Advanced
Compliance Laboratory

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ELECTROMAGNETIC EMISSION COMPLIANCE REPORT

of

PRODUCT NAME: BLE Module
MODEL: **BLE-M**
FCC ID: ST2-BLEM IC: 6012A-BLEM

March 31, 2017

This report concerns (check one): Original grant __x__ Class II change _____ Equipment type: Low Power Intentional Radiator
Deferred grant requested per 47 CF 0.457(d)(1)(ii)? yes _____ no __x__ If yes, defer until: _____ (date) Company agrees to notify the Commission by _____ (date) of the intended date of announcement of the product so that the grant can be issued on that date.
Transition Rules Request per 15.37? yes _____ no __x__ If no, assumed Part 15, Subpart B for unintentional radiators - the new 47 CFR [10-1-90 Edition] provision.
Report prepared for: Centrak, Inc. Report prepared by: Advanced Compliance Lab Report number: 0048-170221-02

NVLAP®

The test result in this report IS supported and covered by the NVLAP accreditation

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1. GENERAL INFORMATION

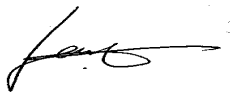
1.1 Verification of Compliance

EUT:	BLE MODULE
Model:	BLE-M
Applicant:	Centrak, Inc.
Standards:	FCC Part 15.249 IC RSS-210 Issue 9/RSS-Gen Issue 4
Result:	PASS
Tested by:	ADVANCED COMPLIANCE LABORATORY
Test Completion Date:	March 31, 2017
Report Number:	0048-170221-02

The above equipment was tested by Compliance Laboratory, Advanced Technologies, Inc. for compliance with the requirement set forth in the FCC & IC rules and regulations. This said equipment in the configuration described in the report, shows the maximum emission levels emanating from equipment are within the compliance requirements.

The estimated uncertainty of the test result is given as following. The method of uncertainty calculation is provided in Advanced Compliance Lab. Doc. No. 0048-01-01.

	Prob. Dist.	Uncertainty(dB)	Uncertainty(dB)	Uncertainty(dB)
		30-1000MHz	1-6.5GHz	Conducted
Combined Std. Uncertainty u_c	norm.	±2.36	±2.99	±1.83



Wei Li
Lab Manager
Advanced Compliance Lab

Date: March 31, 2017

1.2 Equipment Modifications

N/A

1.3 Product Information

System Configuration

ITEM	DESCRIPTION	ID	CABLE
Product	BLE MODULE (1)	FCC ID: ST2-BLEM IC: 6012A-BLEM	
Housing	N/A		
Power Supply	1.8-3.6VDC (2)		
Operation Freq.	2402MHz to 2480MHz		
Max. Channel Number	40		
Channel Separation	2MHz		
Modulation	GFSK (BLE)		

(1) EUT submitted for grant.
(2) provided by external DC source

1.4 Test Methodology

Radiated tests were performed according to the procedures in ANSI C63.10-2013 at an antenna to EUT distance of 3 meters.

1.5 Test Facility

The open area test site and conducted measurement facility used to collect the radiated and conducted data are located at Hillsborough, New Jersey, USA. This site is accepted by FCC to perform measurements under Part 15 or 18 (Registration # 90601) and also designated by IC as " site IC 3130A". The NVLAP Lab code for accreditation of FCC EMC Test Method is: 200101-0.

1.6 Test Equipment

Manufacture	Model	Serial No.	Description	Cal Due dd/mm/yy
Hewlett-Packard	HP8546A	3448A00290	EMI Receiver	25/09/17
Agilent	E4440A	US40420700	3Hz-26.5GHz Spectrum Analyzer	17/06/17
EMCO	3104C	9307-4396	20-300MHz Biconical Antenna	12/11/17
EMCO	3146	9008-2860	200-1000MHz Log-Periodic Antenna	13/11/17
ARA	MWH-1826/B	1013	18-26GHZ Horn Antena	10/2/18
EMCO	3115	49225	Double Ridge Guide Horn Antenna	28/11/17
Electro-Meterics	ALR-25M/30	289	10KHz-30MHz Active Loop Antenna	28/05/17

COM-POWER	L1215A	191994	Line Impedance Stabilization Networks	24/03/18
Fischer Custom	LISN-2	900-4-0009	Line Impedance Stabilization Networks	18/03/18

All Test Equipment Used are Calibrated Traceable to NIST Standards.
Standard Calibration interval: 2 year.

1.7 Statement for the Document Use

This report shall not be reproduced except in full, without the written approval of the laboratory. And this report must not be used by the client to claim product endorsement by NVLAP or any agency of the U.S. & Canada Governments.

2. PRODUCT LABELING

Centrak BLE Module
Model No.: BLE-M

FCC ID: ST2-BLEM IC: 6012A-BLEM

This device complies with part 15 of the FCC & IC RSS-210 & RSS-Gen Rules. Operating is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Figure 2.1 ID Label
(The statement may be shown in its user manual for small size devices)

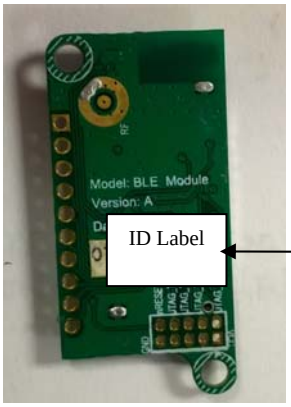


Figure 2.2 Location of Label on EUT

Proposed FCC/IC Label for Hosting Device with BLE-M Module:

Brand Name Product Name & Product Model No.
Contains FCC ID: ST2-BLEM IC: 6012A-BLEM

This device complies with FCC Part 15C & IC RSS-210 Rules. Operating is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

3. SYSTEM TEST CONFIGURATION

3.1 Justification

The product was configured for testing in a typical fashion (as a customer would normally use it). EUT was properly orientated for being tested in the correct plane. Its antenna is permanently connected to PCB.

