Certification Report for M/A-COM MASTRIII 800 MHz Base Station

FCC Part 90 & Industry Canada RSS-119

Document Number: **KP000706-CR-RAD-01-03**
Release Date: **October 8, 2003**

Prepared for: **M/A-COM, Inc.**
221 Jefferson Ridge Parkway
Lynchburg, Virginia
U.S.A., 24501

Author: **Denis Lalonde**
Radio Compliance Discipline Leader

C-MAC Engineering Inc.
A Solectron Company
21 Richardson Side Road,
Kanata, Ontario, K2K 2C1
http://www.solectrontechnicalctr.com/

Release Control Record

This document is based on CEI document template KG000347-TR-EMC-03.

Release no.	Reason for change	Date released
01	Original Release	September 12, 2003
02	Changed from Class 2 Permissive Change to Original Equipment	September 17, 2003
03	Added section for Occupied bandwidth	October 8, 2003

Approvals

Function	Name	Job title	Signature
Document Release Approval	Warren Johnsen	Project Manager	Oct 8/2003
Author	Denis Lalonde	Radio Compliance Discipline Leader	Oct. 8, 2003
Technical Reviewer	Jacques Rollin	EMC Advisor	Oct 8, 2003

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]

Through a Mutual Recognition Agreement (MRA) between the National Voluntary Laboratory Accreditation Program (NVLAP) and SCC, the accreditation status of this facility is valid for the U.S.

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].

Table of Contents

List of Figures

List of Tables

1. Executive Summary

This test report documents the measurements performed on the M/A-COM MASTRIII 800 MHz Base Station as part of a Original Equipment FCC and Industry Canada application.

The M/A-COM MASTRIII 800 MHz Base Station was previously granted authorization by the FCC and Industry Canada.

Reference: - FCCID: OWDTR-329-A2

- Industry Canada: 3636194215

Since the last Grant of Authorization, changes were done to the Receiver IF module and a new DSP module was introduced. This permits the introduction of a new transmitted signal: the C4FM signal (4 level FM modulation). The base station is still capable of transmitting all the signals for which it was granted authorization in the past (FCCID: OWDTR-329-A2, Industry Canada: 3636194215).

The emission designators of the C4FM signal are: 8K2F1D and 8K2F1E. They will be added to the existing list of emission designators.

On the basis of measurements performed in August and September 2003, the M/A-COM MASTRIII 800 MHz Base Station is verified to be compliant with FCC Part 90 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 9.

2. Compliance Summary

This section summarizes all the measurements performed on M/A-COM MASTRIII 800 MHz Base Station and its compliance to FCC Part 90 and Industry Canada RSS-119.

Table 2-1: Compliance Results Summary

Product Summary			
Product Name:	M/A-COM MASTRIII 800 MHz Base Station	Project Manager:	Warren Johnsen
Product Code:		Measurements by :	Denis Lalonde
Product Status:		Date:	Aug. 24 to Sept. 4, 2003

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 and 2.1051 RSS-119 sect. 6.3	■	□	
■	Emission Mask	FCC Part 90.210 and 2.1049 RSS-119 sect. 6.4	■	□	
■	Field Strength of Spurious Emissions	FCC Part 90.210 and 2.1053	■	□	
■	Frequency Stability	FCC Part 90.213 and 2.1055 RSS-119 sect. 7	■	□	
■	Audio Frequency Response	FCC 2.1047	■	□	
■	Audio Low Pass Filter	FCC 2.1047 RSS-119 sect. 6.6	■	□	
■	Modulation Limiting	FCC 2.1047	■	□	
■	Occupied Bandwidth	FCC 2.202 RSP 100 sect. 7.2	■	□	
□	RF Exposure	FCC 1.1310 RSS-119 Sect. 9.0	□	□	To be evaluated during licensing of equipment

