Class 2 Permissive Change Report for M/A-COM MASTRIII VHF Base Station

FCC Part 90 / Part 22 & IC RSS-119

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Approvals

Function	Name	Job title	Signature
Document Release Approval	Warren Johnsen	Project Manager	April 26, 2004
Author	Denis Lalonde	Radio Compliance Discipline Leader	April 26, 2004
Technical Reviewer	Jacques Rollin	EMC Advisor	April 26 2004

Accreditations

C-MAC Engineering test facilities are accredited by the Standards Council of Canada (SCC) in accordance with the scope of accreditation outlined at the following web site http://www.scc.ca/scopes/reg126-eng-s.pdf. [1]. The SCC is a member of the APLAC [13] and ILAC [14] organizations which, through mutual recognition arrangements, provide accreditation of test facilities in the member countries.

C-MAC Engineering EMC test facilities are designated, through Industry Canada MRAs, as accredited labs for EMC measurements in the following countries: USA, Australia, Singapore, Chinese Taipei (Taiwan), and the Republic of Korea.

C-MAC Engineering is ISO 9001:2000 and ISO-IEC 17025 certified and its processes are documented in the C-MAC Engineering Quality Manual [2] and Lab Operations Manual [3].

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1. Executive Summary

This test report documents the measurements performed on the M/A-COM MASTRIII VHF Base Station as part of a Class 2 Permissive Change application for the FCC Part 90/Part 22 and Industry Canada RSS-119 certifications.

Reference: - FCCID: OWDTR-0032-E

- IC: 3636B-0017 and IC: 36361931032C

The only hardware change done on the base station is the frequency change of crystal Y1, located on the Analog Filter Board (CB101070V1) within the SitePro Shelf, from 400 kHz to 384 kHz. The purpose of this Class 2 Permissive Change is to introduce a new emission designator to the grant of authorization. The XNB emission designator is a 2 level 9600 baud frequency modulated signal with a frequency deviation of +/- 1.9 kHz. The new emission designators will be: 8K25F1D, and 8K25F1E. The original equipment which received its grant of authorization in March 2004 had a similar emission with +/- 1.5 kHz deviation (7K50F1D, and 7K50F1E).

On the basis of measurements performed in April 2004, the M/A-COM MASTRIII VHF Base Station is verified to be compliant with FCC Part 90/Part 22 and Industry Canada RSS-119 requirements. The test data included in this report apply to the product titled above manufactured by M/A-COM, Inc. A detailed summary of compliance results is found in Table 2-1: Compliance Results Summary on page 7.

2. Compliance Summary

This section summarizes all the measurements performed on M/A-COM MASTRIII VHF Base Station and its compliance to FCC Part 90/Part 22 and Industry Canada RSS-119.

Table 2-1: Compliance Results Summary

Product Summary			
Product Name:	M/A-COM MASTRIII VHF Base Station	Project Manager:	Warren Johnsen
Product Code:		Measurements by :	Denis Lalonde
Product Status:		Date:	April 22, 2004

Test Cases					
Performed	**Description**	**Specification**	**Test Results**		**Notes**
			Pass	Fail	
■	RF Power	FCC Part 90.205 and 2.1046 RSS-119 sect. 5.4	■	☐	
■	Conducted Spurious Emissions	FCC Part 90.210, 22.359 and 2.1051 RSS-119 sect. 6.3	■	☐	
■	Emission Mask	FCC Part 90.210, 22.359 and 2.1049 RSS-119 sect. 6.4	■	☐	
☐	Field Strength of Spurious Emissions	FCC Part 90.210 and 2.1053	☐	☐	Not evaluated (see note 1)
☐	Frequency Stability	FCC Part 90.213 and 2.1055 RSS-119 sect. 7	☐	☐	Not evaluated
☐	Audio Frequency Response	FCC 2.1047	☐	☐	Not evaluated
☐	Audio Low Pass Filter	FCC 2.1047 RSS-119 sect. 6.6	☐	☐	Not evaluated
☐	Modulation Limiting	FCC 2.1047	☐	☐	Not evaluated
■	Occupied Bandwidth	FCC 2.202 RSP 100 sect. 7.2	■	☐	
☐	Transient Frequency Behavior	FCC 90.214 RSS-119 sect. 6.5	☐	☐	Not evaluated
☐	RF Exposure	FCC 1.1310 RSS-119 sect. 9.0	☐	☐	To be evaluated during licensing of equipment

1. In the previous FCC/Industry Canada application (FCCID: OWDTR-0032-E, IC: 3636B-0017) , the minimum Field Strength of Spurious Emissions passing margin for the VHF MASTRIII BTS was 33.1 dB. No significant increase in the conducted spurious emissions of the VHF MASTRIII BTS are noticed when the levels reported in this report and the previous FCC/Industry Canada application (FCCID: OWDTR-0032-E, IC: 3636B-0017) are compared.

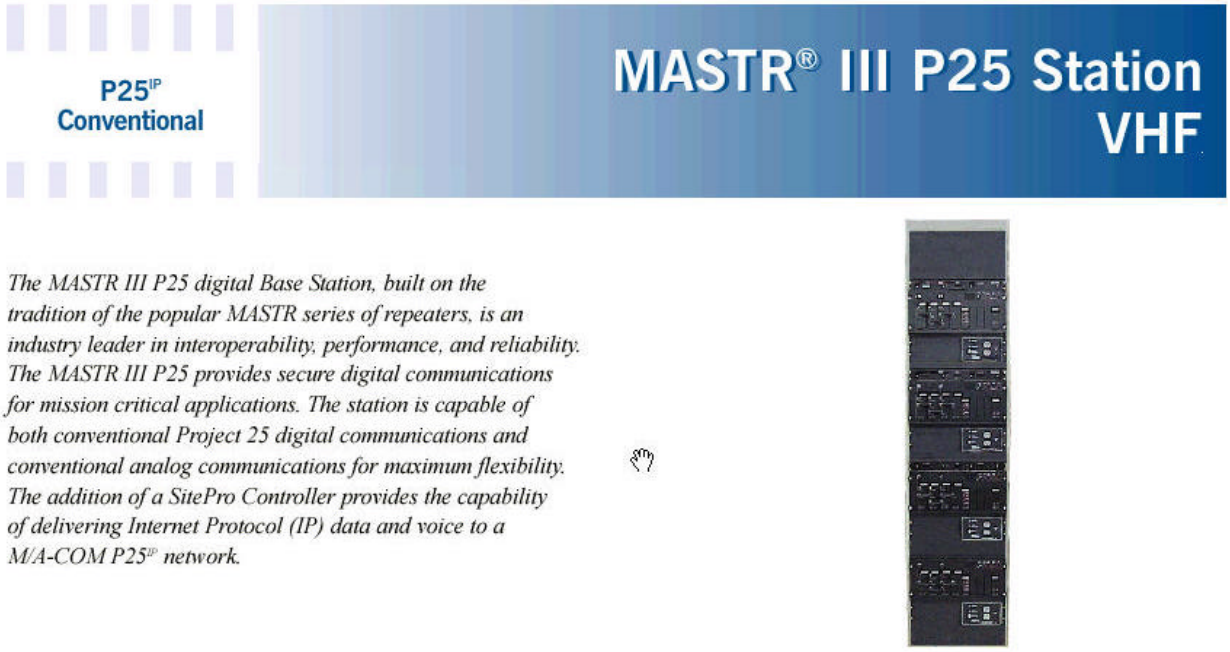
3. Equipment Under Test (EUT)

3.1 Product Functional Description

The product trade name of the unit tested was "M/A-COM MASTRIII VHF Base Station".

