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Technical Report No. 07-062

**“EMI Evaluation of the XG Technology,
XG-VOIP-BTS to FCC Part 15, Class A
Conducted and Radiated Emission Requirements.”**

Performed: 29 May 2007

Customer: XG Technology, Inc.
7771 W. Oakland Park Blvd. #231
Sunrise, FL 33351

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1. INTRODUCTION

The XG Technology, Inc. XG-VOIP-BTS is a base station for transmission and reception of voice over IP, using an XG proprietary modulation scheme within the ISM band of 902 to 928 MHz. The unit, with maximum operating clock frequency of 210 MHz, was evaluated for compliance to the FCC CFR-47, Part 15, Class A requirements. The device was evaluated for both transmitting mode and receiving mode. The results apply only to the specific items of equipment, configurations and procedures supplied to the Florida Atlantic University EMI R&D Laboratory as reported in this document.

2. OBJECTIVE

This evaluation was performed to verify conformance of the XG Technology, XG-VOIP-BTS module to the U.S. Federal Communications Commission (FCC), Code of Federal Regulations (CFR), Title 47 - Telecommunication, FCC Part 15 Subpart B- Unintentional Radiators, Sections 15.107(b) and 15.109 (b), FCC Class A conducted and radiated emission requirements, and Subpart C- Intentional Radiators, Section 15.247, Operation within the bands 902-928 MHz.

3. CONCLUSION

The XG Technology, XG-VOIP-BTS unit met the FCC, Part 15 Subpart B, Class A conducted and radiated emission requirements, as well as the requirements for Section 15.247, operation within the band of 902-928 MHz, as described in the following pages.

4. TEST PROCEDURES AND RESULTS

4.1 TEST PROCEDURES

The measurement techniques identified in the measurement procedure of ANSI C63.4-2003 *"American National Standard of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz"* were followed as close as practical during this evaluation. Complete details and specific procedures used are discussed in the respective test result sections.

4.2 CONDUCTED EMISSIONS TEST RESULTS

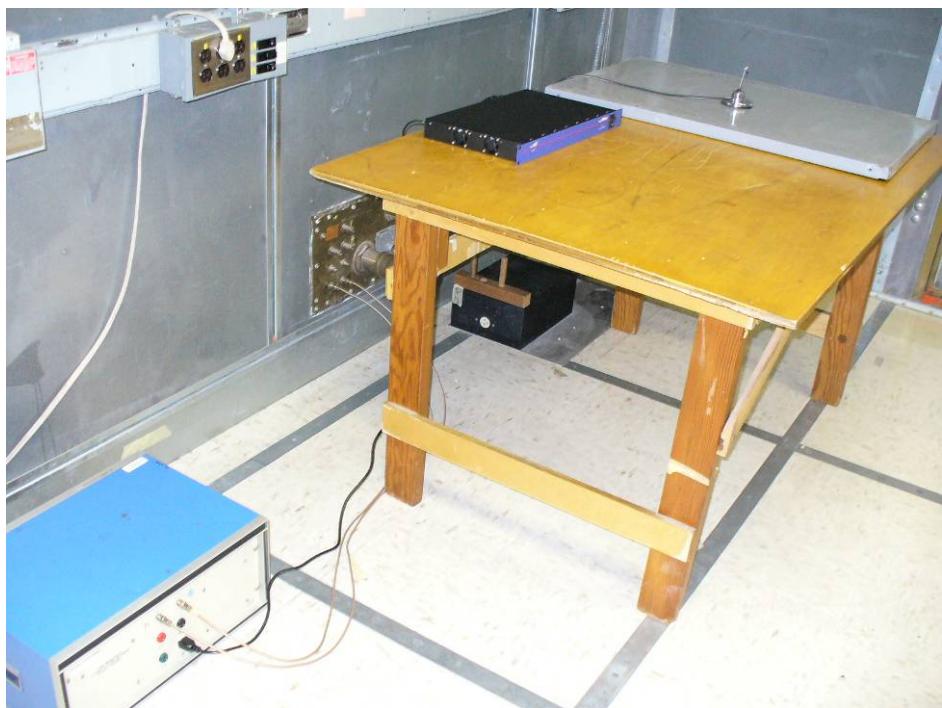
4.2.1 CONDUCTED POWERLINE EMISSIONS

The XG Technology, XG-VOIP-BTS unit was evaluated for conducted emission requirements for both transmitting and receiving modes of operation. The module, powered by an internal switching power supply, was assessed with an antenna set on top of a metal sheet. The data was transmitted and received correctly as confirmed by the XG Technology Engineer. Photographs 1 and 2 show the setup used during the evaluations.

The system was installed in the FAU EMI Research facilities conducted emissions shielded enclosure, on a wooden test table 80 centimeters above the ground plane floor and 40 centimeters from the rear wall. The device was then plugged into a Line Impedance Stabilization Network (LISN) EMCO Model No.3825/2R Serial No. 1095.

Conducted power line emissions were measured on both the phase and neutral lines with reference to earth ground, over the specified 150 kHz to 30 MHz range on a Hewlett Packard HP 8566B Spectrum Analyzer operated in the peak detection mode, in conjunction with HP 85685A Preselector, with a bandwidth of 9 kHz obtained through the HP 85650A Quasi Peak Adapter.

Figures 1 and 2 show the conducted emissions on both the phase and neutral lines measured in the receiver peak detection mode.



Photographs 1 & 2: Conducted Emission Setup

4.2.2 RECEIVING MODE

Figure 1 presents the results for the system evaluated in the receiving mode.

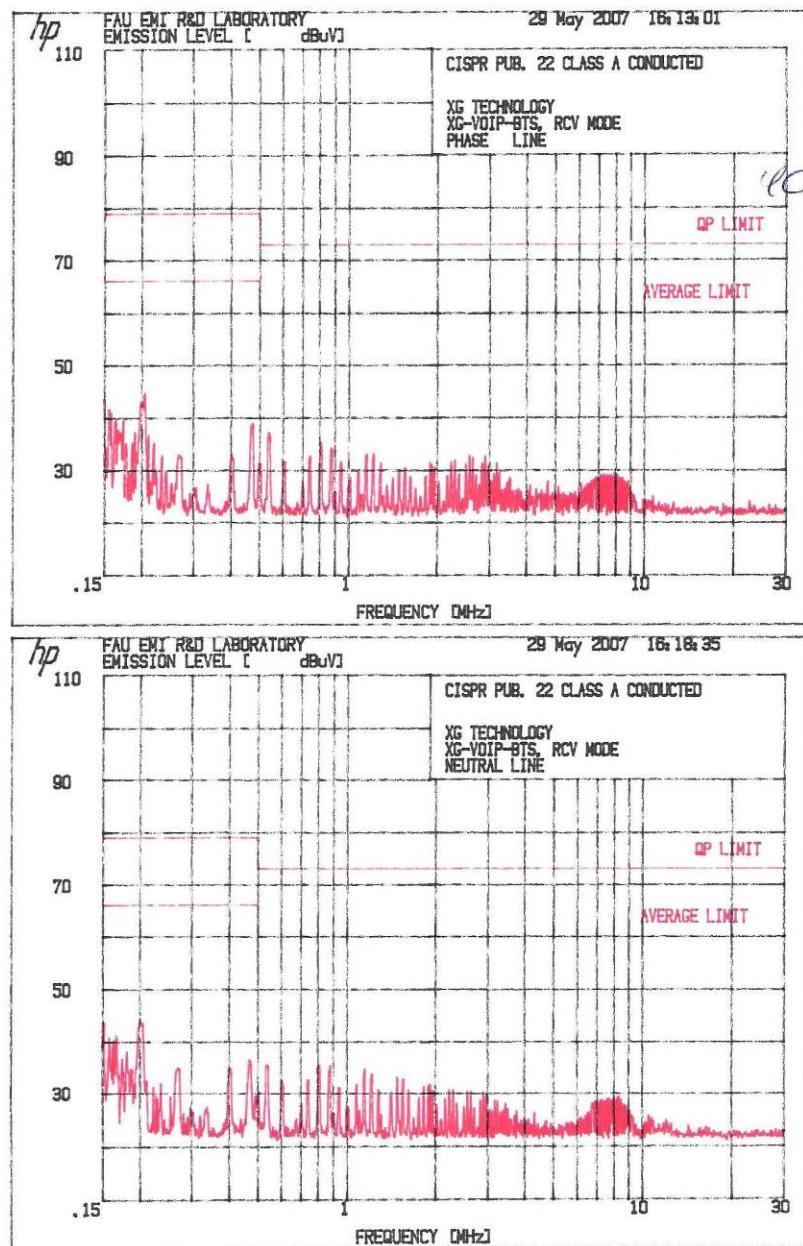


Figure 1: Phase and Neutral Conducted Emissions

4.2.3 TRANSMITTING MODE

Figure 2 presents the results for the unit evaluated in the transmitting mode. The unit was set to transmit voice packets of 30 ms duration using an XG proprietary modulation scheme within the ISM band of 902 to 928 MHz.