Antenna Spec: Dipole SMT 0dBi Max

Testing was performed as EUT was continuously operated with modulation at the following frequency channels:
Low=2402MHz, Middle= 2440MHz, High=2480MHz.

EUT was powered by external DC source for final data collection although this module will be only installed in battery powered hosting devices (per applicant's design spec.).

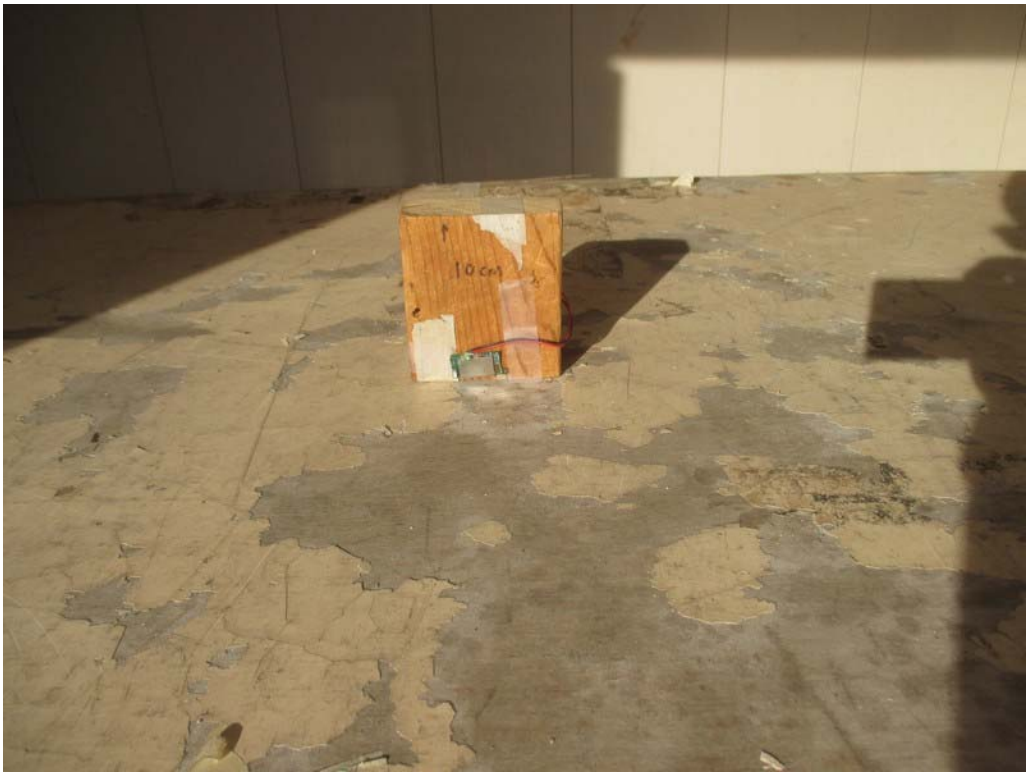
3.2 Special Accessories

N/A

3.3 Configuration of Tested System

Figure 3.x illustrate this system, which is tested standing along.

Orientation (X)



Orientation (Y)

Orientation (Z)

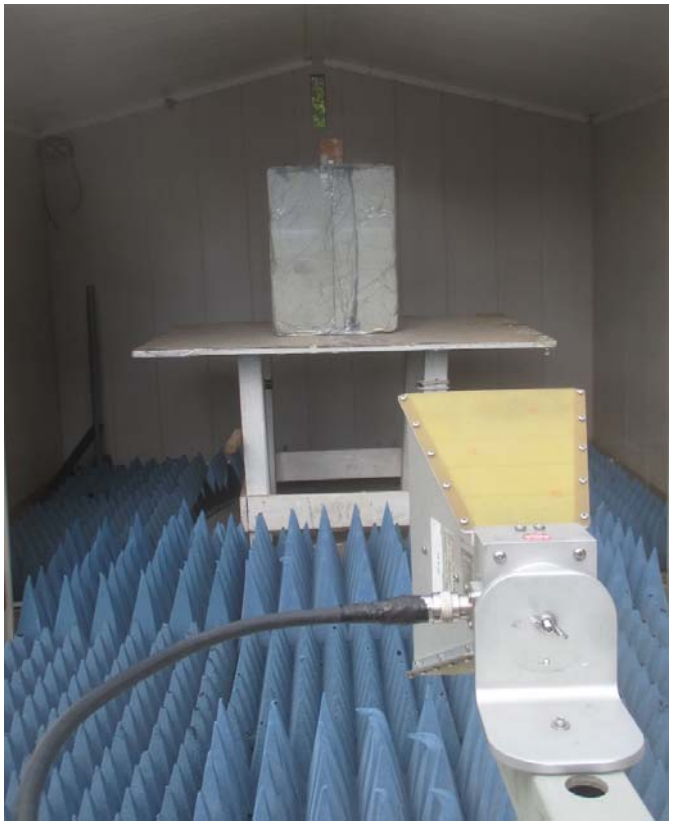


Figure 3.1 Radiated Test Setup

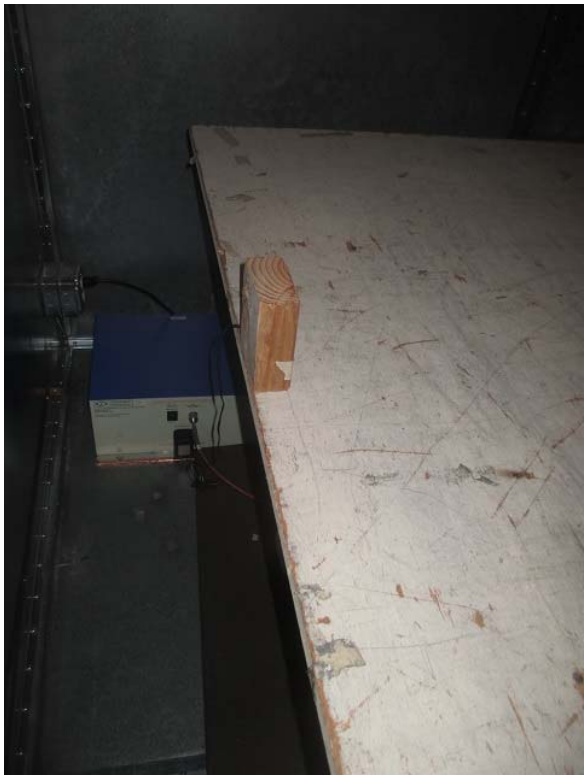


Figure 3.2 Conducted Test Setup

4. SYSTEM SCHEMATICS

See Attachment.