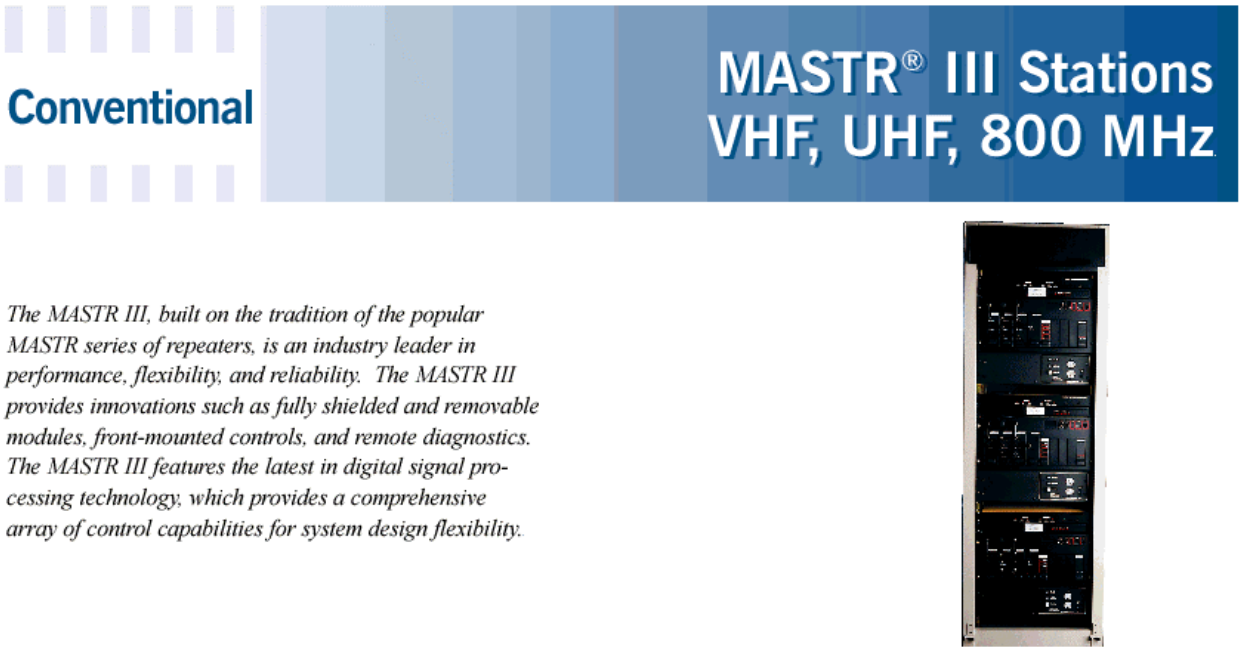
3. Equipment Under Test (EUT)

3.1 Product Functional Description

The product trade name of the unit tested was "M/A-COM MASTRIII 800 MHz 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 rationale for this Original Equipment certification application is the introduction of new and modified modules in the M/A-COM MASTRIII 800 MHz Base Station as follows:

1. New DSP module
2. Modified Receiver IF module

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 800 MHz 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 100 W
Tx frequency	851 to 870 MHz
Channel spacing	851 – 866 MHz: 25 kHz 866 – 869 MHz: 12.5 kHz (NPSPAC)

3.4 System Components

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

Table 3-2: MASTRIII 800 MHZ BTS Components

Component	Model	Serial Number
MASTRIII shelf	SXGPNX	9861756
Tx Synthesizer module	19D902780G5	SLR 02090631
Rx Synthesizer module	19D902781G5	SLR 03102203
Rx Front End module	19D902782G5	SLR 03191157
IF module	19D902783G5	SLR 03190963
System module	19D902590G6	SLR 02512492
DSP module	EA101800V1	SLR 03084077
Power module	19D902589G2	CKA 01390368
Power supply	19A149979P1	31725690
SitePro shelf	EA101209V1	SLR 02190892
RF Power Amplifier	EA101292V1	05322580