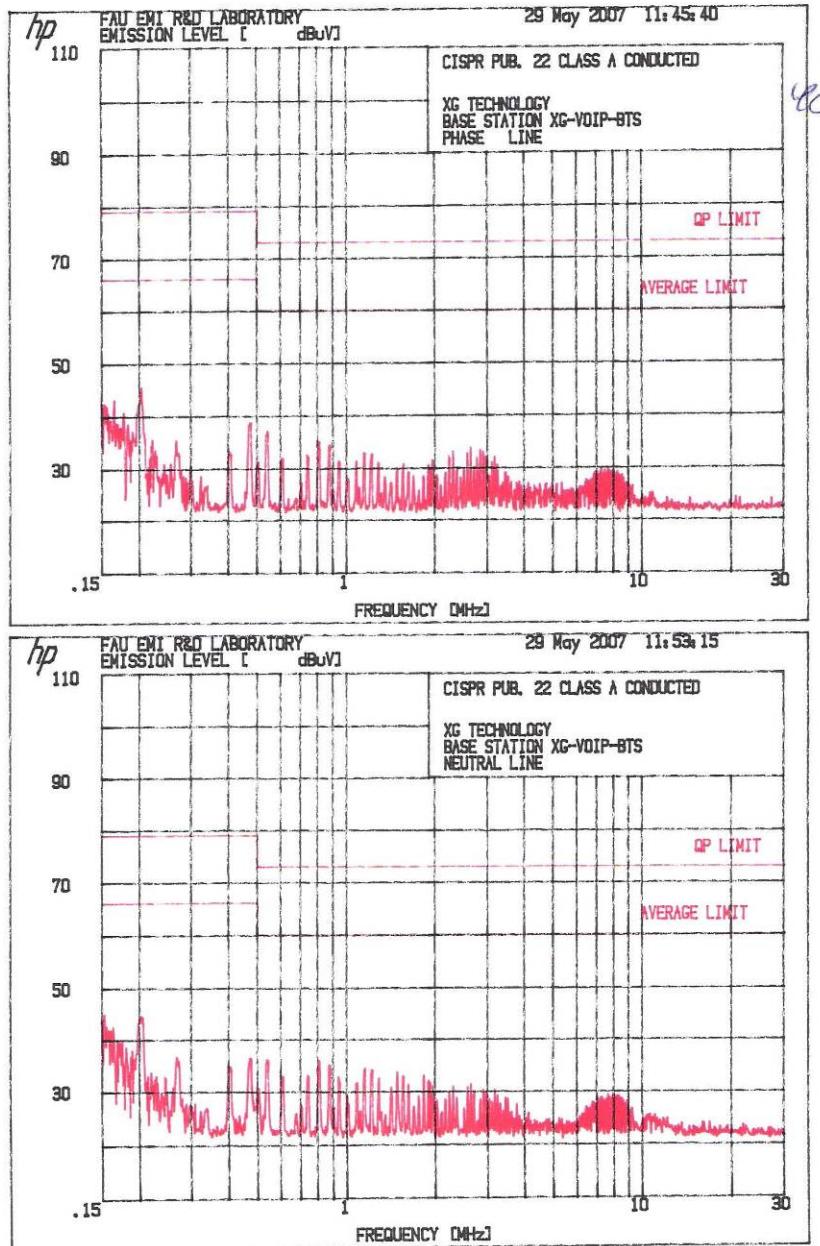


Figure 2: Phase and Neutral Conducted Emissions

From the above figures, the emissions that exceeded or were within 5 dB of the limit are reported in Table 1. Since the peak emissions are more than 5 dB below the average limit, there are no values to report on Table 1.

| Line Tested | Frequency (kHz) | Peak Value (dB μ V) | QP Value (dB μ V) | Average Value (dB μ V) | Avg. Limit (dB μ V) | Margin to Avg. Limit (dB)* |
|-------------|-----------------|-------------------------|-----------------------|----------------------------|-------------------------|----------------------------|
| Phase | | | | | | |
| Neutral | | | | | | |
| Phase | | | | | | |
| Neutral | | | | | | |
| Phase | | | | | | |
| Neutral | | | | | | |
| Phase | | | | | | |
| Neutral | | | | | | |
| Phase | | | | | | |
| Neutral | | | | | | |

Table 1: Conducted Emission Peak Measurement

*Margin to Avg. Limit (dB) = Avg. Limit (dB μ V) – the measured value (either Peak, Quasi-Peak or Average Value) in dB μ V

It can be seen that on both the phase and neutral lines, the emissions did not exceed the limits. Hence, the system is in compliance.

4.3 RADIATED EMISSIONS TEST RESULTS

4.3.1 UNINTENTIONAL RADIATED EMISSIONS

The XG Technology, XG-VOIP-BTS unit was set up on a wooden table 80 centimeters above the ground plane turntable of the Semi-Anechoic test site, as shown in Photographs 3 & 4. An antenna, set on a metal sheet (ground plane), was connected to the antenna jack of EUT. The XG-VOIP-BTS unit was connected to 110V/ 60 Hz power outlet located at the center of the turntable. The unit was evaluated for both transmitting and receiving mode.

An EMCO, Model 3104, S/N 299988A, the Broadband Biconical antenna was installed on an EMCO pneumatically controlled antenna mast at a distance of 3 meters from the system. The 30 MHz to 200 MHz frequency range was automatically scanned on the HP 8566B Spectrum analyzer (SA) that was operated in the peak detector mode with a bandwidth of 120 kHz obtained through the HP 85650A Quasi Peak Adapter. It should be noted that the RES BW and VBW of the spectrum analyzer must be set to 1 MHz for the Quasi Peak Adaptor to provide a 120 kHz bandwidth correctly. Hence, in the figures, RES BW and VBW are still indicated as 1 MHz.

After setting the SA to operate between 30-200 MHz, the max hold switch on the SA was pressed. The Biconical antenna was set to horizontal polarization and at 1-m above the floor. The turntable was then rotated 360 degrees. After a full revolution, the turntable was rotated back to the previously noted azimuth angles where the higher E-fields occurred, and the antenna was then scanned from 1 to 4 meters high at those angles in order to determine the height that will provide to highest amplitude. The antenna was moved back to the location where the highest amplitude was observed and the turn table was rotated again 360°. The maximum value was plotted and presented herein. The antenna was then turned to measure the vertical polarized E-field and the above procedure was repeated.

For the 200-1000 MHz band, a Log Periodic antenna (EMCO 3146) was installed and the SA was set to operate between 200-1000 MHz. To collect data, the above procedure was then repeated.

For the 1 GHz to the 2 GHz band, a double rigged horn antenna as well as a microwave pre-amplifier were installed and the SA was set to operate between 1 GHz to 2 GHz. The RBW and VBW were left at the 1 MHz setting and the bypass instrument function of the HP 85650A Quasi Peak Adapter was enabled. To collect the data, the procedure previously described was repeated again.

Figures 3-14 show the worse case radiated emissions of both configurations, for this evaluation, independent of azimuth or antenna height. The E-field is calculated using antenna factor, cable loss, distance factor and amplifier gain based on the following equation:

$$E (\text{dB}\mu\text{V}/\text{m}) = \text{SA reading} (\text{dB}\mu\text{V}) + \text{Antenna Factor} (\text{dB}/\text{m}) + \text{Cable Loss} (\text{dB}) - \text{Amplifier Gain} (\text{dB}) - \text{Distance Factor} (\text{dB})$$

Note that for the transmitting mode assessment, a Trilithic notch filter 7NM867/122-X1-AA was used at the receiver to notch the RF signal transmitted by the XG-VOIP-BTS module within the frequency band of 902 to 928 MHz.



Photographs 3 & 4: Radiated Emission Setup

4.3.1.1 RECEIVING MODE

Figures 3 to 8 present the results for the XG-VOIP-BTS module set to the receiving mode.

