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## **ELECTROMAGNETIC EMISSION COMPLIANCE REPORT**

of

**SAMPLE BOX SCANNER  
MODEL: BOXMAPPER II  
FCC ID: 2AMHY-BM02**

**July 12<sup>th</sup> , 2017**

|  |                                |
|--|--------------------------------|
| This report concerns (check one): Original grant <input checked="" type="checkbox"/> Class II change <input type="checkbox"/><br>Equipment type: <u>Low Power Intentional Radiator</u>   |                                |
| Deferred grant requested per 47 CF 0.457(d)(1)(ii)?      yes <input type="checkbox"/> no <input checked="" type="checkbox"/><br>If yes, defer until: _____ (date)<br>Company agrees to notify the Commission by _____ (date)<br>of the intended date of announcement of the product so that the grant can be<br>issued on that date. |                                |
| Transition Rules Request per 15.37?      yes <input type="checkbox"/> no <input checked="" type="checkbox"/><br>If no, assumed Part 15, Subpart B for unintentional radiators - the new 47 CFR<br>[10-1-90 Edition] provision.   |                                |
| Report prepared for:   | <b>BIOTILLION LLC.</b>         |
| Report prepared by:  | <b>Advanced Compliance Lab</b> |
| Report number:   | <b>0048-170607-01-FCC</b>      |



**Lab Code: 200101**

**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: Sample Box Scanner

Model: BoxMapper II

Applicant: BIOTILLION LLC.

Test Type: FCC Part 15C Sec. 15.249 CERTIFICATION

Result: PASS

Tested by: ADVANCED COMPLIANCE LABORATORY

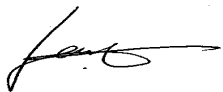
Test Date: June 07, 2017 ~ July 12, 2017

Report Number: 0048-170607-01-FCC

The above equipment was tested by Compliance Laboratory, Advanced Technologies, Inc. for compliance with the requirement set forth in the FCC rules and regulations Part 15 subpart C. 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.       | $\pm 2.36$      | $\pm 2.99$      | $\pm 1.83$      |



Wei Li  
Lab Manager  
Advanced Compliance Lab

Date 07/12/2017

## **1.2 Equipment Modifications**

N/A

### 1.3 Product Information

#### System Configuration

| ITEM            | DESCRIPTION  | ID                 | CABLE |
|-----------------|--|--------------------|-------|
| Product         | Sample Box Scanner<br>BOXMAPPER II <sup>(1)</sup>                          | FCC ID: 2AMHY-BM02 |       |
| Housing         | Plastic w / metal bottom   |                    |       |
| Power Supply    | AC/DC Adaptor<br>Input: 100-240V~ / 0.3A, 50-60Hz<br>Output: 6.0Vdc / 2.0A |                    |       |
| Operation Freq. | 902MHz ~ 927MHz ,  |                    |       |
| Receiver        | BOXMAPPER II(RX)   | Verification       |       |

(1) EUT submitted for grant.

### 1.4 Test Methodology

Radiated tests were performed according to the procedures in ANSI C63.4-2014 & & 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, which is designated by IC as “ site IC 3130A” This site has been accepted by FCC to perform measurements under Part 15 or 18 in a letter dated May 19, 1997 (Refer to: 31040/PRV 1300F2). 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<br>dd/mm/yy |
|-----------------|---------|------------|-------------------------------|---------------------|
| Hewlett-Packard | HP8546A | 3448A00290 | EMI Receiver                  | 25/09/17            |
| Agilent         | E4440A  | US40420700 | 3Hz-26.5GHz Spectrum Analyzer | 17/06/18            |
| R & S           | ESPI    | 100018     | 9KHz-7GHz EMI Receiver        | 25/08/17            |
| EMCO            | 3104C   | 9307-4396  | 20-300MHz Biconical Antenna   | 12/11/17            |
| EMCO            | 3146    | 9008-2860  | 200-1000MHz Log-Periodic      | 13/11/17            |

|                  |            |            |                                       |          |
|------------------|------------|------------|---------------------------------------|----------|
|                  |            |            | Antenna                               |          |
| ARA              | MWH-1826/B | 1013       | 18-26GHZ Horn Antena                  | 10/02/18 |
| EMCO             | 3115       | 49225      | Double Ridge Guide Horn Antenna       | 28/11/17 |
| Electro-Meterics | ALR-25M/30 | 289        | 10KHz-30MHz Active Loop Antenna       | 28/05/18 |
| ARA              | MWH-1826/B | 1013       | 18-26GHZ Horn Antena                  | 10/02/18 |
| 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. Calibration Interval: 2 Years

**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. Government.



## 2. PRODUCT LABELING

**BioTillion     Sample Box Scanner**  
**Model No.:    BoxMapper II**  
**FCC ID: 2AMHY-BM02**

**This device complies with part 15 of the FCC 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**



**Figure 2.2 Location of Label on EUT**

### **3. SYSTEM TEST CONFIGURATION**

#### **3.1 Justification**

The system was configured for testing in a typical fashion (as a customer would normally use it). And the antennas were permanently attached/mounted to the EUT PCB:

PCB trace antenna with +1dB gain for 900MHz Band

Testing was performed as EUT was continuously operated at the following frequency channels:

Low=902.74MHz, Middle= 914.75MHz, High=927.24MHz

USB ports are for design diagnostic only. Not USB protocol port. No Data transfer

#### **3.2 Special Accessories**

N/A

#### **3.3 Configuration of Tested System**

Figure 3.1 to Figure 3.2 illustrate this system, which is tested standing along.