Figure 3-1 provides a brief description of the tested product.

Figure 3-1 Product Description



3.1.1 Description of Equipment Changes

The required modification comprises a frequency change of crystal Y1, located on the Analog Filter Board (CB101070V1) within the SitePro Shelf, from 400 kHz to 384 kHz, plus adjustment of the peak FM deviation of the transmitter. The crystal change has the effect of reducing the (programmable) modulation filter bandwidth by 4%, allowing the equipment to meet the mask with the required deviation setting.

The purpose of this Class 2 Permissive Change is to introduce a new emission designator to the grant of authorization. The XNB emission designator is a 2 level frequency modulated signal with a frequency deviation of +/- 1.9 kHz. The new emission designators will be: 8K25F1D, and 8K25F1E. The original equipment had a similar emission with +/- 1.5 kHz deviation.

3.2 Manufacturer Information

Company Name	M/A-COM, Inc.
Mailing Address	221 Jefferson Ridge Parkway, Lynchburg, Virginia, U.S.A., 24501
Product Name	M/A-COM MASTRIII VHF Base Station

3.3 Transmitter Specifications

Table 3-1 lists the specifications of the transmitter under test.

Table 3-1: Transmitter Specifications

Circuit Pack	Fundamental Frequencies (MHz)
Tx power	10 to 110 W
Tx frequency	136 to 174 MHz
Channel spacing	12.5 or 25 kHz

3.4 System Components

The system tested consists of the following units, as shown in Table 3-2.

Table 3-2: MASTRIII VHF BTS Components

Component	Model	Serial Number
MASTRIII shelf	SXGPNX	9861756
Tx Synthesizer module (low freq. split)	EA101685V1	SLR 0330 1348
Tx Synthesizer module (high freq. Split)	EA101685V2	SLR 0330 1362
Rx Synthesizer module	EA101684V1	SLR 0330 1730
Rx Front End module	19D902782G1	CKA 01346979
IF module	EA101401V1	SLR 03150255
System module	19D902590G6	SLR 03040661
DSP module	EA101800V1	SLR 03084077
Power module	19D902589G2	CKA 01390368
Power supply	19A149979P1	31725690
SitePro shelf	EA101209V1	SLR 02190892
RF Power Amplifier	EA101292V10	08324897

3.5 Support Equipment

The support equipment used for operation and monitoring of the EUT is described in Table 3-3.

Table 3-3: Support equipment

Description	Model Number
IBM Thinkpad PC	600E

3.6 System Set-up and Test Configurations

The system configuration used for all test cases is presented in Figure 3-2 and Figure 3-3.

Figure 3-2: Module configuration

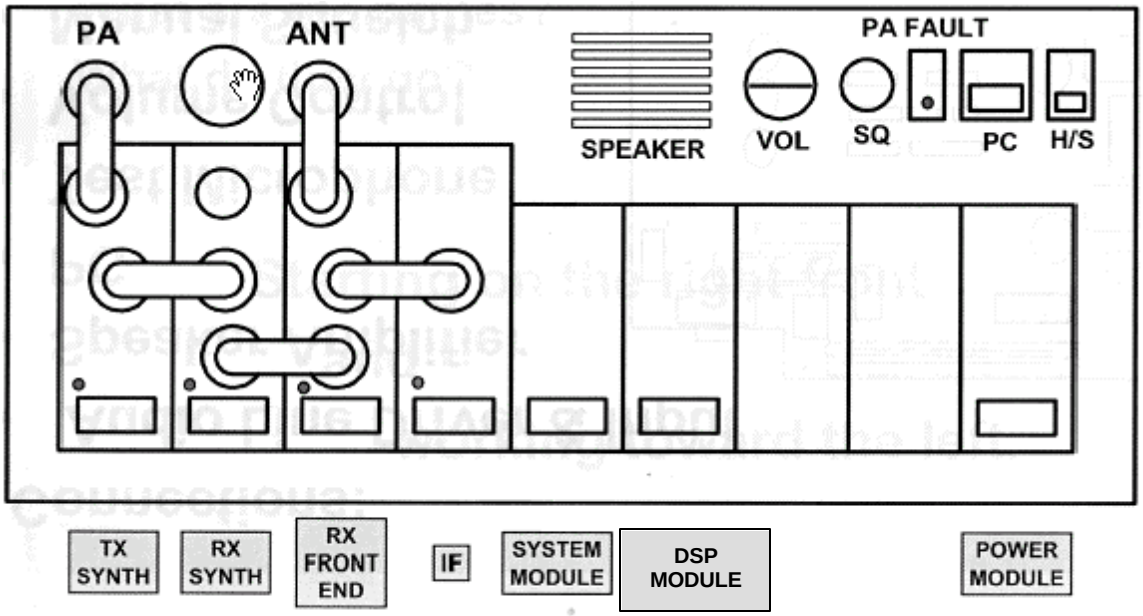
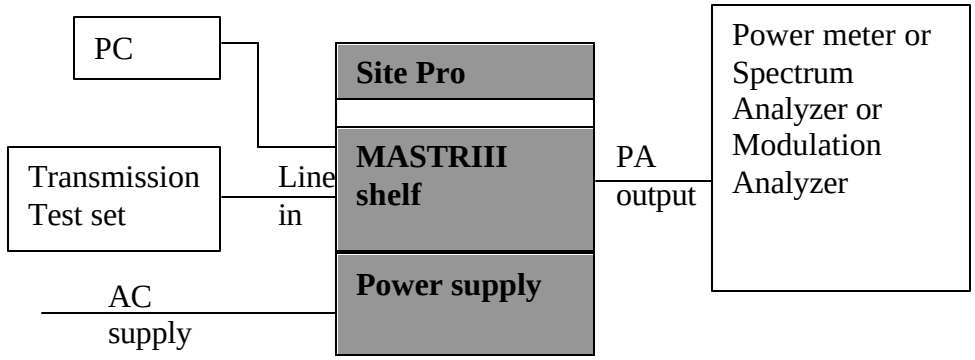


Figure 3-3: System Configuration



A photograph of the test setup used in this test report is presented in Appendix B: Test Set-up Photographs, on page 21.

3.7 System Modifications

No modifications were required to pass the requirements.

4. General Test Conditions

4.1 Test Facility

Radiated emissions testing was performed in a 10-meter Ambient Free Chamber (AFC) located at 21 Richardson Side road, Kanata, Ontario, Canada. The AFC consists of a shielded room lined with ferrite tiles and anechoic material.

These test facilities are accredited by the Standards Council of Canada (SCC) [1]. Through a Mutual Recognition Agreement (MRA) between the National Voluntary Laboratory Accreditation Program (NVLAP) and SCC, the accreditation status of the AFC facility is valid for the U.S.

4.2 Measurement Instrumentation

The measurement instrumentation conforms to ANSI C63.2 [5] and CISPR 16 [6]. Calibration of the measurement instrumentation is maintained in accordance with the supplier's recommendations, or as necessary to ensure its accuracy.

5. Detailed Test Results

5.1 RF Power

5.1.1 Test Specification

The system was tested to the requirements listed in Table 5-1:

Table 5-1: RF Power Requirements

Requirement	Part / Section
FCC	90.205, 2.1046
RSS-119	5.4

5.1.1.1 Limits

The system was tested to the rated power of the EUT, listed in Table 5-2.