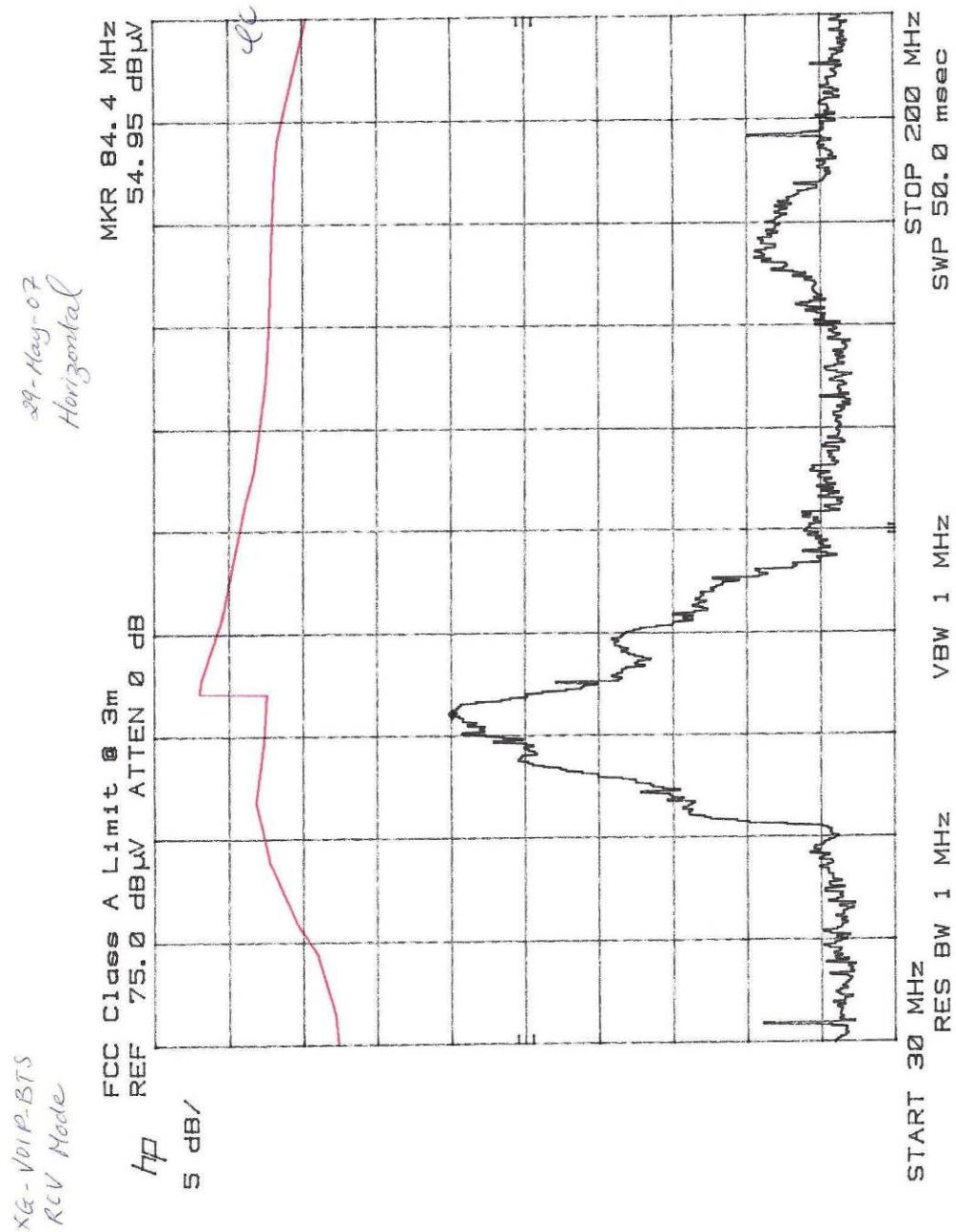


FIGURE 3: Radiated Emission 30 – 200 MHz Horizontal Polarization

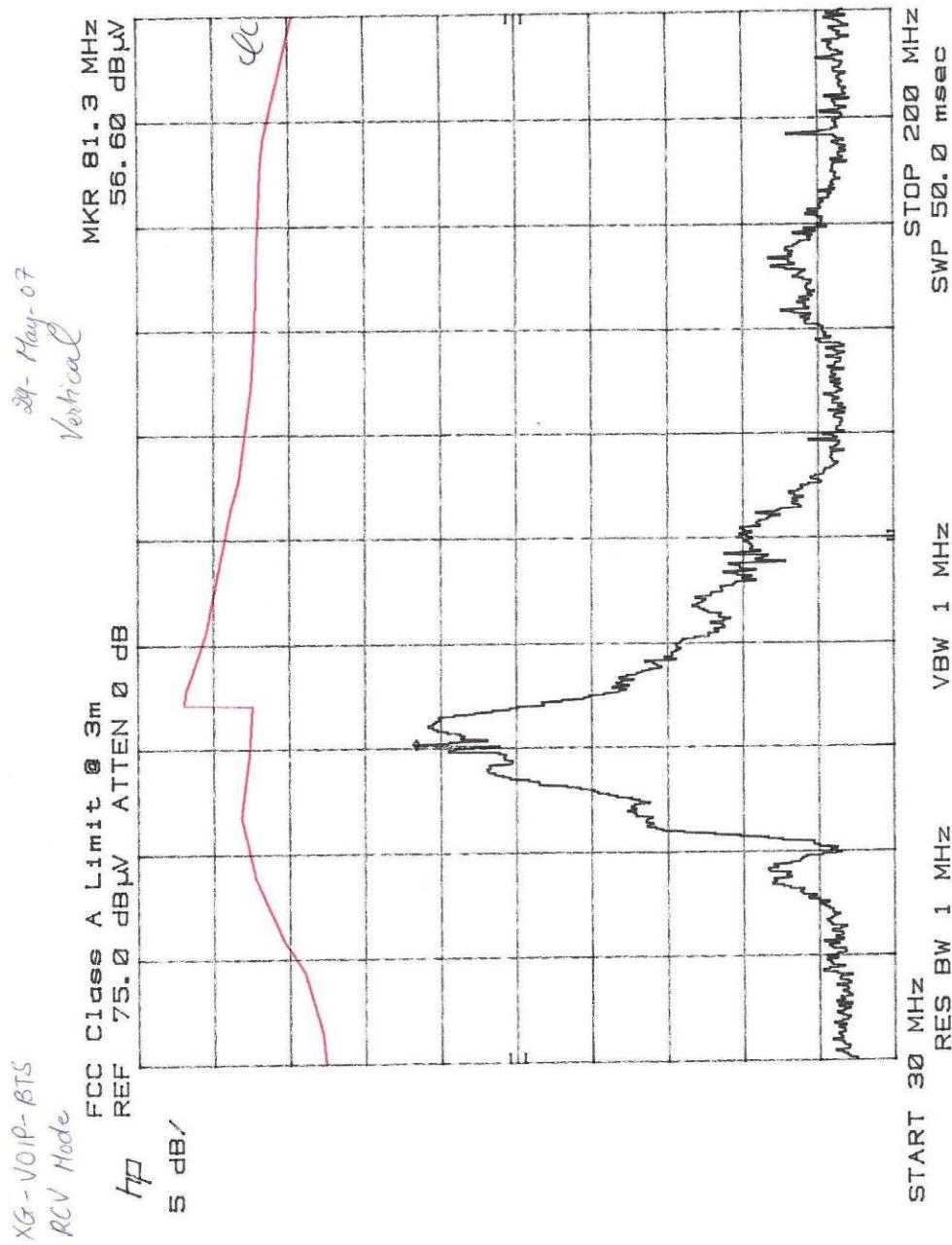


FIGURE 4: Radiated Emission 30 – 200 MHz Vertical Polarization

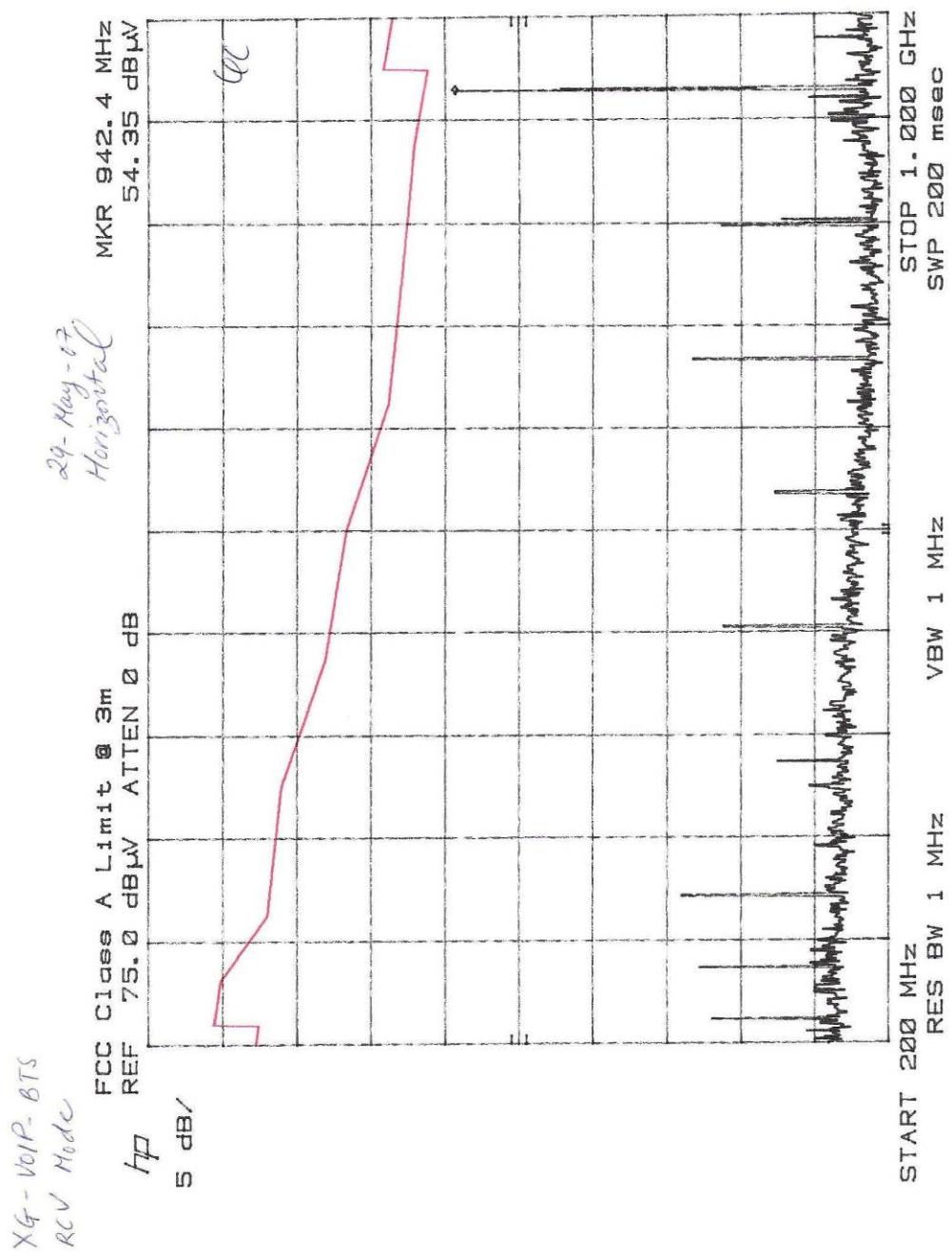