**Figure 3.1 Radiated Test Setup**



**Figure 3.2 Radiated Configuration Test Setup**



**Fig. 3.3 Conducted Emission 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 FCC Part 15 limit in Figure 5.1 through Figure 5.2.

| Conducted Emission Technical Requirements |                    |                 |                    |                 |
|---|--------------------|-----------------|--------------------|-----------------|
| Frequency Range                           | CLASS A            |                 | Class B            |                 |
|   | Quasi-Peak<br>dBuV | Average<br>dBuV | Quasi-Peak<br>dBuV | Average<br>dBuV |
| 150kHz -0.5MHz                            | 79 (8912uV)        | 66 (1995uV)     | 66-56              | 56-46           |
| 0.5MHz-30MHz                              | 73 (4467uV)        | 60 (1000uV)     | ---                | ---             |
| 0.5MHz- 5MHz                              | ---                | ---             | 56                 | 46              |
| 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 Test Data

Figure 5.1 through Figure 5.4 show the neutral and line conducted emissions for the defined operation modes.

| Highest Data for AC Line Conducted Emissions, 120Vac Battery Charging Mode |                 |                 |                 |                    |                    |                    |
|--|-----------------|-----------------|-----------------|--------------------|--------------------|--------------------|
| Frequency (MHz)  | 0.400<br>(Line) | 1.400<br>(Line) | 2.000<br>(Line) | 0.480<br>(Neutral) | 1.840<br>(Neutral) | 3.510<br>(Neutral) |
| Peak/QP Reading<br>(dBuV)*   | 51.05           | 46.85           | 47.01           | 47.25              | 45.03              | 45.44              |
| Average Reading<br>(dBuV)*   | 33.99           | 29.44           | 31.75           | 33.48              |                    |                    |

\* Peak reading is under the average limit. No need to shows peak/QP level.

The following conducted test data shows the worst case emissions are still below FCC Part 15/IECS-003 CLASS B limits.

Test Personnel:

Tester Signature: David Tu

Date: 07/12/2016

Typed/Printed Name: David Tu

## Line Conducted Emission 150kHz-30MHz



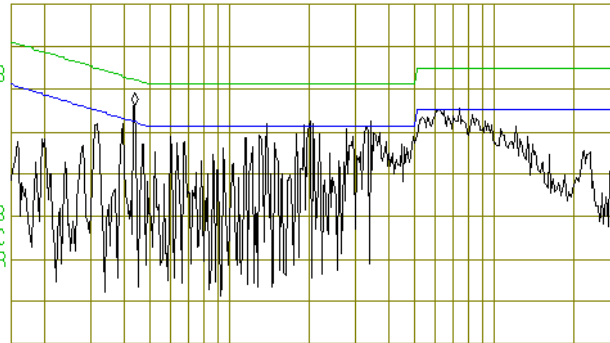
MARKER  
440 kHz  
51.05 dBμV

ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR 440 kHz  
51.05 dBμV

LOG REF 75.0 dBμV

10  
dB/  
ATN  
10 dB

VA SB  
SC FC  
ACORR



START 150 kHz STOP 30.00 MHz  
#IF BW 9.0 kHz AVG BW 30 kHz SWP 2.49 sec

## Line Conducted Emission 400 kHz (Average)



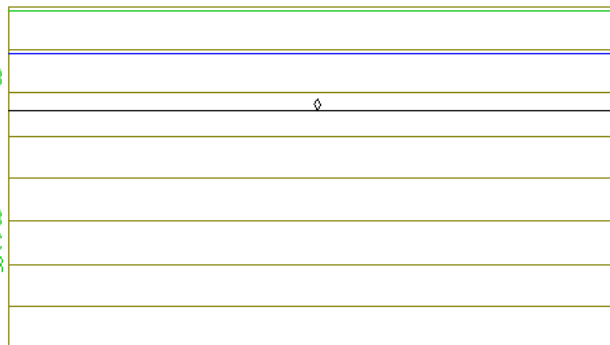
REF LEVEL  
58.2 dBμV

ACTV DET: AVG  
MEAS DET: PEAK QP AVG  
MKR 351.75 msec  
33.99 dBμV

LOG REF 58.2 dBμV

10  
dB/  
ATN  
10 dB

VA SB  
SC FC  
ACORR

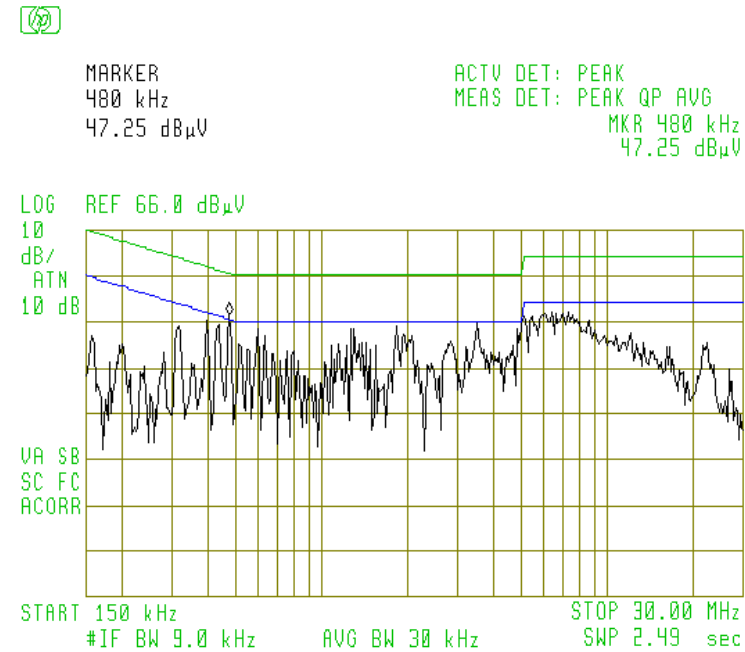


CENTER 439.927 kHz SPAN 0 Hz  
#IF BW 9.0 kHz AVG BW 1.0 Hz SWP 700 msec

**Figure 5.1 Line Conducted Emission**



## Neutral Conducted Emission 150 kHz-30 MHz



## Neutral Conducted Emission 480kHz (Average)

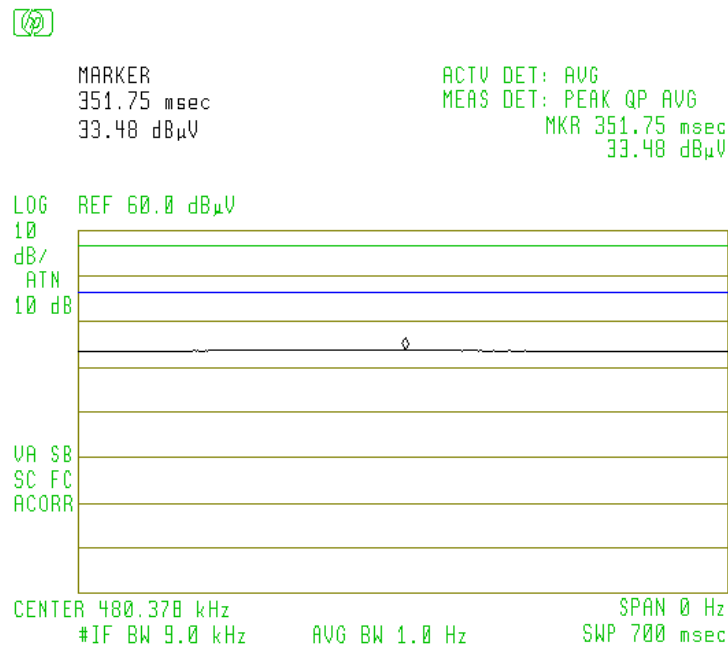


Figure 5.2 Neutral Conducted Emission

## 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 dB $\mu$ V/m

RA: Amplitude of EMI Receiver before correction in dB $\mu$ V

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 30MHz - 1GHz, 100KHz IF bandwidth / 100KHz video bandwidth are used. Both bandwidths are 1MHz for above 1GHz measurement. Frequency range from EUT's lowest crystal frequency to 10<sup>th</sup> harmonics of fundamental was 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 5.1.