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

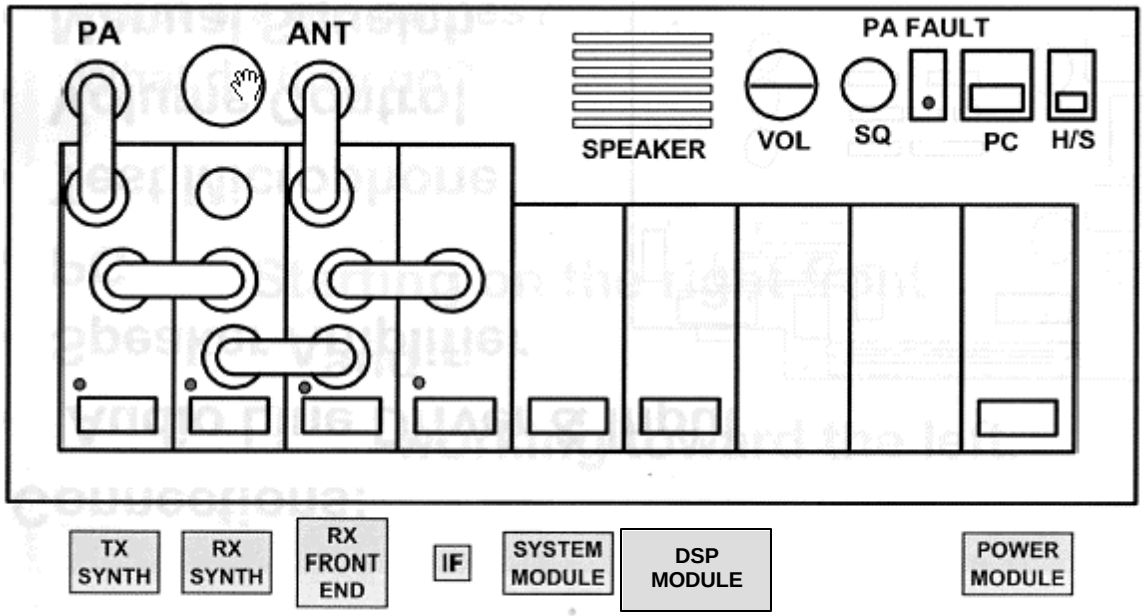
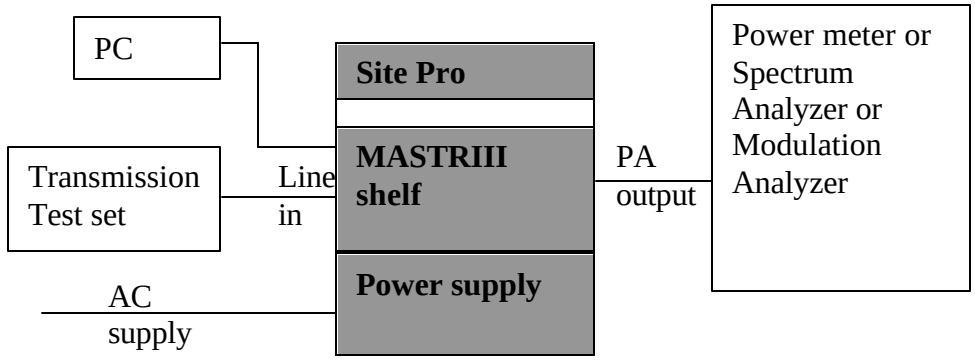


Figure 3-3: System Configuration



A photograph of the test setup used in this test report is presented in Appendix B: Test Set-up Photographs, on page 36.

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 100 W

5.1.2 Test Facility Information

Location: Solectron Technical Centre Lab 13

Date tested: Sept. 4, 2003

Tested by: Denis Lalonde

5.1.3 Test Procedure

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

The unmodulated RF signal was set at both extremities and in the middle of the frequency band. The lowest and highest possible power levels were evaluated.

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)
851.0125	40.1	50.0
860.0	40.0	50.0
869.9875	40.1	50.0

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	KT039	6/02/2004
Attenuator	Weinschel	6070-20	20 dB, 25 W	BE0847	15/04/2004
Power meter	HP	438A		3048U03578	22/10/2003
Power sensor	HP	8482A	300 mW	2652A15075	4/02/2004

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, 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 8690	-13

5.2.2 Table 5-7Test Facility Information

Location: Solectron Technical Centre Lab 13

Date tested: Sept. 4, 2003

Tested by: Denis Lalonde

5.2.3 Test Procedure

Conducted spurious emissions were measured at the bottom, middle, and top of the 851 to 870 MHz frequency band. The measurement was repeated while the power amplifier was operating at 10 W and 100 W.

The signal used for measurements at 851.0125 and 860.0 MHz was a C4FM pseudo-random signal (+/-2826 Hz deviation). The signal used at 869.9875 MHz was a NPSPAC pseudo-random signal (2 level, 9600 baud with +/-2400 Hz deviation).

The measurement was separated in 3 frequency bands;

1. 30 MHz to 1 GHz: the power amplifier output is connected to the spectrum analyzer through a 10 dB and a 20 dB attenuator.
2. 1 GHz to 2.75 GHz: the power amplifier output is connected to the spectrum analyzer through a 10 dB attenuator and a notch filter.
3. 2.75 GHz to 8.7 GHz: the power amplifier output is connected to the spectrum analyzer through a 10 dB attenuator and a high-pass filter.

5.2.4 Test Results

The test result are shown in Table 5-5.

Table 5-8: Conducted Spurious Emissions

Channel (MHz)	Low Power (dBm)	Hi Power (dBm)	Reference
851.0125	<-30 dBm	<-23 dBm	Figure 7-2 to Figure 7-7
860.0	<-30 dBm	<-23 dBm	Figure 7-8 to Figure 7-13
869.9875	<-30 dBm	<-23 dBm	Figure 7-14 to Figure 7-19

5.2.5 Test Conclusion

The test results met the requirement.