Table 5-2: RF Power limit

Rated power
10 to 110 W (40 to 50.4 dBm)

5.1.2 Test Facility Information

Location: Solectron Technical Centre Lab 13

Date tested: April 22, 2004

Tested by: Denis Lalonde

5.1.3 Test Procedure

The output of the power amplifier was connected to a spectrum analyzer using a calibrated RF attenuator and cable.

The unmodulated RF signal was set in the middle of the frequency band. The lowest and highest possible power levels were evaluated. The signal was measured with Tx Synthesizers of both low and high frequency splits.

5.1.4 Test Results

Test results are shown in Table 5-3.

Table 5-3: RF power levels

Channel (MHz)	Low Power (dBm)	Hi Power (dBm)
153.975 (low freq. split)	40.0	50.5
153.975 (high freq. split)	40.1	50.5

5.1.5 Test Conclusion

The test results met the requirement.

5.1.6 Test Equipment List

Table 5-4: Test Equipment used for RF Power

Category	Manufacture	Model Number	Description	Serial Number	Cal. Due
Attenuator	Weinschel	53-10-33	10 dB, 500 W	SSG0012447	11/02/2005
Attenuator	Weinschel	6071	10 dB, 50 W	BE0951	6/11/2004
Attenuator	Microline	768-10	10 dB, 25 W	06214	6/11/2004
Spectrum analyzer	HP	8562B	22 GHz	2913A00400	25/10/2004

The measurement instrumentation conforms to ANSI C63.2[5] and CISPR 16 [6]. Calibration of the measurement instrumentation is maintained in accordance with the supplier's recommendations, or as necessary to ensure its accuracy.

5.2 Conducted Spurious Emissions

5.2.1 Test Specification

The system was tested to the limits of the requirements listed in Table 5-5:

Table 5-5: Conducted Spurious Emissions Requirement

Requirement	Part / Section
FCC	90.210, 22.359, 2.1051
RSS-119	6.3

5.2.1.1 Limits

The following specification levels are applicable to this test:

Table 5-6: Conducted Spurious Emission Limit

Frequency Range (MHz)	Limit (dBm)
30 to 1740	-19.6

The limit was calculated using the minimum attenuation requirement of FCC 90.210 d)3).

Attenuation = minimum of 50 + 10 log (P) dB or 70 dB
= minimum of 50 + 10 log (110) or 70 dB
= minimum of 70.4 dB or 70 dB
= 70 dB

ERP limit = 10 log (110 W) – 70 dB
= -19.6 dBm

5.2.2 Test Facility Information

Location:	Solectron Technical Centre Lab 13
Date tested:	April 22, 2004
Tested by:	Denis Lalonde

5.2.3 Test Procedure

Conducted spurious emissions were measured in the middle of the 136 to 174 MHz frequency band. The signal was measured with Tx Synthesizers of both low and high frequency splits.

The measurements were repeated while the power amplifier was operating at 10 W and 110 W.

The signal modulation used for measurements was a 2 level 9600 baud digital wide band signal (+/-1900 Hz deviation).

The measurement was separated in 2 frequency bands;

1. 30 MHz to 250 MHz: the power amplifier output is connected to the spectrum analyzer through a 30 dB attenuator.
2. 250 MHz to 2.0 GHz: the power amplifier output is connected to the spectrum analyzer through a 30 dB attenuator and a 250 MHz high pass filter.

5.2.4 Test Results

The test result are shown in Table 5-7.

Table 5-7: Conducted Spurious Emissions

Channel (MHz)	Low Power (dBm)	Hi Power (dBm)	Reference
153.975 (low freq. split)	<-27.3 dBm	<-26.0 dBm	Figure 7-2 to Figure 7-5
153.975 (high freq. split)	<-33.3 dBm	<-25.8 dBm	Figure 7-6 to Figure 7-9

5.2.5 Test Conclusion

The test results met the requirement.

5.2.6 Test Equipment List

Table 5-8: Test Equipment used for Conducted Spurious Emissions

Category	Manufacture	Model Number	Description	Serial Number	Cal. Due
Attenuator	Weinschel	53-10-33	10 dB, 500 W	SSG0012447	11/02/2005
Attenuator	Weinschel	6071	10 dB, 50 W	BE0951	6/11/2004
Attenuator	Microline	768-10	10 dB, 25 W	06214	6/11/2004
Spectrum analyzer	HP	8562B	22 GHz	2913A00400	25/10/2004
High Pass filter	Mini Circuits	NHP-300	250 MHz high pass	19950	NA
Signal generator	HP	8648C	3 GHz	3537A01539	05/11/2004

The measurement instrumentation conforms to ANSI C63.2[5] and CISPR 16 [6]. Calibration of the measurement instrumentation is maintained in accordance with the supplier's recommendations, or as necessary to ensure its accuracy.

5.3 Emission Mask

5.3.1 Test Specification

The system was tested to the limits of the requirements listed in Table 5-9:

Table 5-9: Emission Mask Requirement

Requirement	Part / Section
FCC	90.210, 22.359, 2.1049
RSS-119	6.4

5.3.1.1 Limits

The specification levels in Table 5-10 were used.

Table 5-10: Emission Mask Limits

Channel spacing (kHz)	2 level/9600 baud modulation WB/NB, C4FM modulation
12.5	Part 90 Mask D

The equipment was tested to Part 90 Mask D because it is more severe than the mask specified in FCC 22.359.

5.3.2 Test Facility Information

Location: Solectron Technical Centre Lab 13

Date tested: April 22, 2004

Tested by: Denis Lalonde

5.3.3 Test Procedure

One emission mask measurement was performed at 153.975 MHz with the transmitter set with a power level of 110 W and 10 W. The measurement was performed on a low and high frequency split of the tranmitter synthesizer. The signal was setup as follows:

1. XNB emission, 2 level/9600 baud modulation: the power amplifier output was modulated with a 2 level 9600 baud pseudo-random signal which had the level required for +/- 1.9 kHz deviation.

For all of these measurements, the power amplifier output was connected to the spectrum analyzer through a 30 dB attenuator.

5.3.4 Test Results

Table 5-11 lists the highest emissions measured:

Table 5-11: Emission Mask Results

Type of signal	Frequency split	Test result	Reference
XNB 2 level 9600 baud +/- 1.9 KHz deviation	Low	Pass	Figure 7-10 to Figure 7-11
XNB 2 level 9600 baud +/- 1.9 KHz deviation	High	Pass	Figure 7-12 to Figure 7-13

5.3.5 Test Conclusion

The test results met the requirement.

5.3.6 Test Equipment List

Table 5-12: Test Equipment used for Emission Mask

Category	Manufacture	Model	Description	Serial Number	Cal. Due
Attenuator	Weinschel	53-10-33	10 dB, 500 W	SSG0012447	11/02/2005
Attenuator	Weinschel	6071	10 dB, 50 W	BE0951	6/11/2004
Attenuator	Microline	768-10	10 dB, 25 W	06214	6/11/2004
Spectrum analyzer	HP	8562B	22 GHz	2913A00400	25/10/2004

The measurement instrumentation conforms to ANSI C63.2[5]. Calibration of the measurement instrumentation is maintained in accordance with the supplier's recommendations, or as necessary to ensure its accuracy.