FIGURE 5: Radiated Emission 200 MHz – 1 GHz Horizontal Polarization

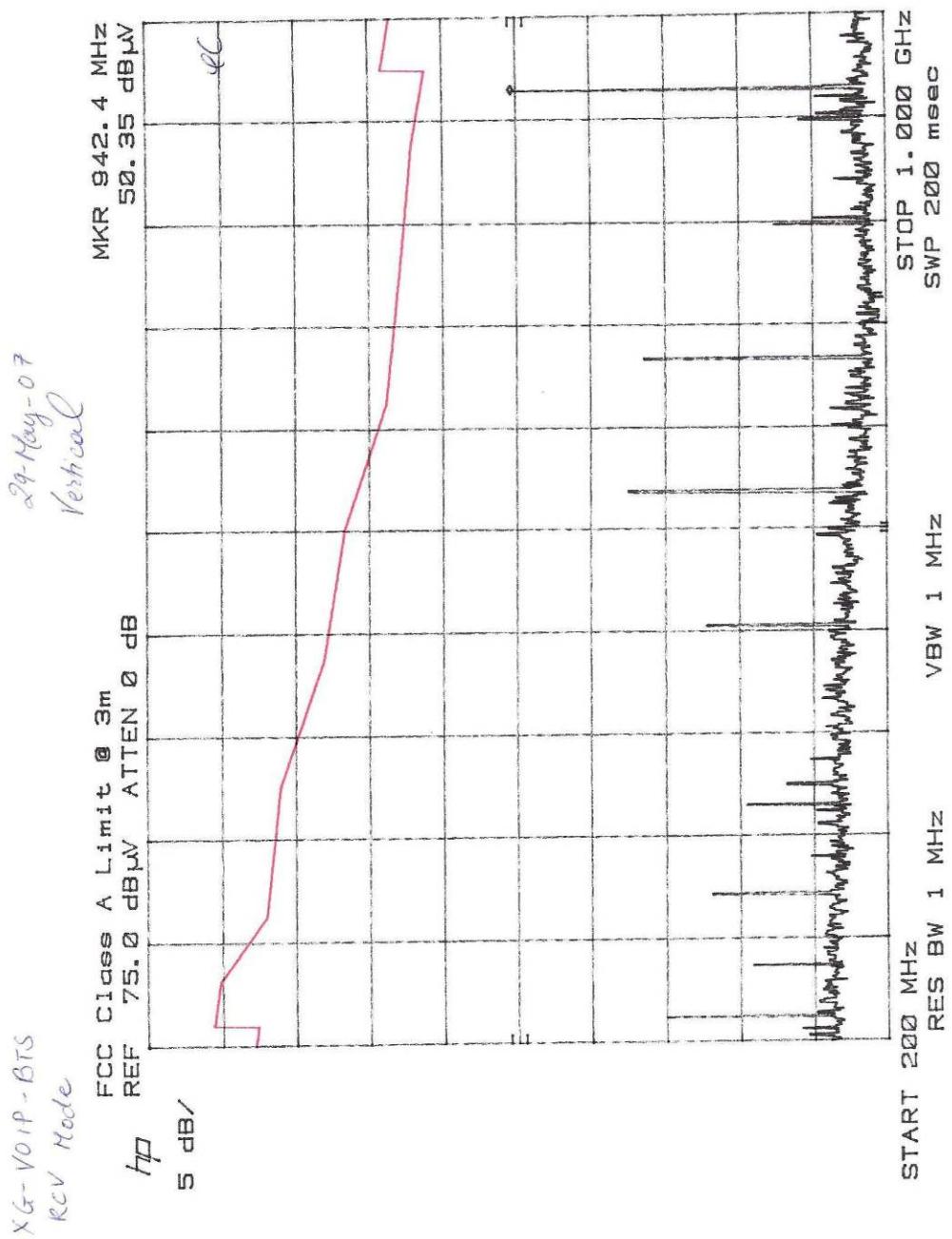


FIGURE 6: Radiated Emission 200 MHz – 1 GHz Vertical Polarization

Since the maximum operating clock frequency is 210 MHz, the unit was evaluated up to 2 GHz.