Test Personnel: \_\_\_\_\_



Typed/Printed Name: Edward Lee

Date: 07/12/2017

**Radiated Test Data for 900 Band (CH-902MHz/914MHz/927MHz & Harmonics)**

| Frequency<br>(MHz) | Polarity<br>(V,H)<br>Position<br>(Zup,Zdown) | Antenna<br>Height<br>(m) | Azimuth<br>(Degree) | Peak<br>Reading<br>at 3m<br>(2)<br>(dBuV/m) | Reading<br>After<br>Correction<br>(dBuV/m) | FCC/IC<br>3m<br>Limit<br>(1)<br>(dBuV/m) | Difference<br>(dBuV/m) |
|--------------------|--|--------------------------|---------------------|---|--|--|------------------------|
| 902.75             | V  | 1.1                      | 000                 | 77.7  |  | 94                                       | -16.3                  |
| 1805.5             | V  | 1.5                      | 000                 | 38.7  |  | 54                                       | -15.3                  |
| 2708.25            | V  | 1.5                      | 000                 | 42.6  |  | 54                                       | -11.4                  |
| 902.75             | H  | 1.0                      | 235                 | 72.2  |  | 94                                       | -21.8                  |
| 1805.5             | H  | 1.5                      | 235                 | 39.4  |  | 54                                       | -14.6                  |
| 2708.25            | H  | 1.5                      | 235                 | 42.8  |  | 54                                       | -11.2                  |
|                    |  |                          |                     |   |  |  |                        |
| 914.75             | V  | 1.1                      | 010                 | 76.3  |  | 94                                       | -17.7                  |
| 1829.5             | V  | 1.5                      | 010                 | 40.1  |  | 54                                       | -13.9                  |
| 2744.25            | V  | 1.5                      | 010                 | 42.1  |  | 54                                       | -11.9                  |
| 914.75             | H  | 1.0                      | 180                 | 73.5  |  | 94                                       | -20.5                  |
| 1829.5             | H  | 1.5                      | 180                 | 39.7  |  | 54                                       | -14.3                  |
| 2744.25            | H  | 1.5                      | 180                 | 42.4  |  | 54                                       | -11.6                  |
|                    |  |                          |                     |   |  |  |                        |
| 927.24             | V  | 1.1                      | 045                 | 76.7  |  | 94                                       | -17.3                  |
| 1854.48            | V  | 1.5                      | 045                 | 38.5  |  | 54                                       | -15.5                  |
| 2781.72            | V  | 1.5                      | 045                 | 42.1  |  | 54                                       | -11.9                  |
| 927.24             | H  | 1.0                      | 200                 | 74.1  |  | 94                                       | -19.9                  |
| 1854.48            | H  | 1.5                      | 200                 | 38.7  |  | 54                                       | -15.3                  |
| 2781.72            | H  | 1.5                      | 200                 | 42.6  |  | 54                                       | -11.4                  |
|                    |  |                          |                     |   |  |  |                        |

(1) The limit for emissions within the 902-928MHz band is 50mV(94dB) per Sec. 15.249 & RSS-210. 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 & RSS-210, whichever is higher.

(2) If each peak reading is less than the FCC average limit, it'll be not necessary to show the measured/ calculated average reading.

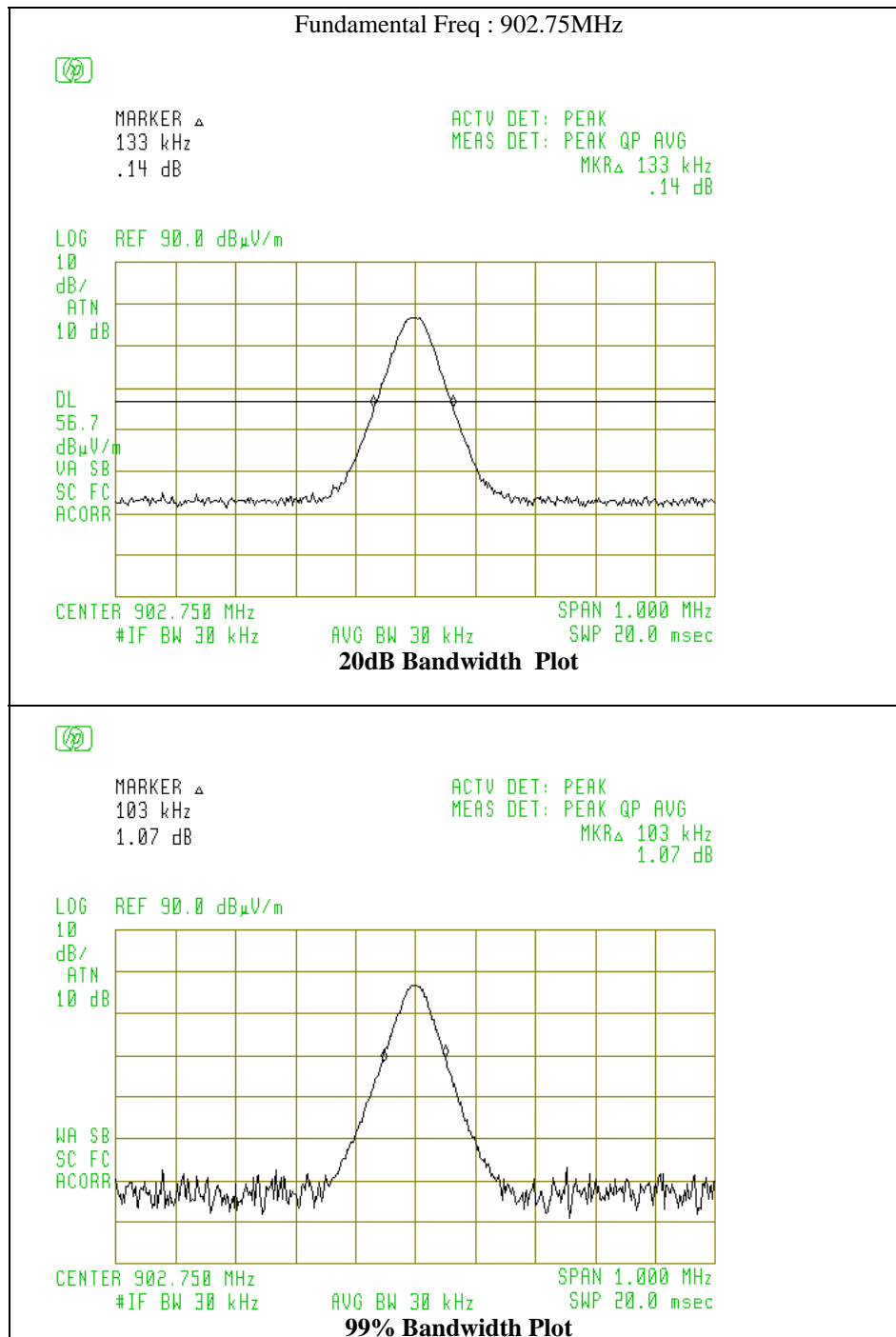
Other Spurious outside of the band 902-928MHz\*