Figure 4.1 System Schematics

5. CONDUCTED EMISSION DATA

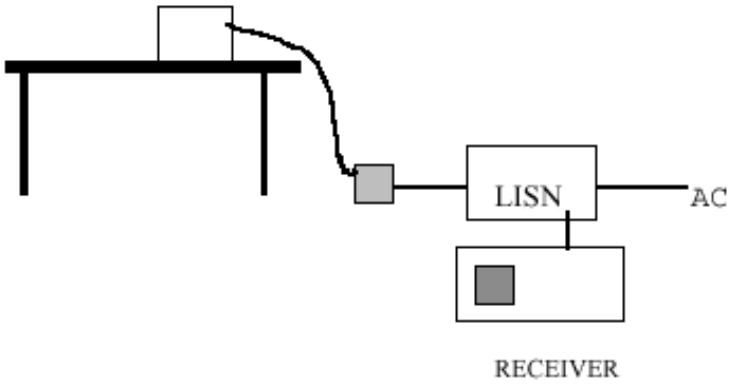
5.1 Test Methods and Conditions

The EUT was under normal operational mode during the conducted emission test. EMI Receiver was scanned from 150KHz to 30MHz with maximum hold mode for maximum emission. Recorded data was sent to the plotter to generate output in linear format. At the input of the spectrum analyzer, a HP transient limiter is inserted for protective purpose. This limiter has a 10 dB attenuation in the range of 150KHZ to 30MHZ. That factor was automatically compensated by the receiver, so the readings are the corrected readings. The reference of the plot is the CISPR 22 Class B limit in Figure 5.1 through Figure 5.2.

Conducted Emission Technical Requirements				
	Class A		Class B	
Frequency Range	Quasi-Peak dBuV	Average dBuV	Quasi-Peak DBuV	Average dBuV
150kHz –0.5MHz	79 (8912uV)	66 (1995uV)	66-56	56-46
0.5MHz-30MHz	73 (4467uV)	60 (1000uV)	---	---
0.5MHz- 5MHz	---	---	56	46 (250uV)
5MHz-30MHz	---	---	60	50

Emissions that have peak values close to the specification limit (if any) are also measured in the quasi-peak mode to determine compliance.

5.2 Measurement Instrument Configuration for Conducted Emission



5.3 Testing Data

The following plots show the neutral and line conducted emissions for the typical operation condition. The conducted test data shows the worst case emissions still below the FCC Part 15/CISPR22 Class B limits.

Optional ac/dc adaptor (providing 3V DC power) was used .

Highest Data for AC Line Conducted Emissions

AC Main	**Line**				**Neutral**			
Frequency (MHz)	0.520	0.680	3.960	23.810	0.170	0.540	0.610	23.480
Peak/QP Reading (dBuV)	13.58	13.72	13.31	13.99	13.84	12.89	13.84	13.32
Class B QP limit	56	56	56	60	65.42	56	56	60
Average Reading (dBuV)*								
Class B Average Limit	46	46	46	50	55.42	46	46	50
Complied	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

* peak reading is well below the QP & AVG limit.

Test Personnel:

Tester Signature: David Tu

Typed/Printed Name: David Tu

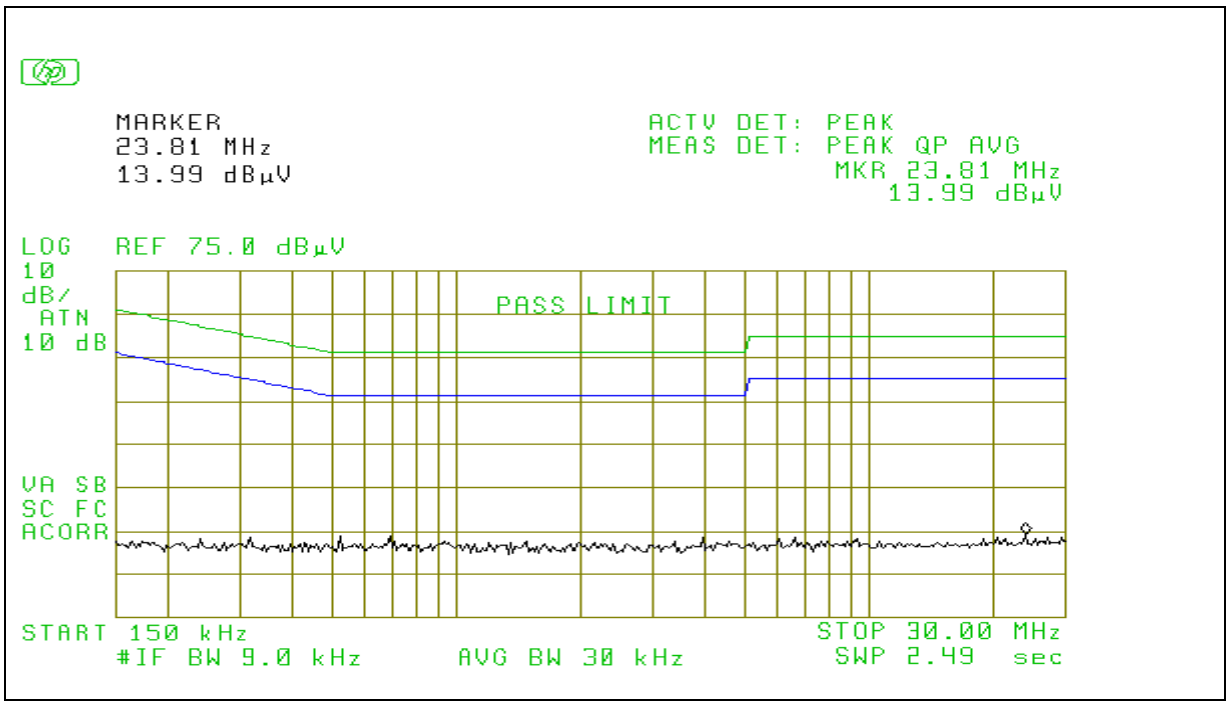


Figure 5.1 Line Conducted Emission

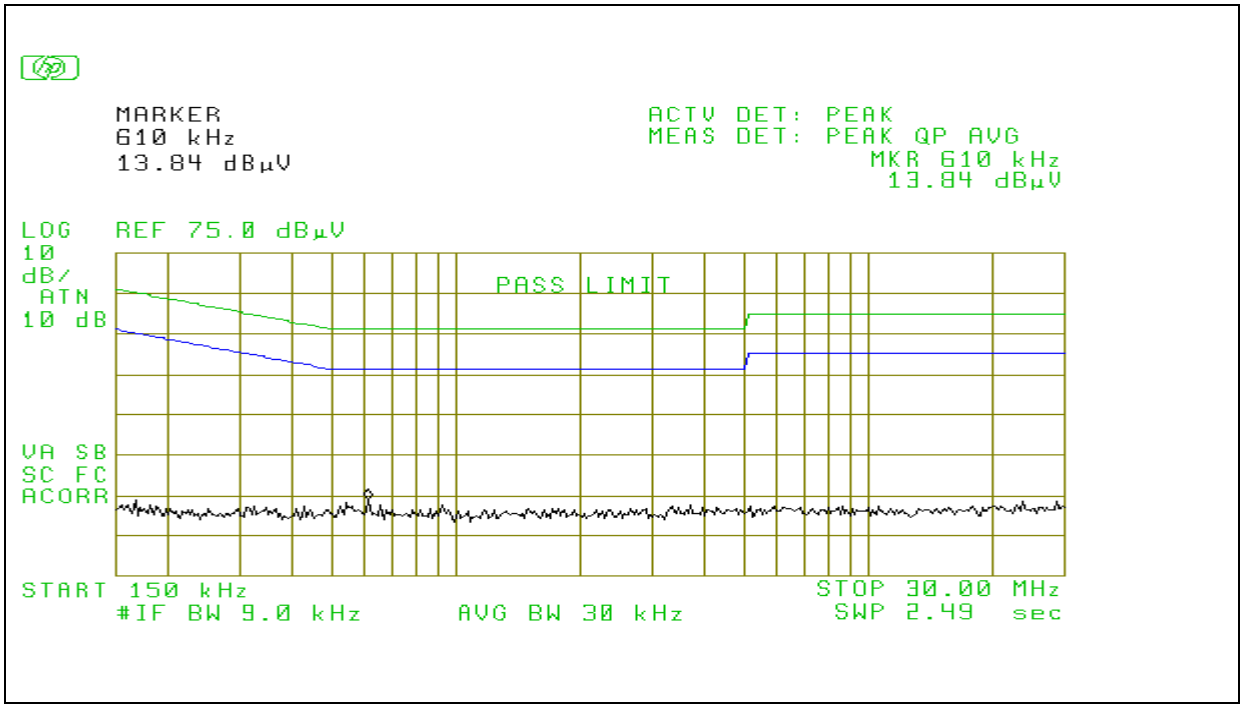


Figure 5.2 Neutral Conducted Emission

6. RADIATED EMISSION DATA

6.1 Field Strength Calculation

The corrected field strength is automatically calculated by EMI Receiver using following:

$$FS = RA + AF + CF + AG$$

where FS: Corrected Field Strength in dBμV/m
RA: Amplitude of EMI Receiver before correction in dBμV
AF: Antenna Factor in dB/m
CF: Cable Attenuation Factor in dB
AG: Built-in Preamplifier Gain in dB (Stored in receiver as part of the calibration data)

6.2 Test Methods and Conditions

The initial step in collecting radiated data is a EMI Receiver scan of the measurement range below 30MHz using peak detector and 9KHz IF bandwidth / 30KHz video bandwidth. For the range under 1GHz, 120KHz IF bandwidth / 120KHz video bandwidth are used. Both bandwidths are 1MHz for above 1GHz measurement. The frequency range from the lowest clock frequency in EUT circuitry to 10^{th} harmonics were investigated.

6.3 Test Data

The following data lists the significant emission frequencies, polarity and position, peak reading of the EMI Receiver, the FCC limit, and the difference between the peak reading and the limit. Explanation of the correction and calculation are given in section 6.1.

Test Personnel: 

Typed/Printed Name: Edward Lee Date: March 31, 2017

Radiated Test Data for Fundamental and Harmonics per 15.249/RSS-210 (CH-2402MHz/2440MHz/2480MHz)

