK

Data Rate: 1 Mbps



— 74 dBuV per m
— Preview Result 2-RMS

--- 54 dBuV per m
* Data Reduction Result 1 [6]-PK+
* Data Reduction Result 2 [6]-RMS

— Preview Result 1-PK+
* Data Reduction Result 2 [6]-RMS

11 EUT Setup Pictures

Please refer to EMC-PEARL-004-16001-P110-TestSetupPhotos.pdf

12 Test Equipment and Ancillaries used for tests

Item Name	Equipment Type	Manufacturer	Model	Serial #	Calibration Cycle	Last Calibration Date
Turn table	Turn table	EMCO	2075	N/A	N/A	N/A
MAPS Position Controller	Controller	ETS Lindgren	2092	0004-1510	N/A	N/A
Antenna Mast	Antenna Mast	EMCO	2075	N/A	N/A	N/A
High Pass Filter	Filter	5HC2700	Trilithic Inc.	9926013	Part of system calibration	
High Pass Filter	Filter	4HC1600	Trilithic Inc.	9922307	Part of system calibration	
6GHz High Pass Filter	Filter	HPM50106	Microtronics	001	Part of system calibration	
Pre-Amplifier	Amplifier	JS4-00102600	Miteq	00616	Part of system calibration	
Relay Switch Unit	Relay Switch Unit	Rohde&Schwarz	RSU	338964/001	N/A	N/A
Spectrum Analyzer	Analyzer	Rohde&Schwarz	FSU	200302	3 Years	Jun 2013
Antenna Biconilog 3142E	Biconlog Antenna	EMCO	3142E	166067	3 years	6/14/2014
Antenna Loop 6512	Loop Antenna	ETS Lindgren	6512	49838	3 years	3/13/2014
Antenna Horn 3115 SN 35111	Horn Antenna	EMCO	3115	35111	3 years	7/24/2015
Spectrum Analyzer FSU26	Spectrum Analyzer	R&S	FSU26	200065	3 years	7/4/2015
Antenna Horn 3116	Horn Antenna	ETS Lindgren	3116	70497	3 years	7/22/2015
Digital Barometer	Compact Digital Barometer	Control Company	35519-055	91119547	2 Years	4/7/2015
ESU 40	Receiver	R&S	ESU 40	100251	2 years	6/29/2015
Thermometer Humidity TM320	Thermometer Humidity	Dickson	TM320	5283196	1 Year	10/27/2015

Equipment used meets the measurement uncertainty requirements as required per applicable standards for 95% confidence levels.

Calibration due dates, unless defined specifically, falls on the last day of the month.

Items indicated "N/A" for cal status either do not specifically require calibration or is internally characterized before use.

13 Revision History

Date	Report Name	Changes Details	Prepared By
2016-09-30	EMC-PEARL-004-16001-15.247-P110-DTS-BTLE	First Version	James Donnellan