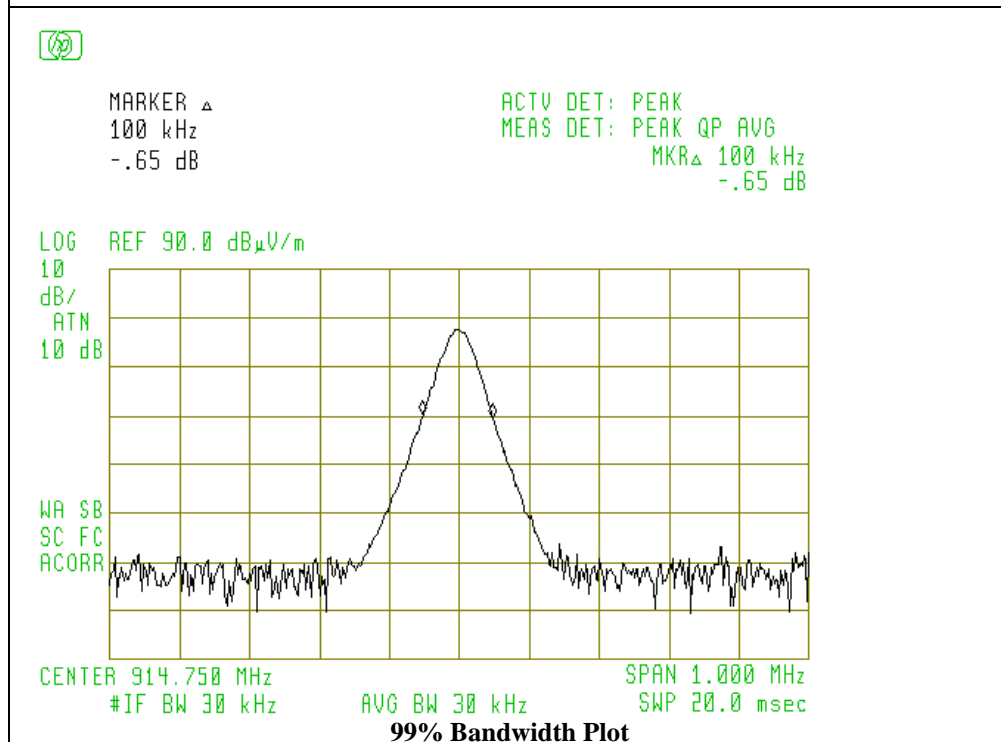
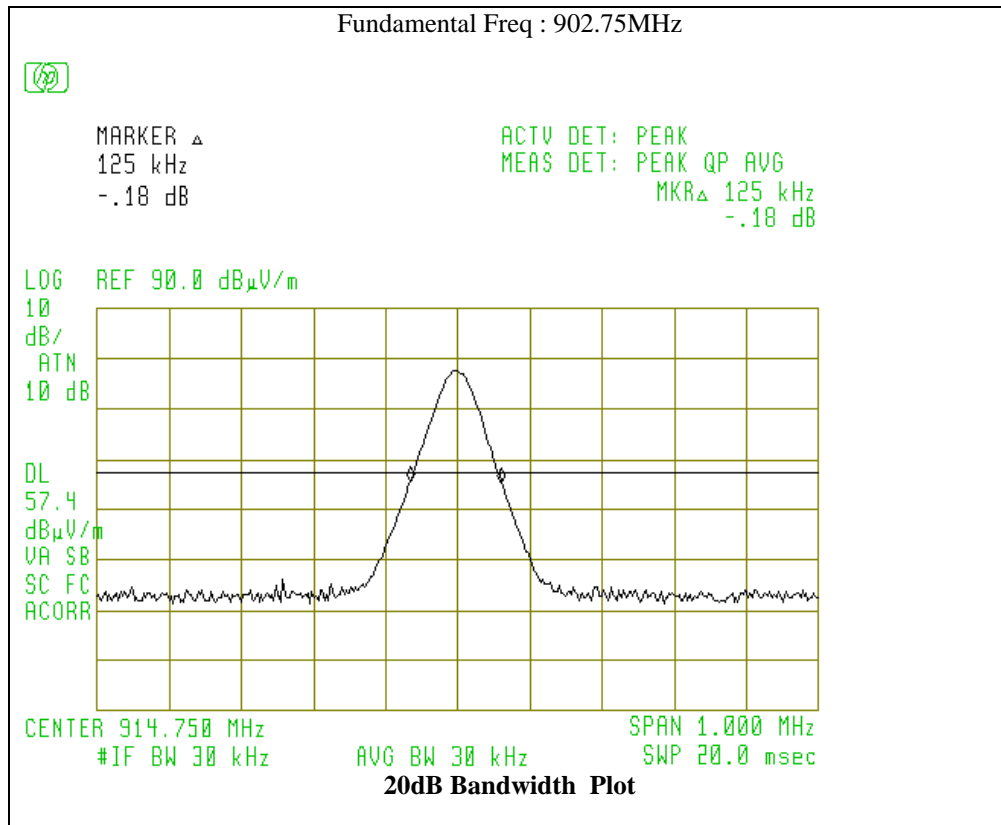
| <b>Frequency<br/>(MHz)*</b> | <b>Polarity<br/>(V,H)<br/>Position<br/>(Z-<br/>down)</b> | <b>Antenna<br/>Height<br/>(m)</b> | <b>Azimuth<br/>(Degree)</b> | <b>Peak<br/>Reading<br/>at 3m<br/>(dBuV/m)</b> | <b>FCC/IC<br/>3m<br/>Limit<br/>(dBuV/m)</b> | <b>Difference<br/>(dBuV/m)</b> |
|-----------------------------|--|-----------------------------------|-----------------------------|--|---|--------------------------------|
| 714.0                       | V  | 1.1                               | 000                         | 45.5*  | 46.5  | -1.0                           |
| 860.1                       | V  | 1.1                               | 045                         | 45.0*  | 46.5  | -1.5                           |
| 714.0                       | H  | 1.0                               | 190                         | 44.7*  | 46.5  | -1.8                           |
| 860.0                       | H  | 1.0                               | 235                         | 45.3*  | 46.5  | -1.2                           |