Low Channel: 2402MHz

Freq.(4) (MHz)	Worst H/V, Z(1)	Height. (m)	Azimuth	Peak@3m (2) (dBuV/m)	QP/Avg @3m (dBuV/m)	PK Lim (3)(dB uV/m)	QP /Avg. Lim (1) (dBuV/m)	PK Mar (dBuV/ m)	QP /Avg.Mar. (dBuV/m)
2402	HX	1.1	000	93.8	91.1	114	94	-20.2	-2.9
4804	HX	1.1	090	48.6	42.5	74	54	-25.4	-11.5
7206	HX	1.0	330	50.6	40.4	74	54	-23.4	-13.6
2402	VX	1.1	270	89.3	86.5	114	94	-24.7	-7.5
4804	VX	1.1	330	51.9	47.8	74	54	-22.1	-6.2
7206	VX	1.0	000	50.6	40.4	74	54	-23.4	-13.6
2402	**HY**	**1.1**	**000**	**94.5**	**91.7**	**114**	**94**	**-19.5**	**-2.3**
4804	HY	1.1	090	48.7	41.7	74	54	-25.3	-12.3
7206	HY	1.0	090	49.6	40.2	74	54	-24.4	-13.8
2402	VY	1.1	090	90.1	87.5	114	94	-23.9	-6.5
4804	**VY**	**1.1**	**180**	**53.8**	**49.2**	**74**	**54**	**-20.2**	**-4.8**
7206	VY	1.0	180	51.3	42.3	74	54	-22.7	-11.7
2402	HZ	1.1	000	90.2	87.7	114	94	-23.8	-6.3
4804	HZ	1.1	180	53.7	49.0	74	54	-20.3	-5
7206	HZ	1.0	180	50.1	40.9	74	54	-23.9	-13.1
2402	VZ	1.1	090	93.7	91.0	114	94	-20.3	-3
4804	VZ	1.1	270	51.7	45.9	74	54	-22.3	-8.1
7206	VZ	1.0	160	50.7	40.8	74	54	-23.3	-13.2

Middle Channel: 2440MHz

Freq.(4) (MHz)	Worst H/V, Z(1)	Height. (m)	Azimuth	Peak@3m (2) (dBuV/m)	QP/Avg @3m (dBuV/m)	PK Lim (3)(dB uV/m)	QP /Avg. Lim (1) (dBuV/m)	PK Mar (dBuV/ m)	QP /Avg.Mar. (dBuV/m)
2440	HX	1.1	000	93.0	90.2	114	94	-21	-3.8
4880	HX	1.1	000	50.7	45.3	74	54	-23.3	-8.7
7320	HX	1.0	270	50.1	40.7	74	54	-23.9	-13.3
2440	VX	1.1	270	88.4	85.7	114	94	-25.6	-8.3
4880	VX	1.1	000	48.4	43.8	74	54	-25.6	-10.2
7320	VX	1.0	160	51.5	41.0	74	54	-22.5	-13
2440	HY	1.1	000	93.2	90.8	114	94	-20.8	-3.2
4880	HY	1.1	180	46.0	41.1	74	54	-28	-12.9
7320	HY	1.0	090	49.8	40.1	74	54	-24.2	-13.9
2440	VY	1.1	090	87.8	85.0	114	94	-26.2	-9
4880	VY	1.1	180	50.1	45.4	74	54	-23.9	-8.6
7320	VY	1.0	180	51.9	41.8	74	54	-22.1	-12.2
2440	HZ	1.1	000	89.8	87.4	114	94	-24.2	-6.6
4880	HZ	1.1	000	52.9	48.2	74	54	-21.1	-5.8
7320	HZ	1.0	000	51.0	41.3	74	54	-23	-12.7
2440	VZ	1.1	090	92.8	89.9	114	94	-21.2	-4.1
4880	VZ	1.1	090	49.2	44.3	74	54	-24.8	-9.7
7320	VZ	1.0	180	50.5	40.9	74	54	-23.5	-13.1

High Channel: 2480MHz

Freq.(4) (MHz)	Worst H/V, Z(1)	Height. (m)	Azimuth	Peak@3m (2) (dBuV/m)	QP/Avg @3m (dBuV/m)	PK Lim (3)(dB uV/m)	QP /Avg. Lim (1) (dBuV/m)	PK Mar (dBuV/ m)	QP /Avg.Mar. (dBuV/m)
2480	HX	1.1	180	92.6	89.9	114	94	-21.4	-4.1
4960	HX	1.1	330	52.3	47.6	74	54	-21.7	-6.4
7440	HX	1.0	160	50.2	40.3	74	54	-23.8	-13.7
2480	VX	1.1	090	87.6	84.8	114	94	-26.4	-9.2
4960	VX	1.1	330	51.4	45.7	74	54	-22.6	-8.3
7440	VX	1.0	180	51.5	42.4	74	54	-22.5	-11.6
2480	HY	1.1	180	93.0	90.4	114	94	-21	-3.6
4960	HY	1.1	180	51.4	43.5	74	54	-22.6	-10.5
7440	HY	1.0	180	50.6	40.4	74	54	-23.4	-13.6
2480	VY	1.1	180	89.4	86.7	114	94	-24.6	-7.3
4960	VY	1.1	000	51.9	43.8	74	54	-22.1	-10.2
7440	VY	1.0	180	50.3	44.3	74	54	-23.7	-9.7
2480	HZ	1.1	180	88.6	86.0	114	94	-25.4	-8
4960	HZ	1.1	000	52.0	48.3	74	54	-22	-5.7
7440	HZ	1.0	135	50.5	41.8	74	54	-23.5	-12.2
2480	VZ	1.1	090	91.4	88.9	114	94	-22.6	-5.1
4960	VZ	1.1	045	51.5	47.1	74	54	-22.5	-6.9
7440	VZ	1.0	045	50.0	41.3	74	54	-24	-12.7

(1) The limit for emissions within the 2400-2483.5MHz band is 50mV(94dB) per FCC Sec. 15.249 & IC RSS-210 Issue 9, Annex B.10. The limit for its harmonics is 500uV (54dB). Other spurious emissions shall be lower than either its fundamental by 50dB or the limit defined in Sec. 15.209, whichever is higher.
(2) If the peak reading is less than the FCC/IC quasi-peak or average limit, it'll be not necessary to show the measured/ calculated quasi-peak or average reading.
(3) For above 1GHz range, peak reading shall meet the limit: average Limit+20dB.
(4)Comparing to the limit defined in FCC Sec. 15.249, emissions average reading below the limit by 20dB were not recorded.