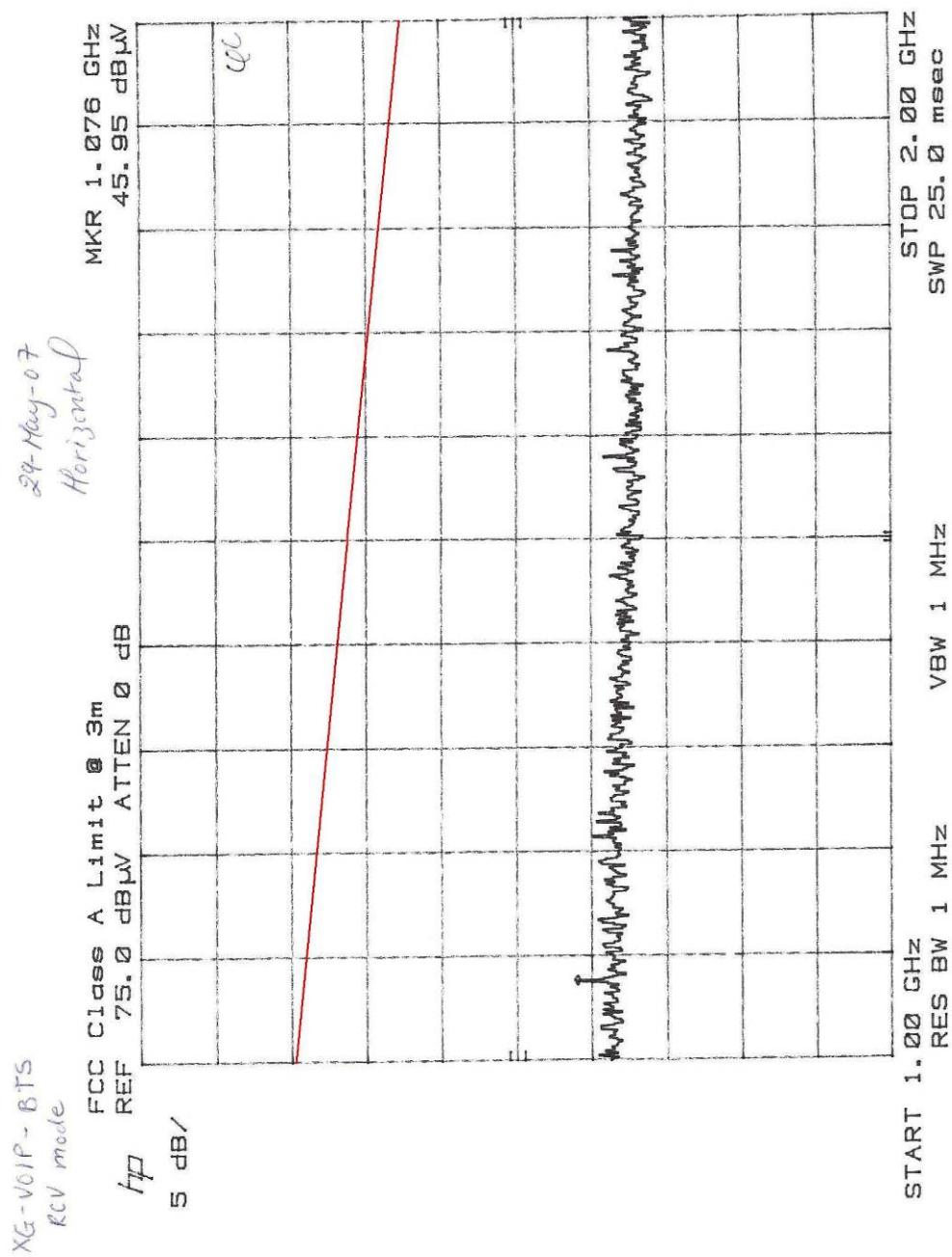


FIGURE 7: Radiated Emission 1 GHz – 2 GHz Horizontal Polarization

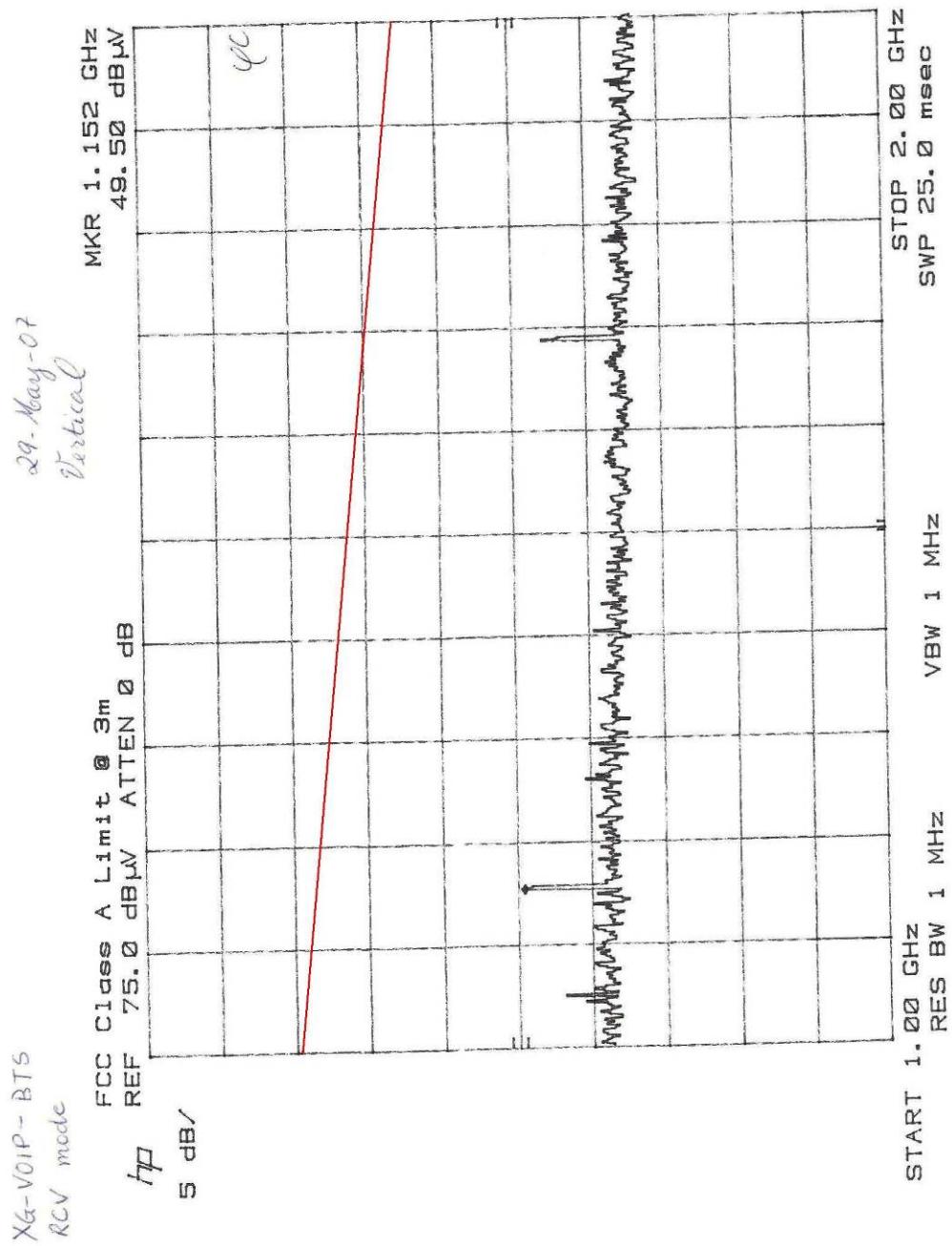


FIGURE 8: Radiated Emission 1 GHz – 2 GHz Vertical Polarization

4.3.1.2 TRANSMITTING MODE

Figures 9 to 14 present the results for the XG-VOIP-BTS unit evaluated in the transmitting mode. The module was set to transmit voice packets of 30 ms duration using an XG proprietary modulation technique. A Trilithic filter 7NM867/122-X1-AA was used at the receiver to notch the RF signal transmitted by the XG-VOIP-BTS module within the frequency band of 902 to 928 MHz. It should be noted from Figures 11-12 that even with the notch filter, the transmitting signal is attenuated, but the receiving system is able to measure the intentional TX signal around 916.8-918.4 MHz.