5.2.6 Test Equipment List

Table 5-9: 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	KT039	6/02/2004
Attenuator	Weinschel	6070-20	20 dB, 25 W	BE0847	15/04/2004
Spectrum analyzer	HP	8562B	22 GHz	2913A00400	24/10/2003
Spectrum analyzer	Rohde & Schwarz	FSM	26.5 GHz	828260/005	25/10/2003
High Pass filter	FSY Microwave	HR2380-11XNXN	2.5 GHz high pass	002	NA
Notch filter	Wainwrigth Instruments	WRCAS915/960-0.2/40-6EE	Tunable notch filter	1	NA
Signal generator	HP	83732A	20 GHz	3314A00190	25/10/2003

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 5-10:

Table 5-10: Emission Mask Requirement

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

5.3.1.1 Limits

The specification levels in Table 5-11 were used.

Table 5-11: Emission Mask Limits

Frequency Range (MHz)	Audio modulation	2 level/9600 baud modulation, C4FM modulation, NPSPAC modulation
851 to 866	Mask B	Mask G
866 to 869	Mask B	Mask H

5.3.2 Test Facility Information

Location: Solectron Technical Centre Lab 13

Date tested: Sept. 4, 2003

Tested by: Denis Lalonde

5.3.3 Test Procedure

Three emission mask measurements were performed at 860 MHz and one at 869.9875 MHz. Four different modulated signals were evaluated as follows:

1. Analog signal: the power amplifier output was modulated with a 2500 Hz signal which had a level 16 dB higher than what was required to produce a deviation of 50% of rated system deviation at 1 kHz. Tested at 860 MHz.
2. Two 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 +/- 3 kHz deviation. Tested at 860 MHz.
3. C4FM modulation: the power amplifier output was modulated with a C4FM pseudo-random signal which had the level required for a maximum of +/- 2826 Hz deviation. Tested at 860 MHz.
4. NPSPAC modulation (9600 baud): the power amplifier output was modulated with a 2 level 9600 baud pseudo-random signal which had the level required for +/- 2.4 kHz deviation. Tested at 869.9875 MHz.
5. NPSPAC modulation (analog) : the power amplifier output was modulated with a 2500 Hz signal which had a level 16 dB higher than what was required to produce a deviation of 50% of rated system deviation (4 kHz) at 1 kHz. Tested at 869.9875 MHz.

For all of these measurements, the power amplifier output was connected to the spectrum analyzer through a 10 dB and a 20 dB attenuator.

5.3.4 Test Results

Table 5-12 lists the highest emissions measured:

Table 5-12: Emission Mask Results

Type of signal	Test result	Reference
2500 Hz Audio	Pass	Figure 7-20
2 level 9600 baud / 3 KHz deviation	Pass	Figure 7-21
C4FM	Pass (99% bandwidth = 8.2 kHz)	Figure 7-22
NPSPAC (9600 baud)	Pass	Figure 7-23
NPSPAC (analog)	Pass	Figure 7-25

5.3.5 Test Conclusion

The test results met the requirement.

5.3.6 Test Equipment List

Table 5-h13: Test Equipment used for Emission Mask

Category	Manufacture	Model	Description	Serial Number	Cal. Due
Attenuator	Weinschel	53-10-33	10 dB, 500 W	KT039	6/02/2004
Attenuator	Weinschel	6070-20	20 dB, 25 W	BE0847	15/04/2004
Spectrum analyzer	HP	8562B	22 GHz	2913A00400	24/10/2003

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 Field Strength of Spurious Emissions

5.4.1 Test Specification

The system was tested to the limits of the following requirements:

Table 5-14: Emission Mask Requirement

Requirement	Part / Section
FCC	90.210, 2.1053

5.4.1.1 Limits

The following specification levels are worst-case limits taken from all test specifications.

Table 5-15: Field Strength of Spurious Emissions Limit

Frequency Range (MHz)	ERP Limit (dBm)
30 to 8690	-13

5.4.2 Test Facility Information

Location: Solectron Technical Centre 10m Ambient Free Chamber

Date tested: August 28, 2003

Tested by: Alain Lavoie and Denis Lalonde

5.4.3 Test Procedure

Verifications of the test equipment and AFC were performed prior to the installation of the EUT in accordance with the quality assurance procedures in KP000270-LP-EMC-01-DF [7]. The test was performed as per the relevant Test procedures: ANSI C63.4 [4].