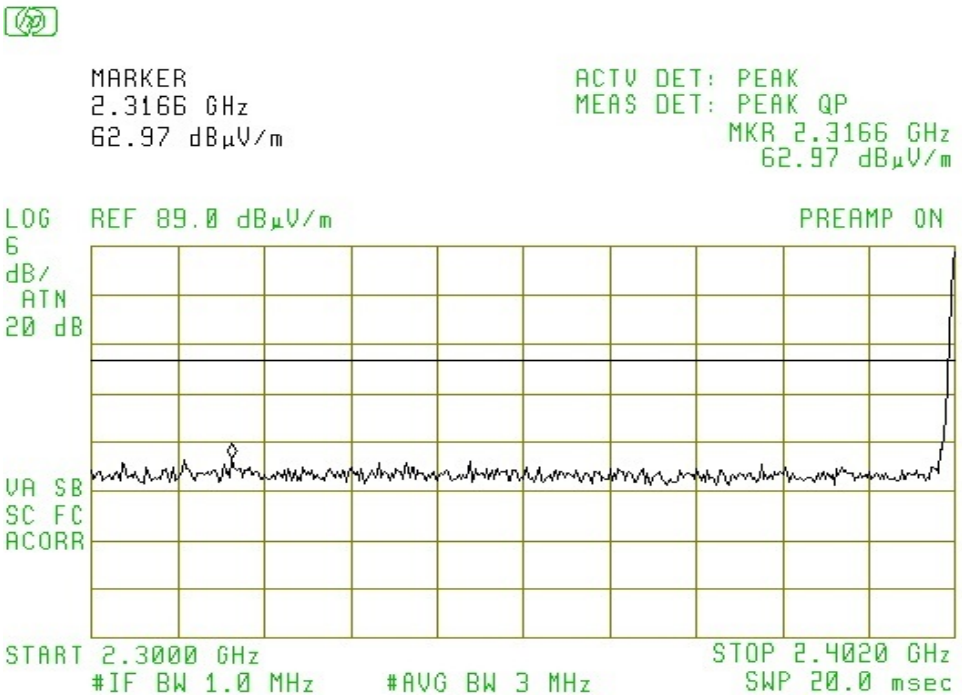
Other Spurious (non-harmonics) outside of 2400-2483.5MHz band per 15.209 & RSS-Gen

(Transmitting & Receiving Modes)***

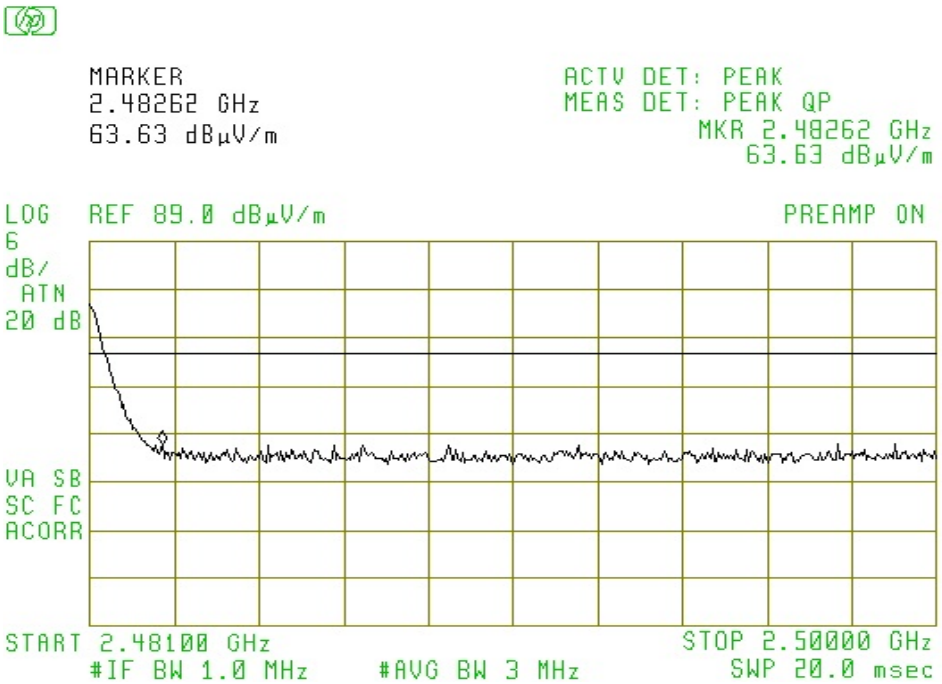
Frequency (MHz)	Polarity (V,H) Position (Z)	Antenna Height (m)	Azimuth (Degree)	Peak Reading at 3m * (dBuV/m)	QP/Average Reading (dBuV/m)	FCC 3m Limit ** (dBuV/m)	Difference (dBuV/m)
54.1	H	1.8	045	34.5		40.0	-5.5
58.5	H	1.8	090	34.7		40.0	-5.3
112.0	H	1.8	090	35.3		43.5	-8.2
384	H	1.1	180	35.3		46.5	-11.2
700	H	1.0	135	39.1		46.5	-7.4
914	H	1.0	120	43.5		46.5	-3.0
954	H	1.0	180	42.6		46.5	-3.9
1130	H	1.1	180	43.5		54.0	-10.5
1606	H	1.1	160	49.2		54.0	-4.8
1920	H	1.1	235	50.7		54.0	-3.3
1956	H	1.1	235	50.9		54.0	-3.1
40.2	V	1.2	000	32.7		40.0	-7.3
48.3	V	1.2	000	36.0		40.0	-4.0
115.0	V	1.1	235	35.2		43.5	-8.3
120.0	V	1.1	235	36.1		43.5	-7.4
150.0	V	1.1	135	40.4		43.5	-3.1
680	V	1.1	180	39.3		46.5	-7.2
700	V	1.1	160	39.1		46.5	-7.4
880	V	1.1	235	41.5		46.5	-5.0
920	V	1.1	160	41.8		46.5	-4.7
1256	V	1.1	090	47.9		54/0	-6.1
1640	V	1.1	045	48.1		54.0	-5.9
1893	V	1.1	180	50.3		54.0	-3.7
2204	V	1.1	180	51.6		54.0	-2.4

* If the peak reading is less than the FCC/IC quasi-peak or average limit, it'll be not necessary to show the measured/ calculated quasi-peak or average reading.
**Comparing to the limit defined in FCC Sec. 15.209& RSS-Gen, emissions below the limit by 20dB were not recorded.
*** Per prescan results, non-harmonics spurious with Transmitting mode are higher than those with receiving mode and they are chosen for final data record.