5.4 Occupied Bandwidth

5.4.1 Test Specification

The system occupied bandwidth was evaluated according to the specifications listed in Table 5-13:

Table 5-13: Occupied Bandwidth

Requirement	Part / Section
FCC	2.202
RSP-100	7.2

5.4.2 Test Facility Information

Location: Solectron Technical Centre Lab 13

Date tested: April 22, 2004

Tested by: Denis Lalonde

5.4.3 Test Procedure

One occupied bandwidth measurement was performed at 153.975 MHz with the transmitter set at a power level of 110 W. The measurement was performed on a low and high frequency split of the tranmitter synthesizer. The signal was setup as follows:

1. XNB emission, 2 level/9600 baud modulation: the power amplifier output was modulated with a 2 level 9600 baud pseudo-random signal which had the level required for +/- 1.9 kHz deviation.

For all of these measurements, the power amplifier output was connected to the spectrum analyzer through a 30 dB attenuator.

The occupied bandwidth was measured using the 99% bandwidth measuring feature of the spectrum analyzer.

5.4.4 Test Results

Table 5-14 lists the occupied bandwidth calculated and measured results:

Table 5-14: Occupied bandwidth values

Type of signal	Calculation	Measurement (kHz)	Emission designator
XNB, 2 level 9600 baud / 1.9 KHz deviation	Max. modulation (B) = 9.6 kHz Max. deviation (D) = 1.9 kHz K = 1 Bn = B + 2DK Bn = 13.4 kHz	8.25 kHz Figure 7-14 & Figure 7-15	8K25F1D 8K25F1E

5.4.5 Test Equipment List

Table 5-15: Test Equipment used for Occupied bandwidth

Category	Manufacture	Model	Description	Serial Number	Cal. Due
Attenuator	Weinschel	53-10-33	10 dB, 500 W	SSG0012447	11/02/2005
Attenuator	Weinschel	6071	10 dB, 50 W	BE0951	6/11/2004
Attenuator	Microline	768-10	10 dB, 25 W	06214	6/11/2004
Spectrum analyzer	HP	8562B	22 GHz	2913A00400	25/10/2004

The measurement instrumentation conforms to ANSI C63.2[5]. Calibration of the measurement instrumentation is maintained in accordance with the supplier's recommendations, or as necessary to ensure its accuracy.

6. References

1. Standards Council of Canada Scope of Accreditation Letter SCC 1003-15/163 dated 2002-12-16 (Scope of accreditation is effective until 2005-10-05 and includes FCC Part 15 and ICES-003). This scope of accreditation is outlined at the following web site http://www.scc.ca/scopes/reg126-eng-s.pdf.
2. C-MAC Engineering Inc. Quality Manual, K0000608-QD-QM-01-05, March 2003.
3. C-MAC Engineering Inc. Lab Operations Manual KG000347-QD-LAB-01-03, January 2003.
4. ANSI C63.4-2001, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz, 17 June 2001.
5. ANSI C63.2-1996, American National Standard for Electromagnetic Noise and Field Strength Instrumentation, 10 Hz to 40 GHz – Specifications.
6. CISPR 16-1, Specification for Radio Disturbance and Immunity Measuring Apparatus and Methods - Part 1: Radio Disturbance and Immunity Measuring Apparatus, Edition 2.0, 1999-10.
7. C-MAC Engineering Inc., EMC General Lab Test Procedure, KP000270-LP-EMC-01-DF Feb 2002.
8. FCC Rules for Radio Frequency Devices, Title 47 of the Code of Federal Regulations), Part 2, U.S. Federal Communications Commission.
9. FCC Rules for Radio Frequency Devices, Title 47 of the Code of Federal Regulations), Part 90, U.S. Federal Communications Commission.
10. FCC Rules for Radio Frequency Devices, Title 47 of the Code of Federal Regulations), Part 22, U.S. Federal Communications Commission.
11. RSS-119, Issue 6, “Land Mobile and Fixed Radio, Transmitters and Receivers, 27.41 to 960 MHz” March 25, 2000.
12. ANSI/TIA-603-B-2002, “Land Mobile FM or PM Communications Equipment Measurement and Performance Standards”, November 7, 2002
13. APLAC, Asia Pacific Laboratory Accreditation Cooperation, Website (February 10th, 2004): http://www.aplac.org.
14. ILAC, International Laboratory Accreditation Cooperation, Website (February 10th, 2004): http://www.ilac.org/

7. Appendices

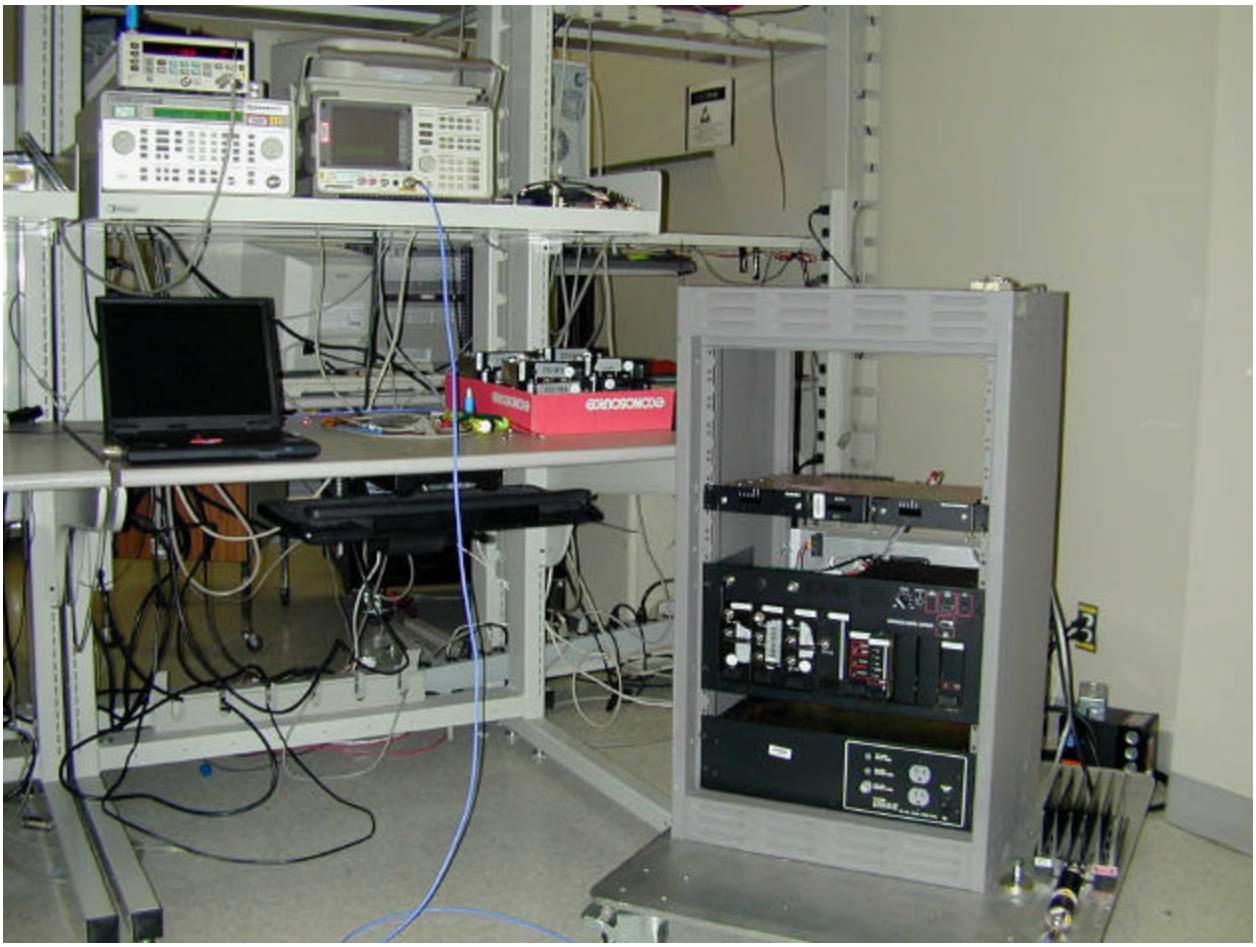
7.1 Appendix A: Glossary

Included below are definitions and abbreviations of terms used in this document.