\* Emissions from digital circuitry ( non-intentional radiator ) are excluded.

Comparing to the limit defined in Sec. 15.209 & RSS-Gen, emissions below the limit by 20dB were not recorded.

## 20 dB Bandwidth : 900MHz Band





Fundamental Freq : 914.75MHz



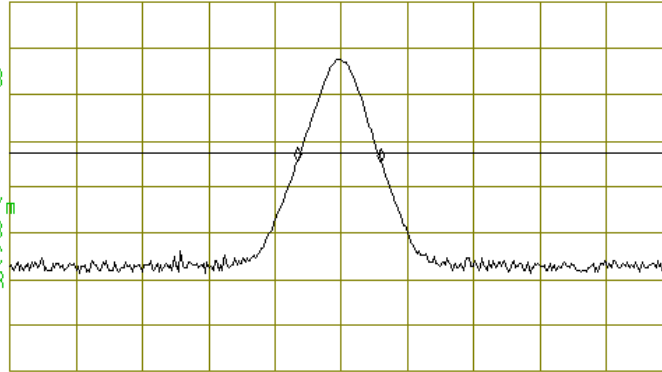
MARKER  $\Delta$   
125 kHz  
-.18 dB

ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR  $\Delta$  125 kHz  
-.18 dB

LOG REF 90.0 dB $\mu$ V/m

10  
dB/  
ATN  
10 dB

DL  
57.4  
dB $\mu$ V/m  
VA SB  
SC FC  
ACORR



CENTER 914.750 MHz SPAN 1.000 MHz  
#IF BW 30 kHz AVG BW 30 kHz SWP 20.0 msec

**20dB Bandwidth Plot**

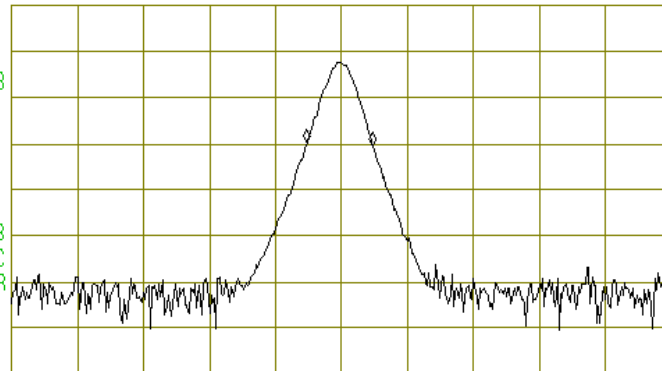
MARKER  $\Delta$   
100 kHz  
-.65 dB

ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR  $\Delta$  100 kHz  
-.65 dB