2400 Band Band-edge Spurious (20dB attenuation setting)

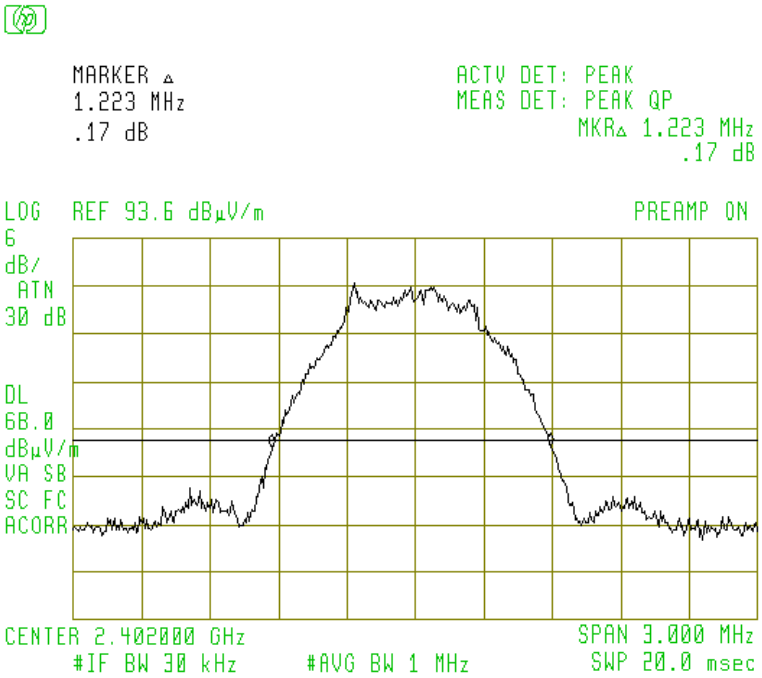


* Max. Peak Reading is 62.97dBuV/m, Average Reading 49.20dBuV/m with correction factors. Both are under FCC /IC limit.

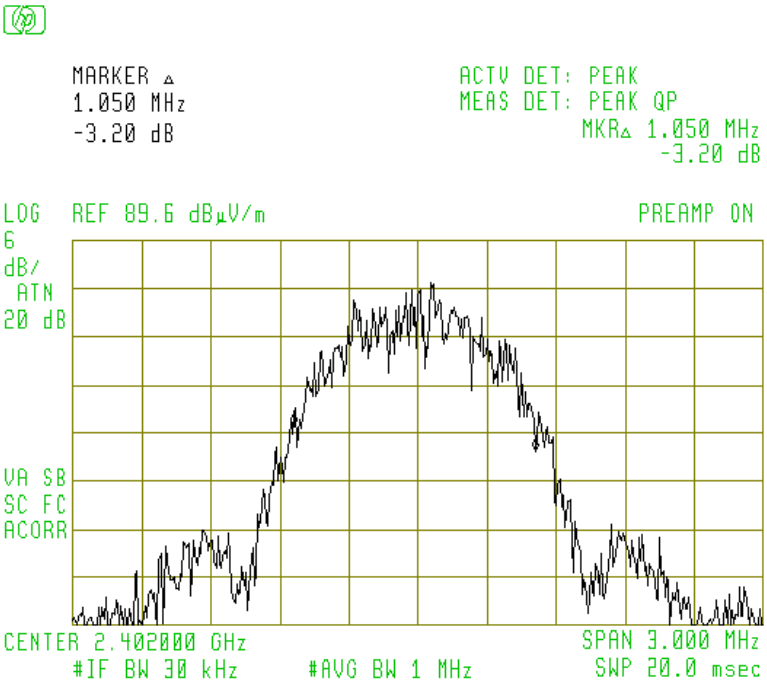


* Max. Peak Reading is 63.63dBuV/m, Average Reading 50.74dBuV/m with correction factors. Both are under FCC /IC limit.