Term	Definition
AC	Alternating Current
AFC	Ambient Free Chamber
AM	Amplitude modulation
ANSI	American National Standards Institute
AVG	Average detector
CISPR	Comité International Spécial Perturbation Radioélectrique (International Special Committee on Radio Interference)
Class A	Class A Limits for typical commercial establishments
Class B	Class B Limits for typical domestic and residential establishments
dB	Decibel
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EN	European Normative
EUT	Equipment Under Test
FCC	Federal Communications Commission, USA
GND	Ground
IC	Industry Canada
PA	Broadband Power Amplifier
RBW	Resolution Bandwidth
RF	Radio-Frequency
RFI	Radio-Frequency Interference
SCC	Standards Council of Canada

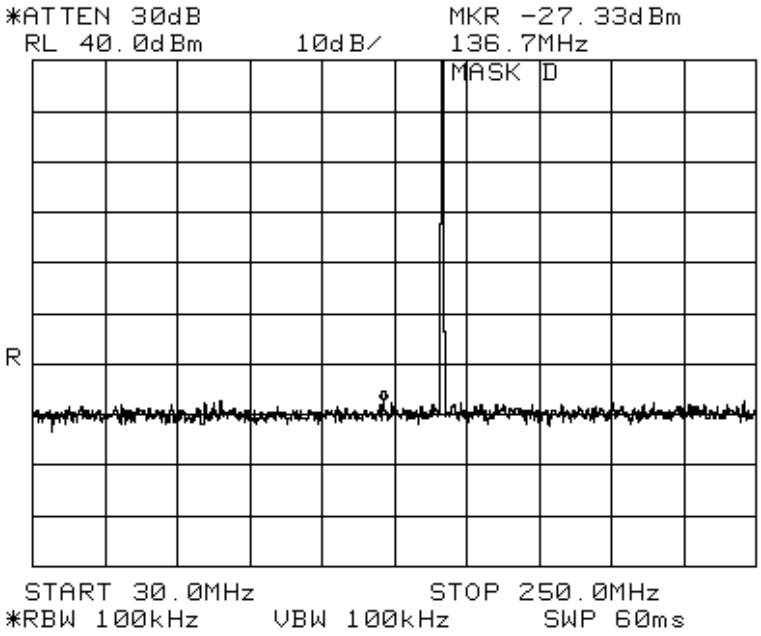
7.2 Appendix B: Test Set-up Photographs

Figure 7-1: M/A-COM MASTRIII VHF Base Station conducted emissions set-up



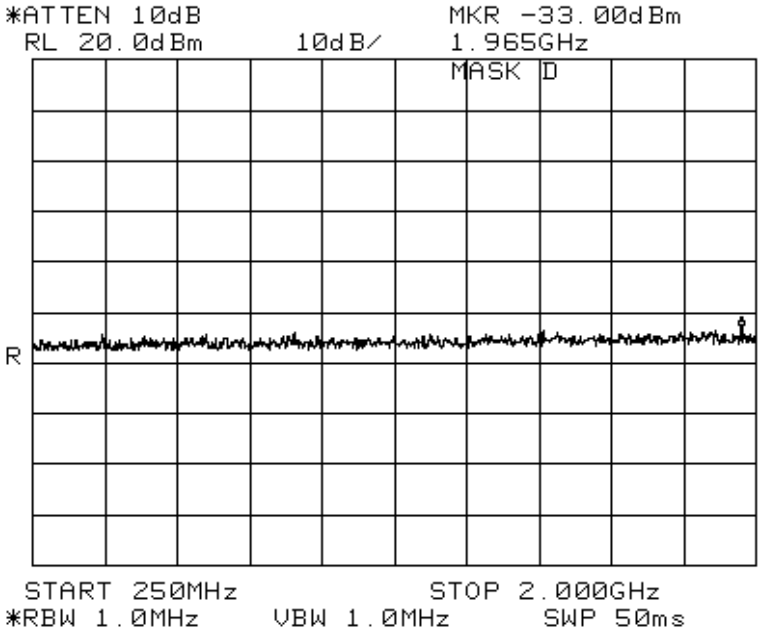
7.3 Appendix C: Conducted Spurious Emissions Plots

Figure 7-2: Tx at 153.975 MHz (low split) , 10 W power, 30 MHz to 250 MHz



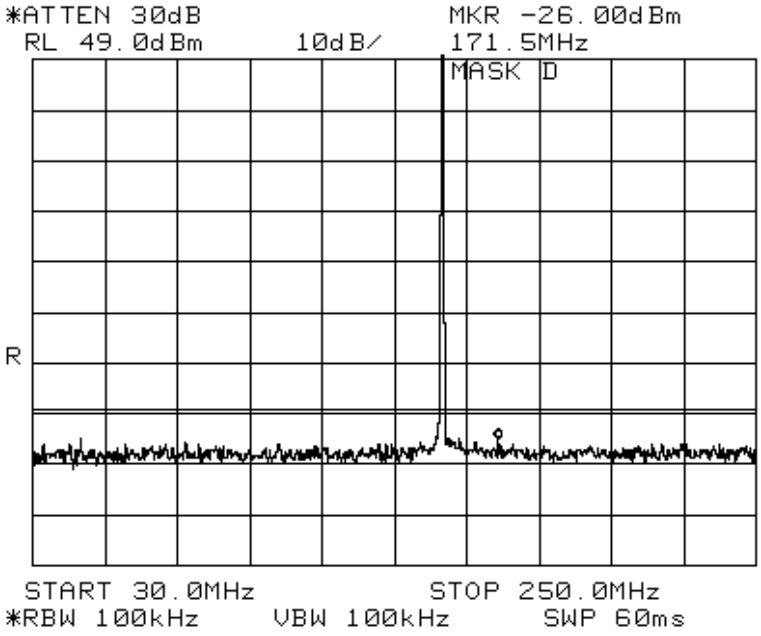
Tx at 153.975 MHz
10 W, low freq. split
2 level digital mod.
+/- 1.9 kHz deviation