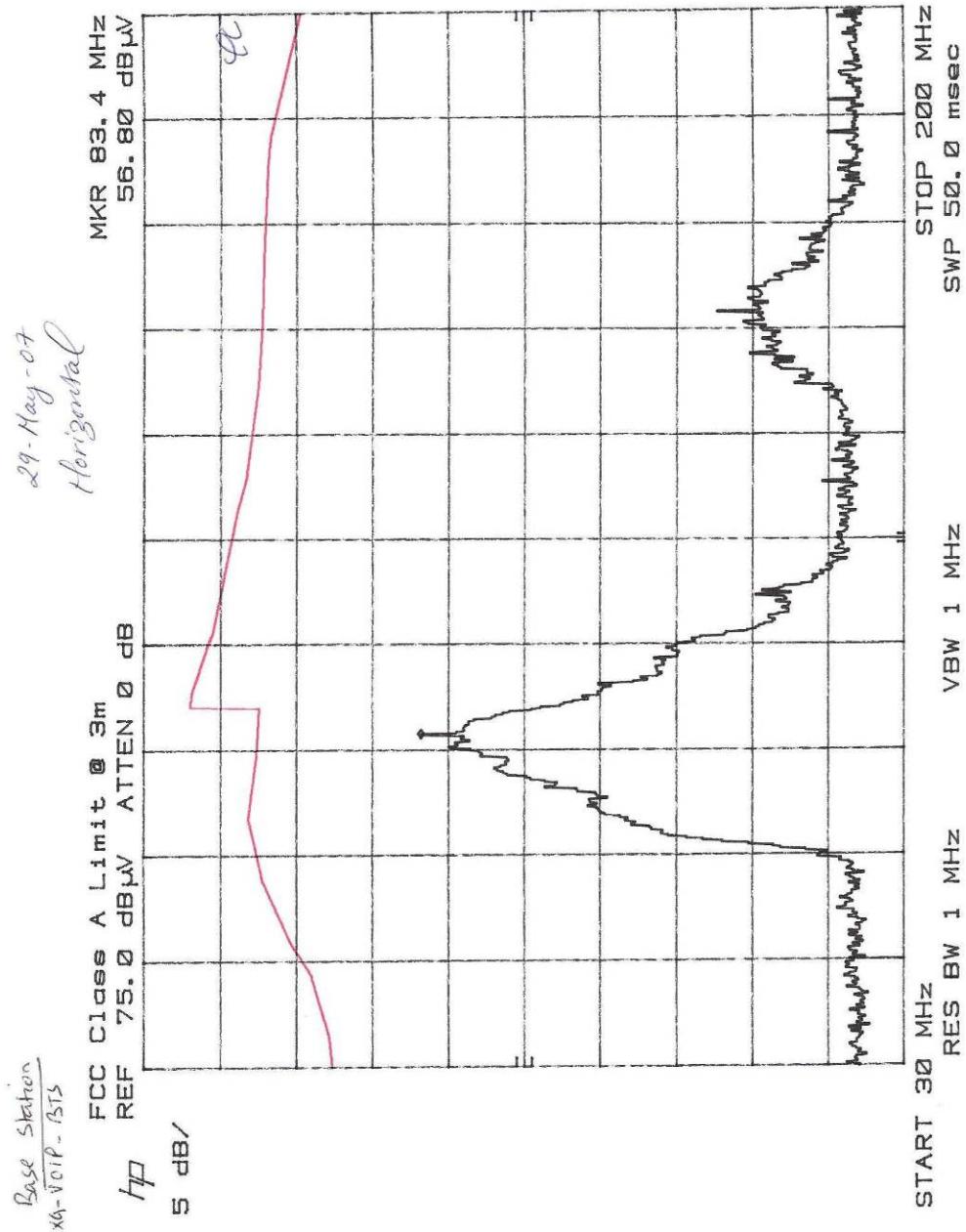


FIGURE 9: Radiated Emission 30 – 200 MHz Horizontal Polarization

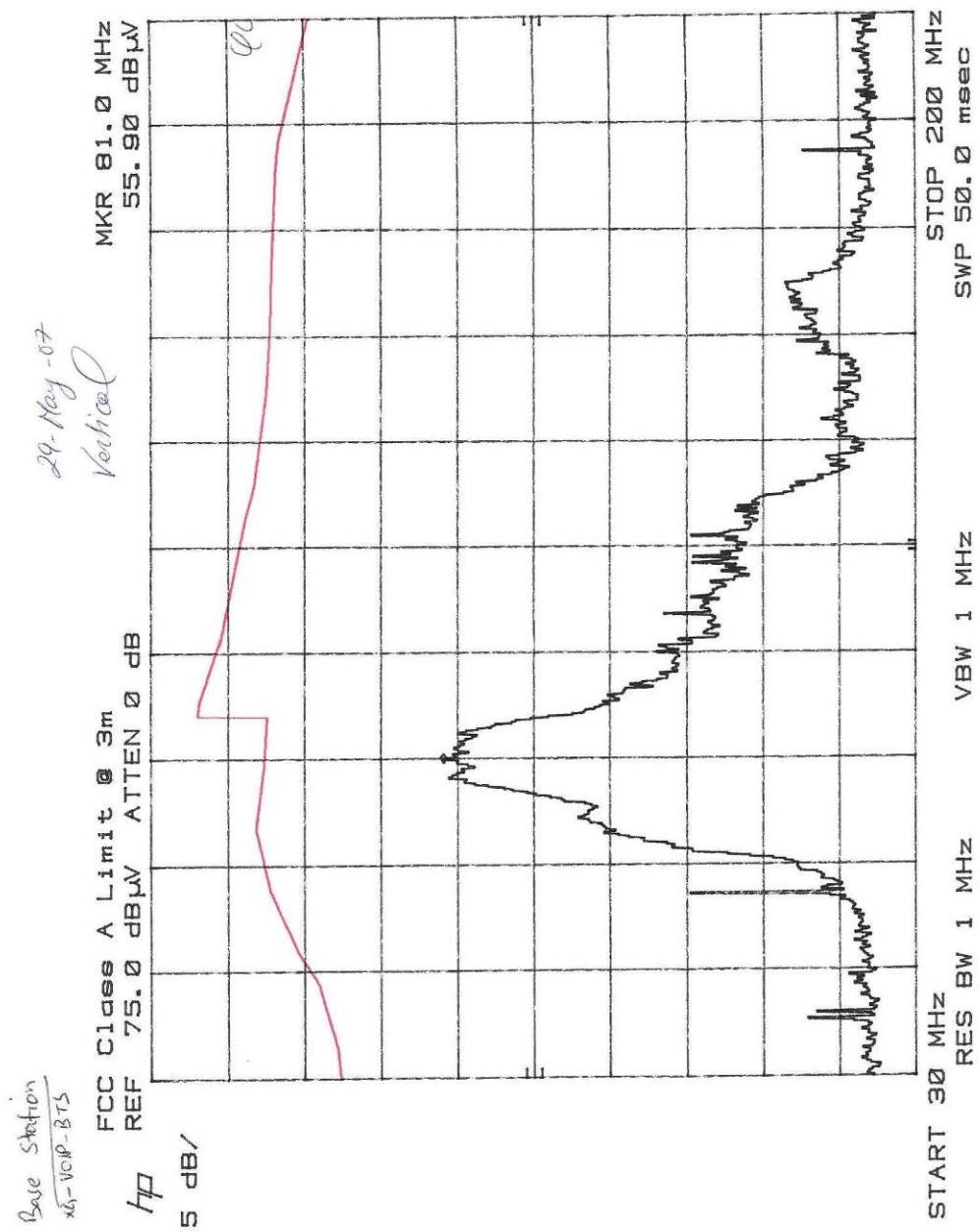


FIGURE 10: Radiated Emission 30 – 200 MHz Vertical Polarization

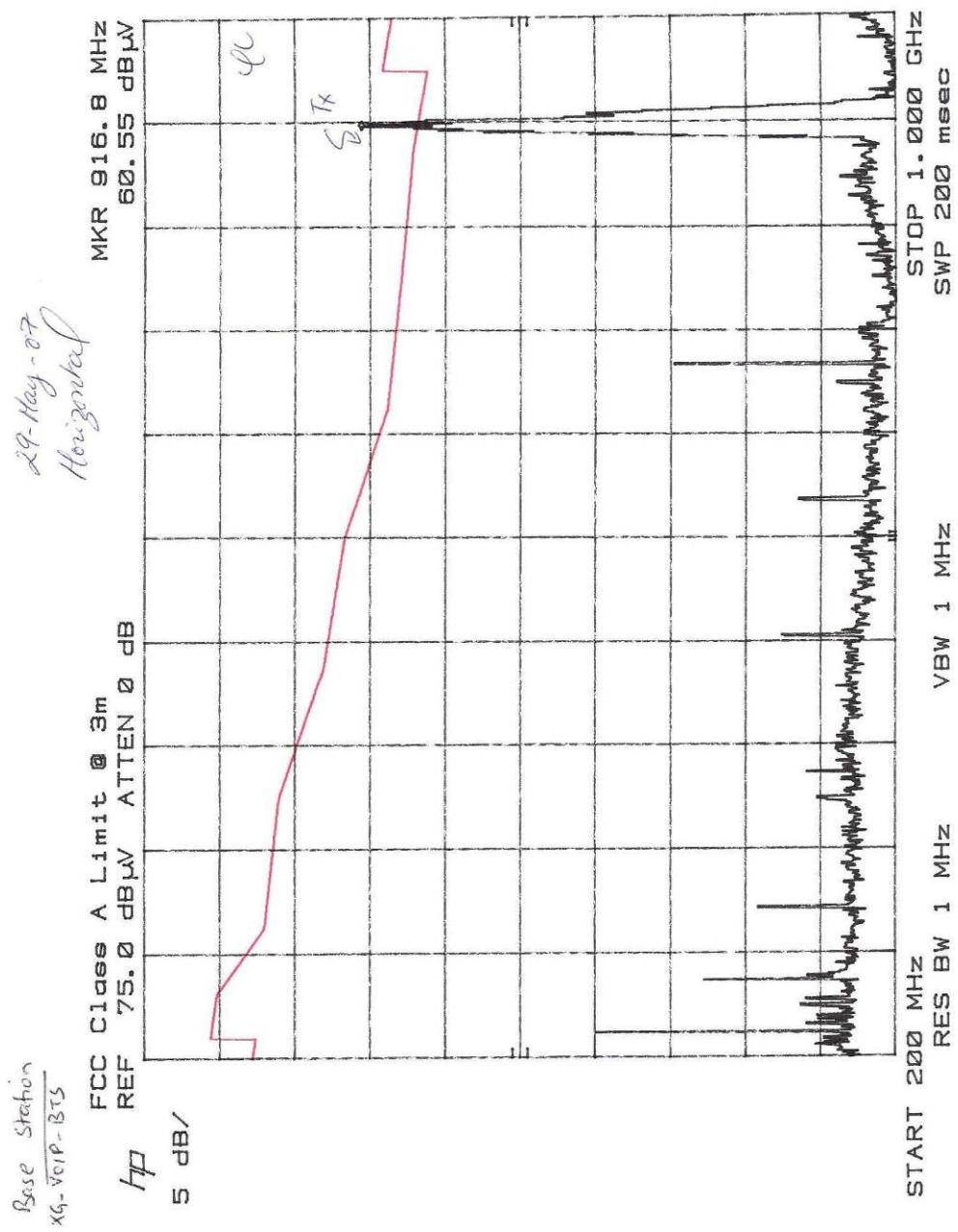