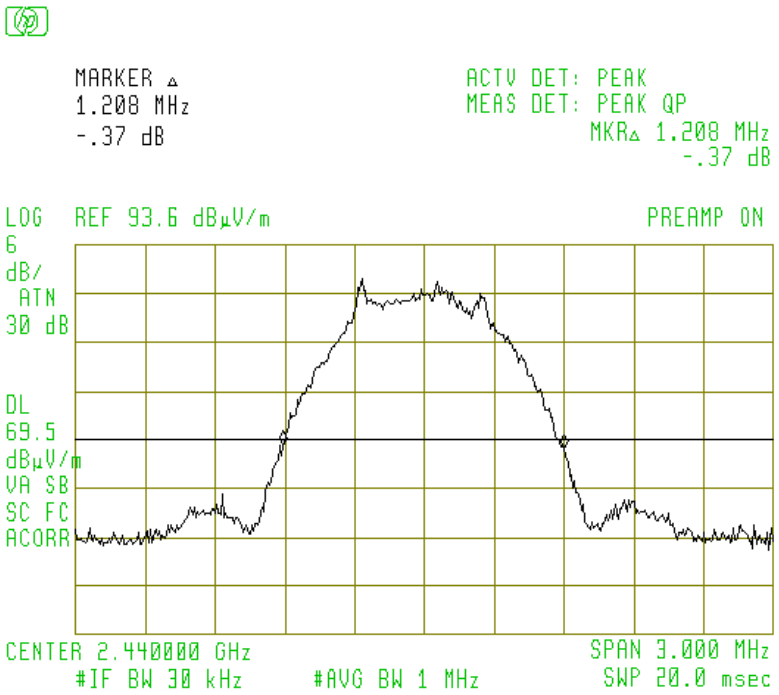
6.4 Occupied Bandwidth



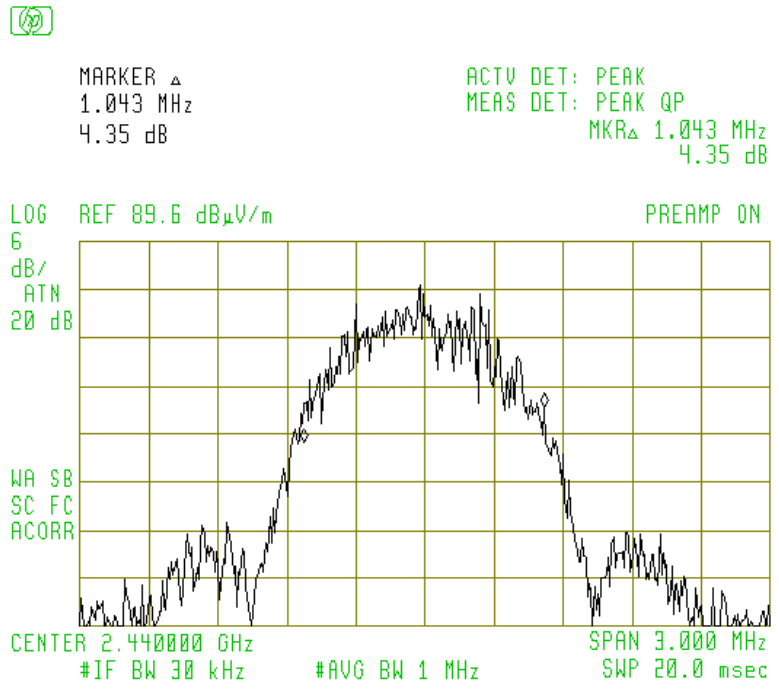
Low Channel (Max. -20dB BW: 1.223MHz)



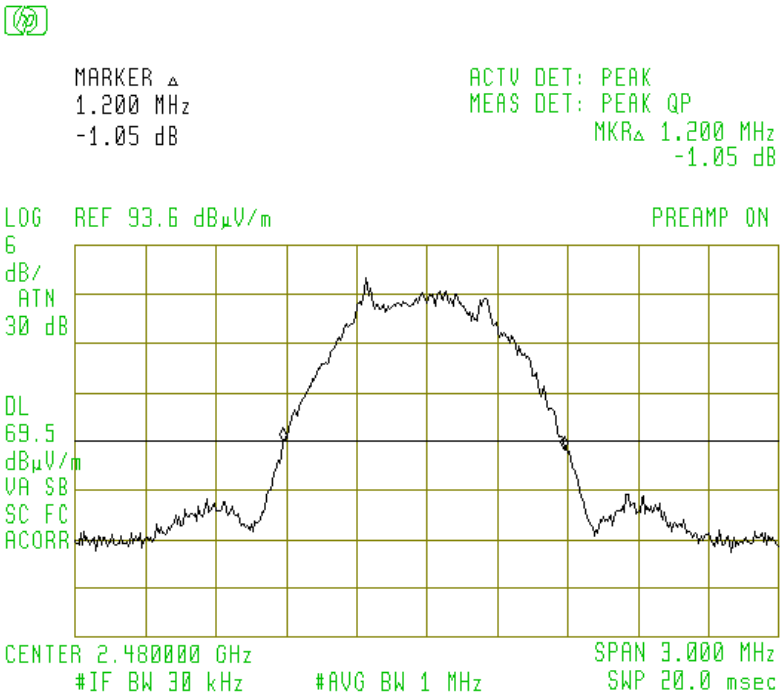
Low Channel (99% BW: 1.050MHz)



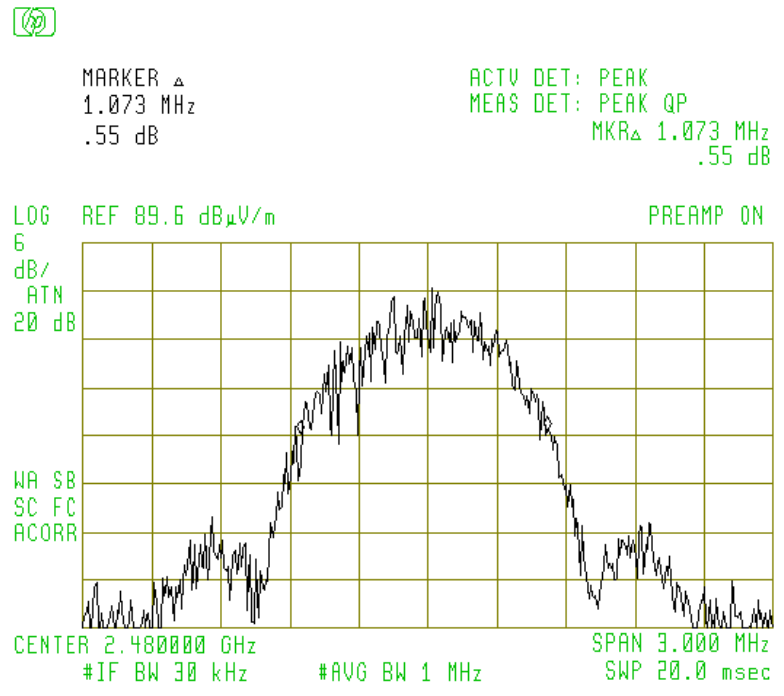
Middle Channel (Max. -20dB BW: 1.208MHz)



Middle Channel (99% BW: 1.043MHz)



High Channel (Max. -20dB BW: 1.200MHz)



High Channel (99% BW: 1.073MHz)