Figure 7-3: Tx at 153.975 MHz (low split), 10 W power, 250 MHz to 2 GHz



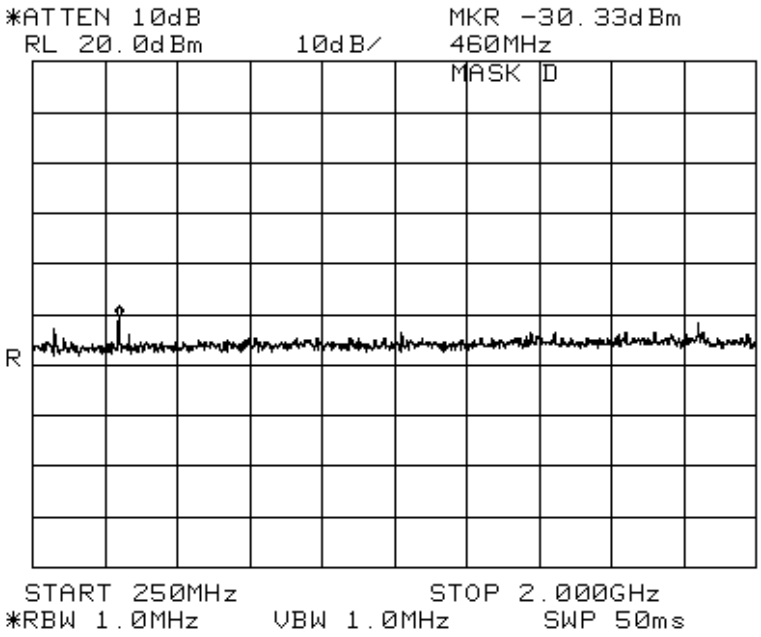
Tx at 153.975 MHz
10 W, low freq. split
2 level digital mod.
+/- 1.9 kHz deviation

Figure 7-4: Tx at 153.975 MHz (low split), 110 W power, 30 MHz to 250 MHz



Tx at 153.975 MHz
110 W, low freq. split
2 level digital mod.
+/- 1.9 kHz deviation

Figure 7-5: Tx at 153.975 MHz (low split), 110 W power, 250 MHz to 2 GHz



Tx at 153.975 MHz
110 W, low freq. split
2 level digital mod.
+/- 1.9 kHz deviation

Figure 7-6: Tx at 153.975 MHz (high split), 10 W power, 30 MHz to 250 MHz

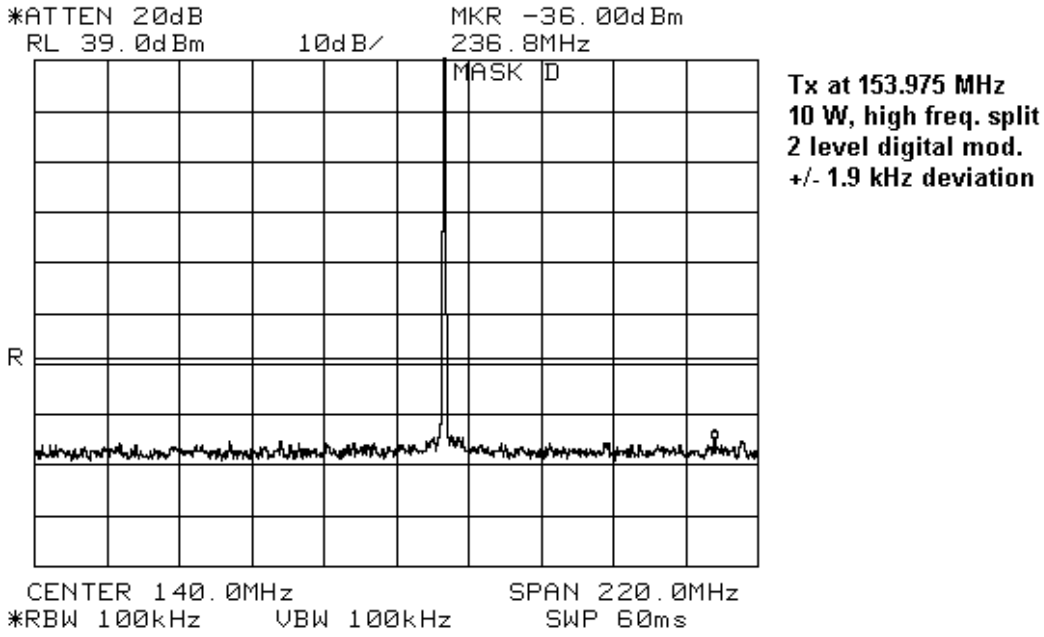


Figure 7-7: Tx at 153.975 MHz (high split), 10 W power, 250 MHz to 2 GHz

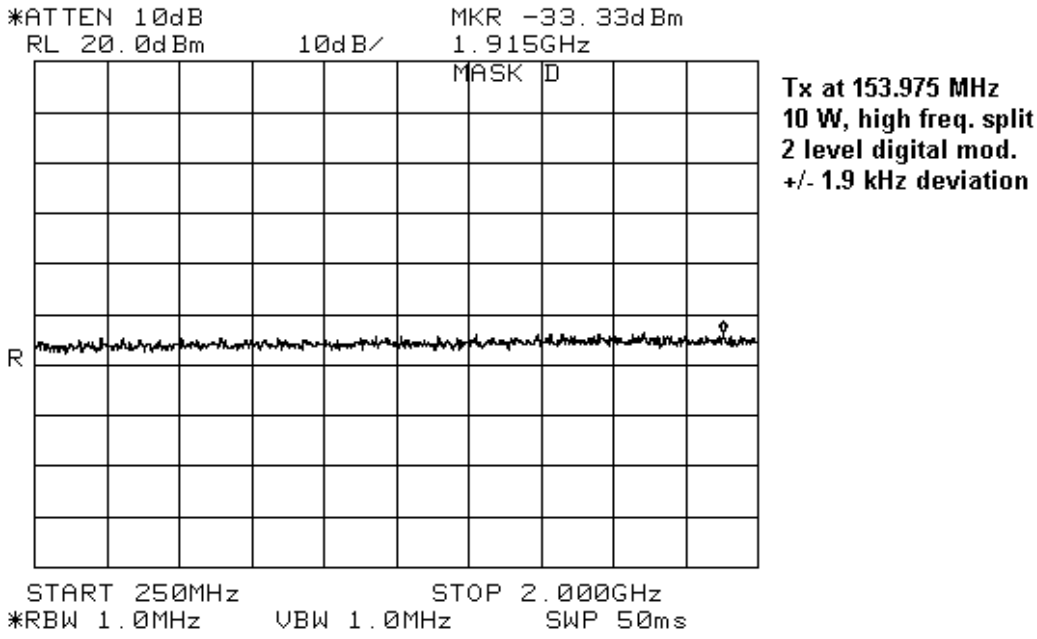
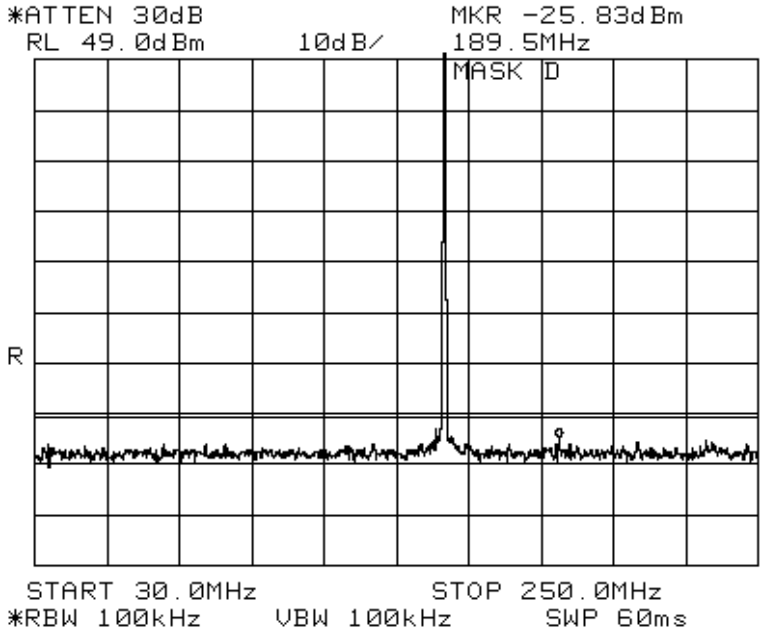
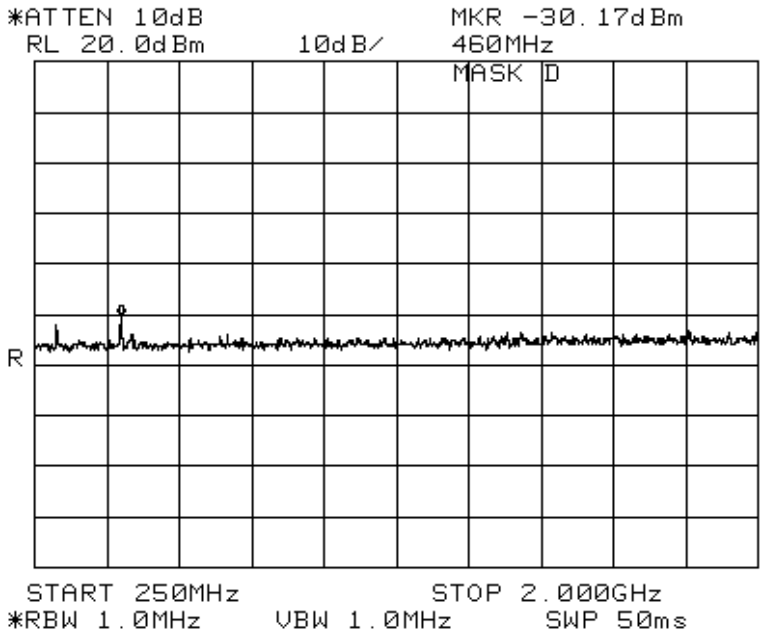