FIGURE 11: Radiated Emission 200 MHz – 1 GHz Horizontal Polarization

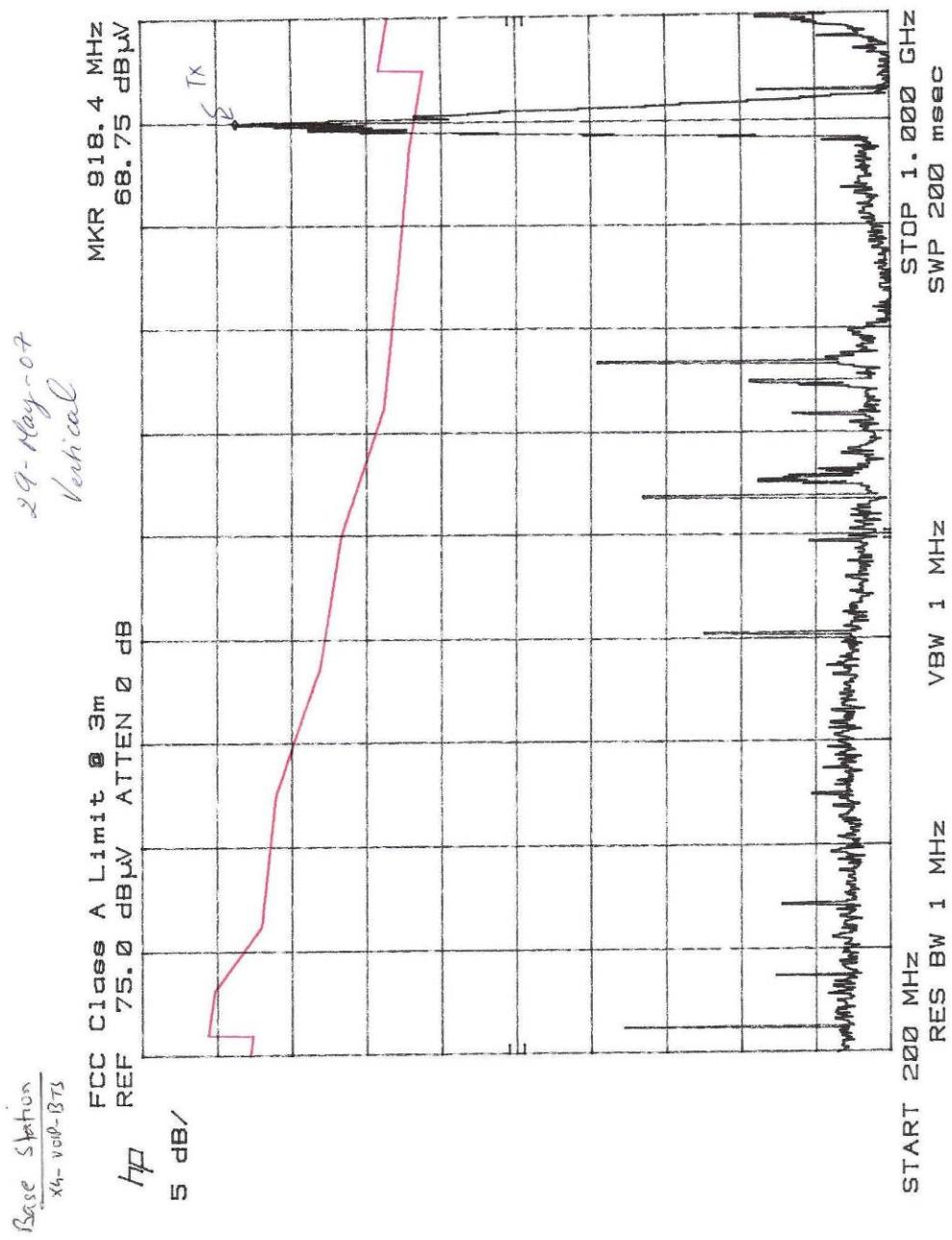


FIGURE 12: Radiated Emission 200 MHz – 1 GHz Vertical Polarization

Since the maximum operating clock frequency is 210 MHz, the unit was evaluated up to 2 GHz.