LOG REF 90.0 dB $\mu$ V/m

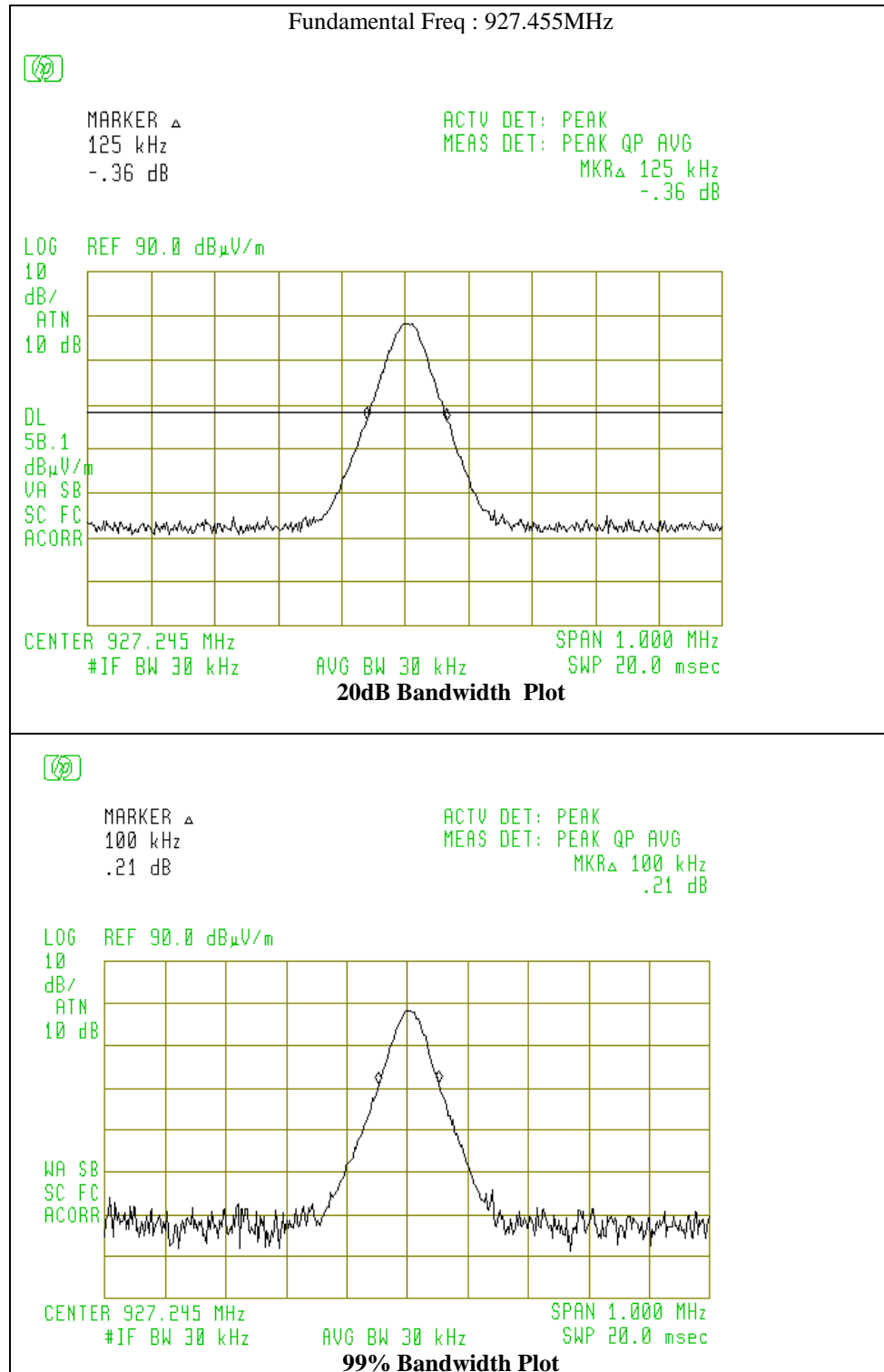
10  
dB/  
ATN  
10 dB

VA SB  
SC FC  
ACORR



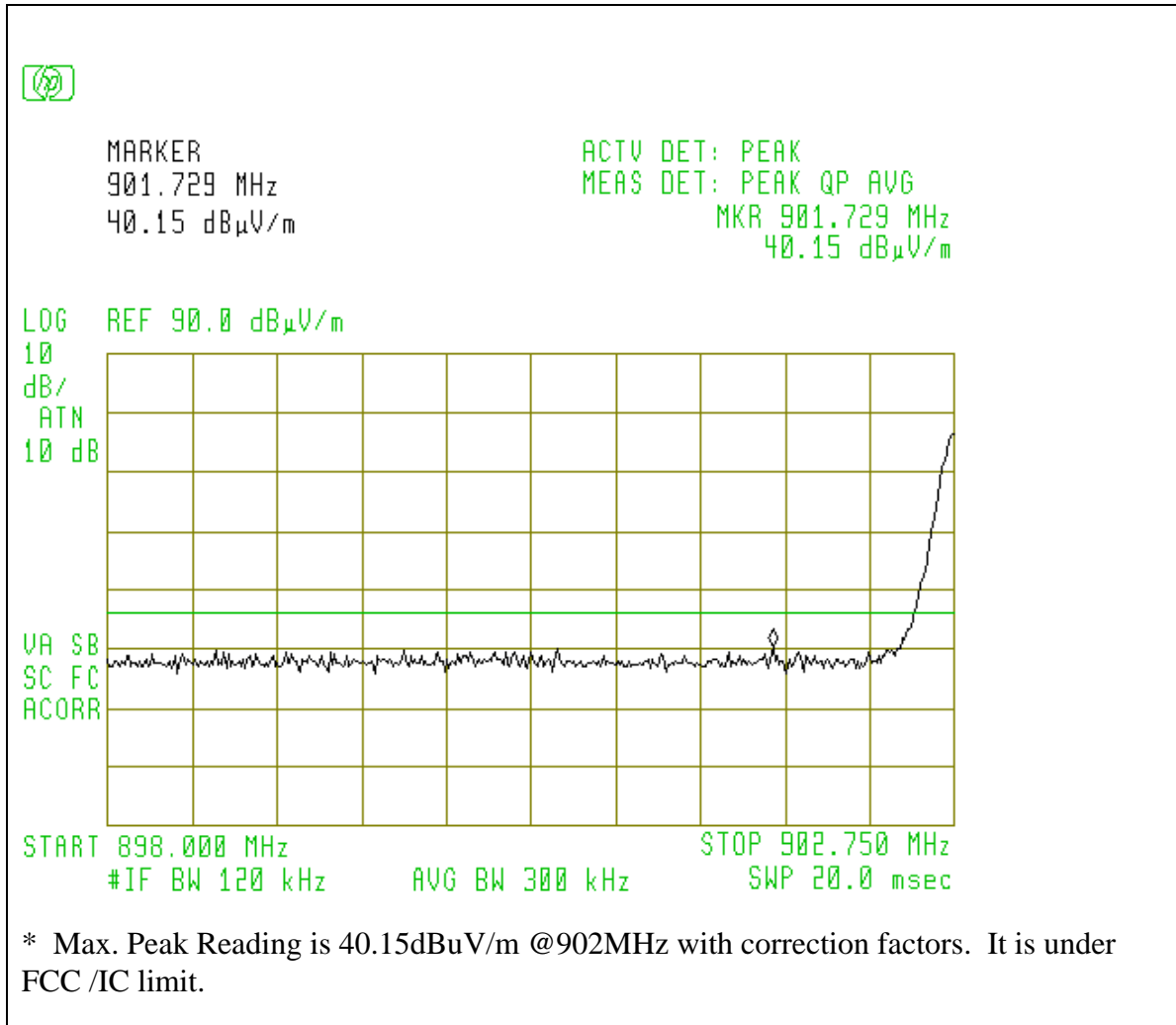
CENTER 914.750 MHz SPAN 1.000 MHz  
#IF BW 30 kHz AVG BW 30 kHz SWP 20.0 msec

**99% Bandwidth Plot**





## 900MHz Band-edge Spurious





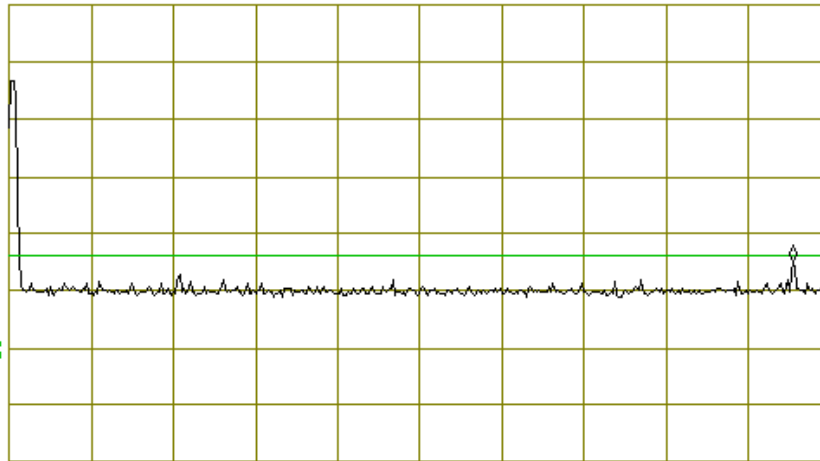
MARKER  
958.53 MHz  
45.05 dB $\mu$ V/m

ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR 958.53 MHz  
45.05 dB $\mu$ V/m

LOG REF 90.0 dB $\mu$ V/m

10  
dB/  
ATN  
10 dB

VA SB  
SC FC  
ACORR



START 927.24 MHz

#IF BW 120 kHz

AVG BW 300 kHz

STOP 960.00 MHz

SWP 30.7 msec

\* \* Max. Peak Reading is 45.1dBuV/m @958MHz with correction factors. It is under FCC /IC limit.