Figure 7-8: Tx at 153.975 MHz (high split), 110 W power, 30 MHz to 250 MHz



Tx at 153.975 MHz
110 W, high freq. split
2 level digital mod.
+/- 1.9 kHz deviation

Figure 7-9: Tx at 153.975 MHz (high split), 110 W power, 250 MHz to 2 GHz



Tx at 153.975 MHz
110 W, high freq. split
2 level digital mod.
+/- 1.9 kHz deviation

7.4 Appendix D: Emission Mask Plots

This appendix presents all emission mask plots for the test cases measured.

Figure 7-10: XNB 2 level 9600 baud signal with +/- 1.9 kHz deviation (low freq. split, 10 W)

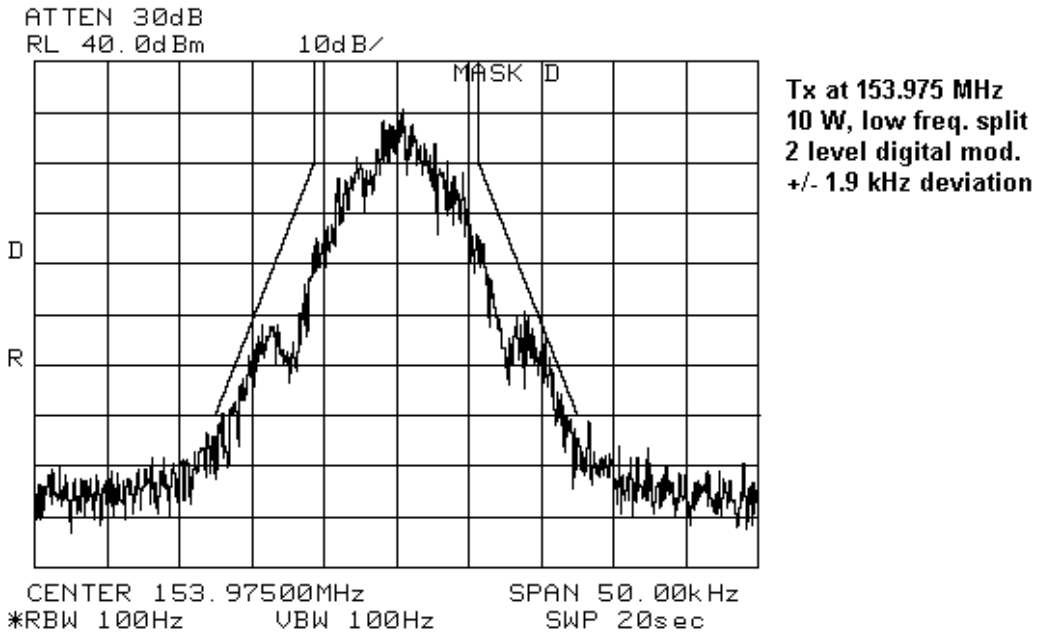


Figure 7-11: XNB 2 level 9600 baud signal with +/- 1.9 kHz deviation (low freq. split, 110 W)