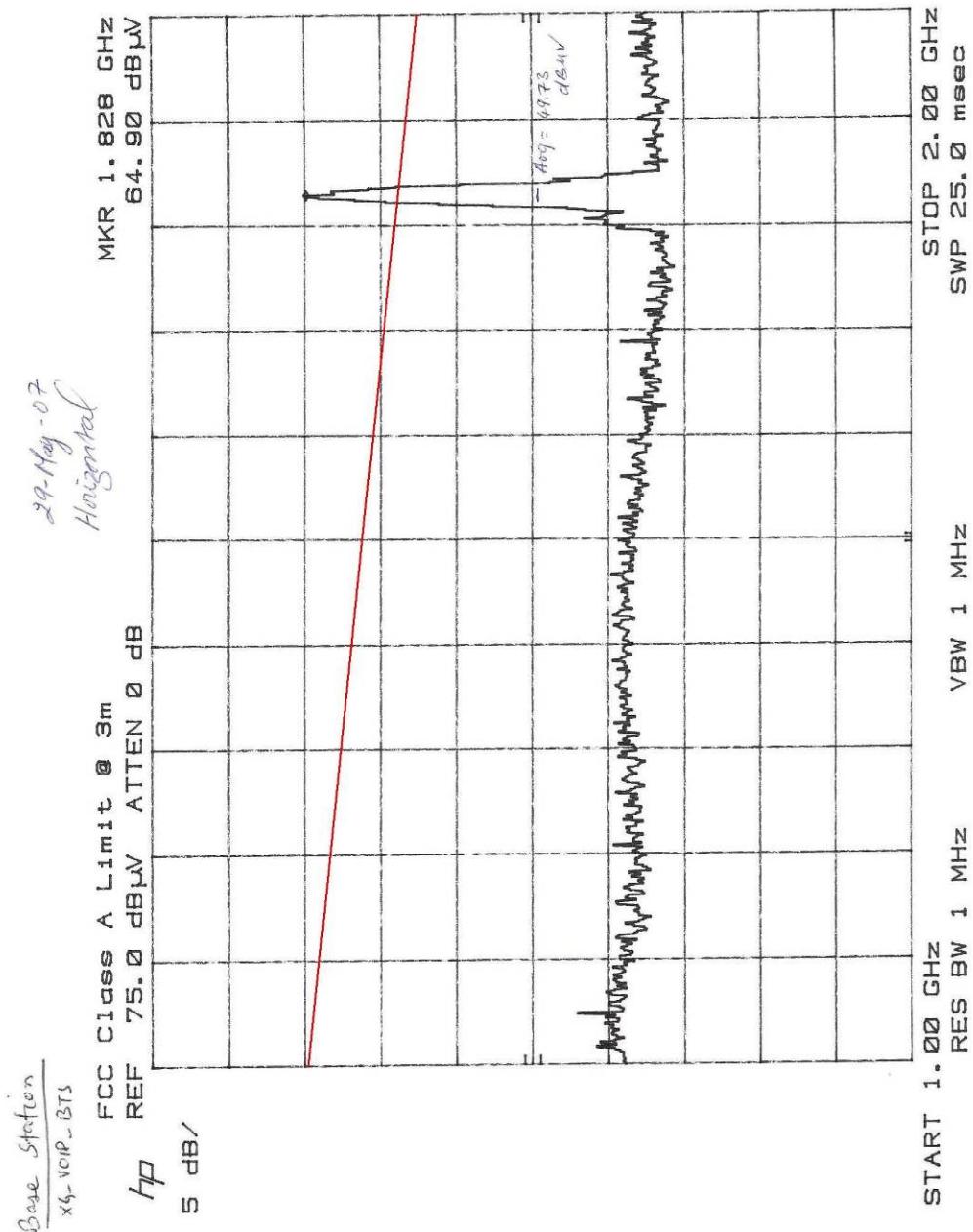


FIGURE 13: Radiated Emission 1 GHz – 2 GHz Horizontal Polarization

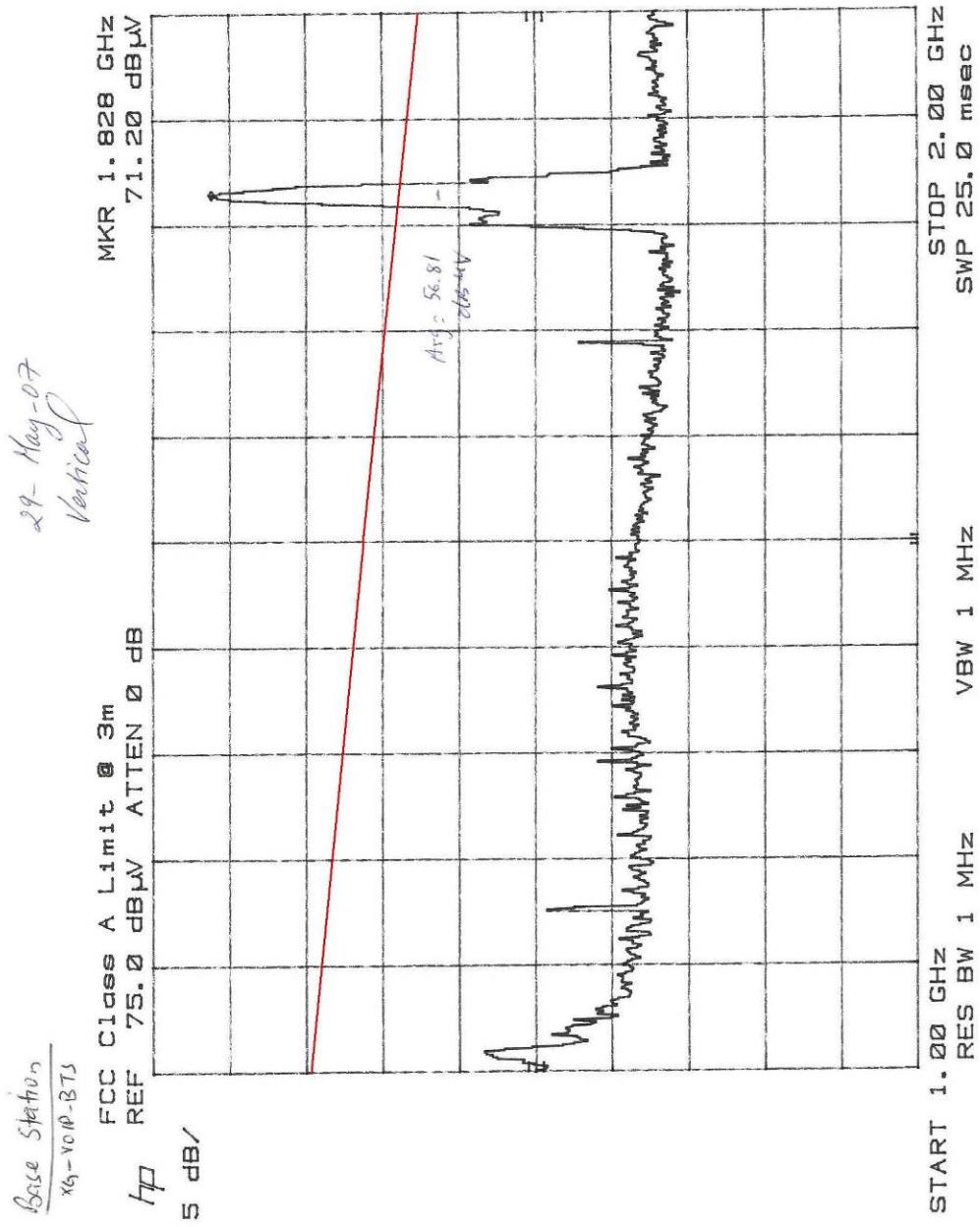


FIGURE 14: Radiated Emission 1 GHz – 2 GHz Vertical Polarization

From Figures 3-14, the unintentional peak emissions that exceeded or were within 5 dB of the limit are reported in Table 2.

| Figure No. | Frequency (MHz) | Measured Peak (dB μ V) | Quasi Peak (dB μ V) | Average (dB μ V) | Correction Factor (dB/m) | Peak Field* (dB μ V/m) | FCC Limit (dB μ V/m) | Margin to limit (dB) |
|------------|-----------------|----------------------------|-------------------------|----------------------|--------------------------|----------------------------|--------------------------|----------------------|
| 5 | 942.4 | 54.35 | | | -0.58 | 54.93 | 56.5 | 1.57 |
| 6 | 942.4 | 50.35 | | | -0.58 | 50.93 | 56.5 | 5.57 |
| 13 | 1828 | 64.9 | | 49.73 | -0.77 | 50.5 | 60 | 9.5 |
| 14 | 1828 | 71.2 | | 56.81 | -0.77 | 57.58 | 60 | 2.42 |

Table 2: Peak Measurement Results

* Peak field (dB μ V/m) = the measured value (either Peak, Quasi Peak or Average) in dB μ V - Correction Factor (dB/m)

Note that the peak emissions at 918.4 MHz from Figures 11 and 12 represent the intentional RF signal transmitted by the module, attenuated by the band reject Trilithic filter 7NM867/122-X1-AA. Therefore, these values are not reported in Table 2. The level of the transmitted signal is evaluated in Section 4.4.

It can be seen from the previous figures and Table 2 that the unintentional radiated emissions are below limit. Hence the unit is in compliance.

4.4 OCCUPIED BANDWIDTH AND CONDUCTED POWER TEST RESULTS

The XG Technology, XG-VOIP-BTS, programmed to transmit a digitally modulated signal within the ISM band of 902 to 928 MHz, using an XG proprietary modulation technique, was evaluated for occupied bandwidth and conducted power level. The device was connected to an HP 8566B Spectrum Analyzer through a Narda high power attenuator (Model 26298, Serial No.: A500) and an HP 8495B attenuator (Serial No.: 2626A11012) set to a total of 40 dB attenuation.

Figure 15 presents the occupied bandwidth using 6 dB criteria and the conducted power test results.

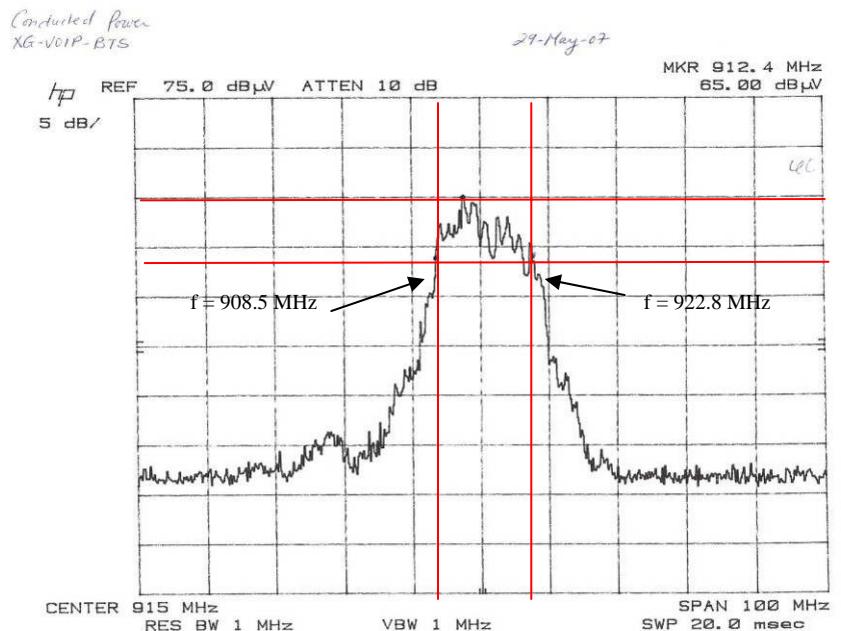


Figure 15: Conducted Power and Occupied Bandwidth Results

The 6 dB bandwidth of the XG Technology XG-VOIP-BTS unit was measured to be 14.3 MHz (908.5-922.8 MHz). Hence, the unit is operating within the band.

| SA Reading (dBµV) | Attenuator Insertion Loss (dB) | Corrected Reading (dBµV) | Corrected Power (dBm) | Power (mW) |
|-------------------|--------------------------------|--------------------------|-----------------------|------------|
| 65 | -60.3 | 125.3 | 18.3 | 67.61 |

Table 3: Conducted Power Results

Table 3 presents the conducted power results. The conducted power was measured to be 67.61 mW. Hence, the device meets the requirements of FCC Part 15, Section 15.247, occupied bandwidth and conducted power requirements.

MAJOR TEST EQUIPMENT

| FAU EMI R&D LABORATORY TEST EQUIPMENT | | | | | | |
|---------------------------------------|-----------------|---------------------|---------|------------|------------------|------------------------------|
| Equipment Type | Manufacturer | Description | Model | Serial No. | Calibration Date | Calibration Interval (Years) |
| Spectrum Analyzer | Hewlett Packard | RF Section | 8566B | 2403A06381 | Aug-22-06 | 2 |
| Spectrum Analyzer | Hewlett Packard | Display | 85662A | 2407A06381 | Aug-22-06 | 2 |
| Spectrum Analyzer | Hewlett Packard | Quasi Peak Adapter | 85650A | 2430A00559 | Aug-22-06 | 2 |
| RF Preselector | Hewlett Packard | Preselector | 85685A | 2510A00151 | Feb-8-06 | 2 |
| LISN | EMCO | LISN | 3825/2R | 1095 | March-10-06 | 2 |
| Antenna | EMCO | Biconical | 3108 | 2147 | Feb-24-06 | 2 |
| Antenna | EMCO | Log Periodic | 3146 | 1385 | Feb-24-06 | 2 |
| Amplifier | Hewlett Packard | Amplifier | 8447D | 2443A03952 | Dec-01-06 | 2 |
| Amplifier | Hewlett Packard | Microwave Amplifier | 83017A | 3123A00324 | Nov-27-06 | 2 |

TEST FACILITY

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A2LA Certification No. 2129.01

FCC Registration: 90599

Industry of Canada: IC46405-4076

| | |
|--------------------|--|
| Description | The 3m semi-anechoic chamber and Power Line Conducted Spurious Voltage test setup are constructed and calibrated to meet the FCC requirements of Section 2.948, as well as Industry Canada RSS 212 Issue 1. |
| Site Filing | A site description is on file with the Federal Communications Commission, 7435 Oakland Mills Road, Columbia, MD 21046, and with the Industry Canada, Certification and Engineering Bureau, 3701 Carling Ave., Building 94, P.O. Box 11490, Station "H", Ottawa Ontario, K2H 8S2. |
| Instrument | All measuring equipment is in accord with ANSI C63.4 and CISPR 22 requirements. |

End of Report