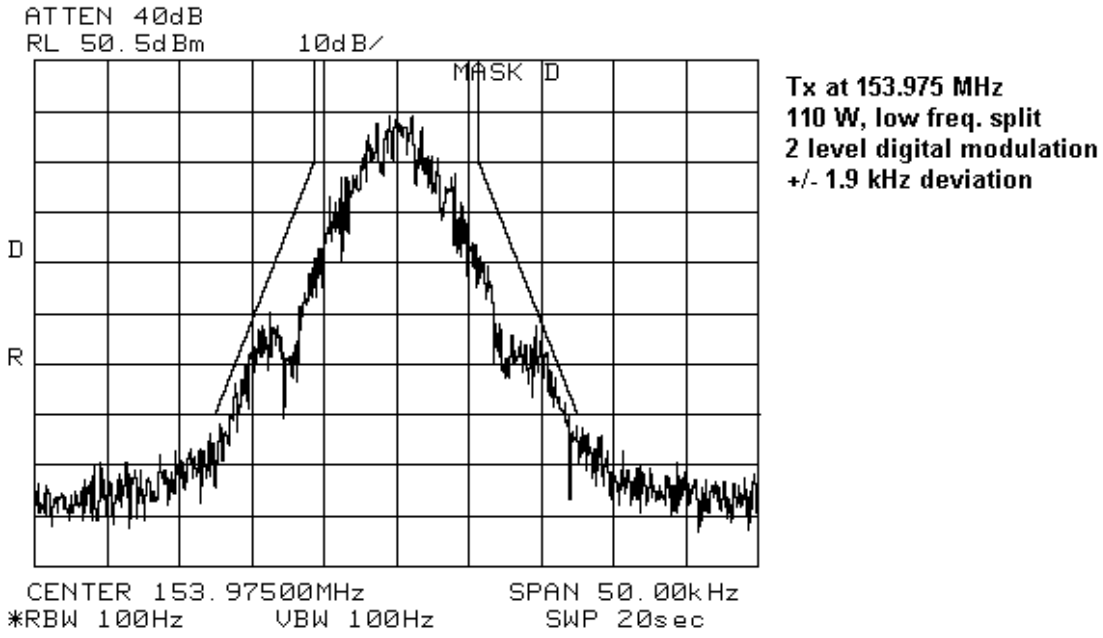
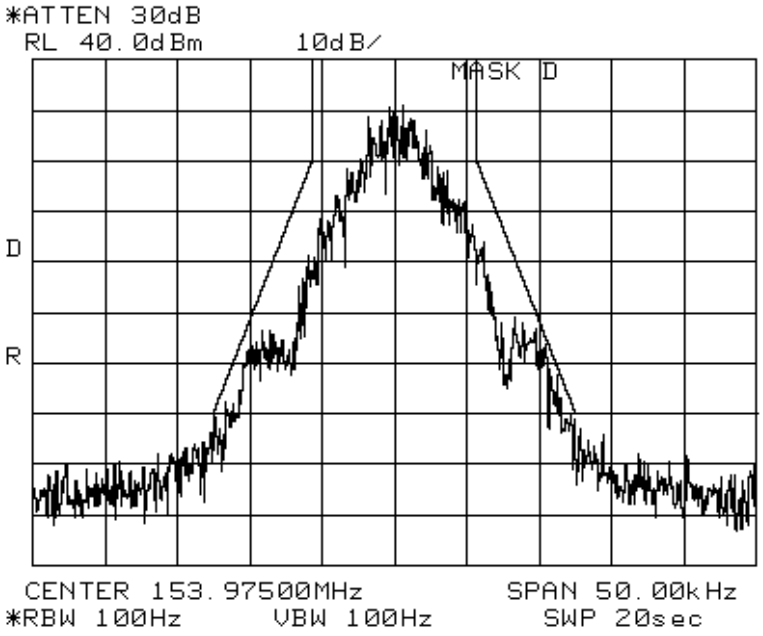
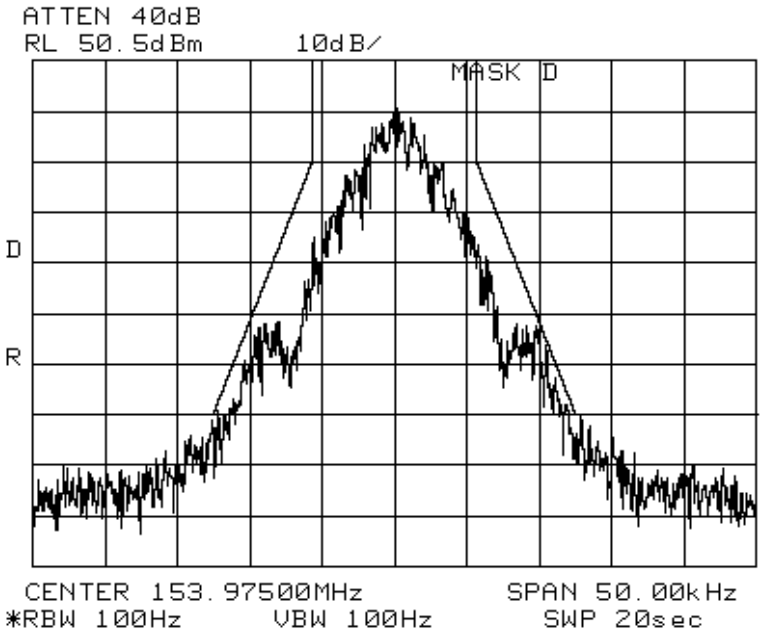


Figure 7-12: XNB 2 level 9600 baud signal with +/- 1.9 kHz deviation (high freq. split, 10 W)



Tx at 153.975 MHz
10 W, high freq. split
2 level digital mod.
+/- 1.9 kHz deviation

Figure 7-13: XNB 2 level 9600 baud signal with +/- 1.9 kHz deviation (high freq. split, 110 W)

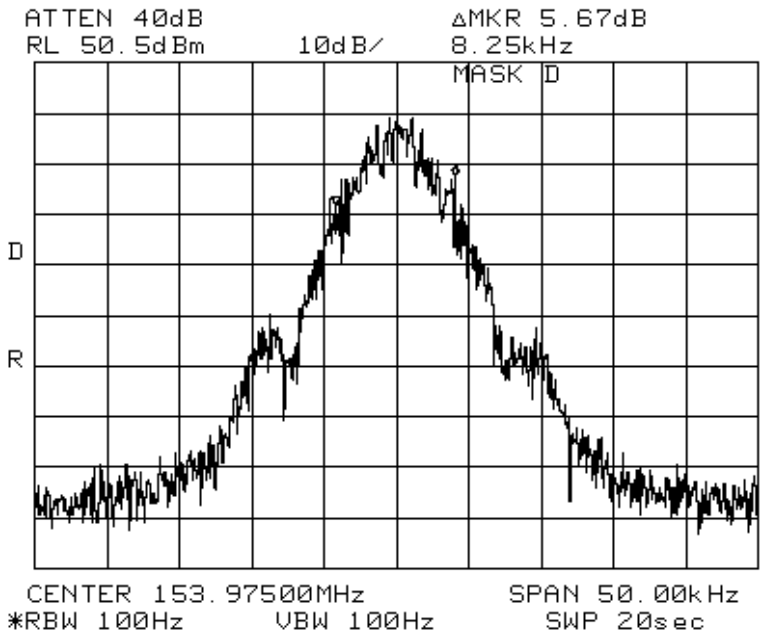


Tx at 153.975 MHz
110 W, high freq. split
2 level digital mod.
+/- 1.9 kHz deviation

7.5 Appendix E: Occupied Bandwidth Plots

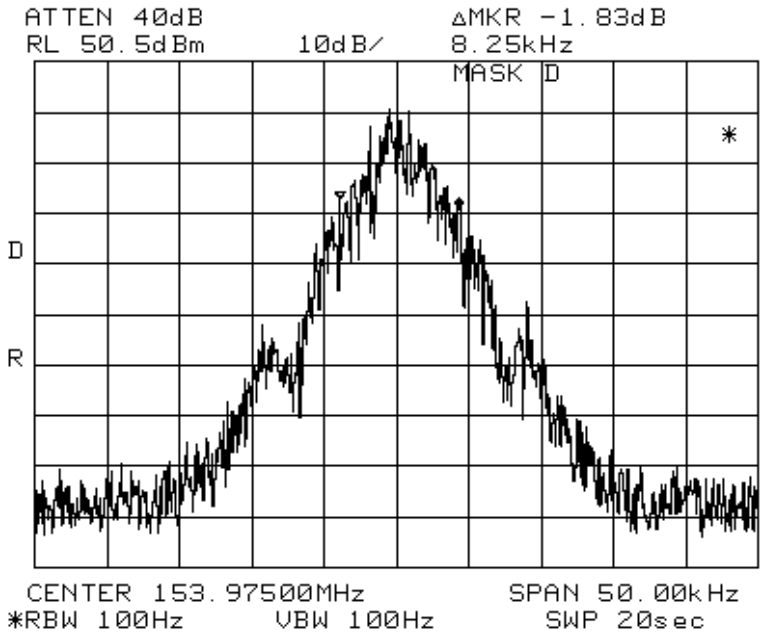
This appendix presents all occupied bandwidth plots for the test cases measured.

Figure 7-14: 2 level 9600 baud signal with 1.9 kHz deviation (low freq. split synthesizer)



Tx at 153.975 MHz
110 W, low freq. split
2 level digital mod.
+/- 1.9 kHz deviation

Figure 7-15: 2 level 9600 baud signal with 1.9 kHz deviation (high freq. split synthesizer)



Tx at 153.975 MHz
110 W, high freq. split
2 level digital mod.
+/- 1.9 kHz deviation

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