The system was tested in the following manner:

- The EUT was placed on a turntable inside the AFC and it was configured as in normal operation. The system and its cables were separated from the ground plane by an insulating support 10 mm in height. The system was grounded in accordance with its normal installation specifications. No additional grounding connections are allowed.
- For tests between 30 MHz and 1 GHz a broadband bilog antenna was placed at a 10 m distance; a horn antenna, placed also at 10 m distance from the EUT, was used for measurements between 1 GHz and 8.7 GHz.
- A pre-scan was performed to find emissions (frequencies) requiring detail measurement. The pre-scan (using a peak detector) was performed by rotating the system 360 degrees while recording all emissions (frequency and amplitude). This procedure was repeated for antenna heights of 1 to 4 meters, in steps of 1 meter, and for horizontal and vertical polarizations of the receiving antenna (for measurements above 30 MHz).
- Prescan optimization was performed based on the pre-scan data. All frequencies, having emission levels within 10 dB of the specification(s) limits, were optimized. For each such frequency, the EUT was rotated in azimuth over 360 degrees and the direction of maximum emission was noted. Antenna height was then varied from 1 to 4 meters at this azimuth to obtain maximum emissions. The procedure was repeated for both horizontal and vertical polarizations of the search antenna. Then the maximum level measured was recorded.
- The frequency range investigated was 30 MHz to 8.7 GHz.
- Between 30 MHz and 1 GHz, a resolution bandwidth of 120 kHz was used.
- Above 1 GHz, a 1 MHz resolution bandwidth and 1 MHz video bandwidth were used.

- The highest emissions were evaluated using the substitution method. This is accomplished by replacing the EUT by a calibrated antenna, cable and signal generator. This equipment is used to transmit a signal that will generate a RF meter reading level identical to the one recorded when the EUT was present. The signal generator power level, the calibration data of the cable and antenna is then used to evaluate the Effective Radiated Power (ERP) of the EUT. The following formula is used:

ERP = Signal generator level – Cable losses + Antenna gain (dBi) – Gain of tuned dipole (dBi)

Margin = Limit – ERP

The measurement was performed while the power amplifier was operating at 10 W and 100 W. A C4FM signal at 860 MHz was used for this test. A 50 ohm load was connected to the power amplifier output.

5.4.4 Test Results

Table 5-16 lists the highest emissions measured, all other emission had more than 20 dB margin:

Table 5-16: Field Strength of Spurious Emissions

Channel (MHz)	ERP Low Power (dBm)	ERP Hi Power (dBm)	Margin (dB)	Reference
1720	-40	-33	20	Figure 7-25 to Figure 7-28
2580	-30.8	-14.7	1.7	Figure 7-25 to Figure 7-28
3266	-25.0	-28.3	12.0	Figure 7-25 to Figure 7-28
3440	<-50	-44.7	31.7	Figure 7-25 to Figure 7-28
4300	<-47	-22.4	9.4	Figure 7-25 to Figure 7-28
5160	<-50	-34.3	21.3	Figure 7-25 to Figure 7-28
6020	<-48	-26.3	13.3	Figure 7-25 to Figure 7-28
6880	<-49	-37.6	24.6	Figure 7-25 to Figure 7-28
7740	<-55	-35.3	22.3	Figure 7-25 to Figure 7-28
8600	<-47	-43.1	30.1	Figure 7-25 to Figure 7-28

5.4.5 Test Conclusion

The test results met the requirement.

5.4.6 Test Equipment List

Table 5-17: Test Equipment used for Field Strength of Spurious Emissions

Category	Manufacture	Model	Description	Serial Number	Cal. Due
Antenna	EMCO	3115	Horn antenna	9603-4692	19/02/2004
Substitution cable	UTIFLEX	UFA210B	3m , N-type conn.	N99KS0791	22/10/2003
Substitution signal generator	Wiltron	69369A	40 GHz	670022	5/11/2003
Amplifier	HP	8447D	Pre Amplifier #2	2944A06919	4-Mar-04
Amplifier	BNR	LNA-A5	LNA 1-18GHz	A5	6-Feb-04
Antenna	A R	2420/A	Bilog - 30MHz-1000MHz	1113	19-Dec-03
Antenna	EMCO	3115	Double Ridge Guide Horn	9711-5314	19-Dec-03
Cable-RF	HUBER & SUHNER	SUCO 104PEA	AFC Bulkhead #5	10242/4PEA	22-Oct-03
Cable-RF	SUCOFLEX	106/A	AFC Bulkhead #2	1060	18-Feb-04
Cable-RF	SUCOFLEX	106/A	AFC Bulkhead #1	1061	18-Feb-04
Cable-RF	MICRO-COAX		AFC Bulkhead #4	97G1446	23-Oct-03
Software	UL	EMI Software	EMI Software	V 3.02	n/a
S A	HP	8566B	(AFC#1) SA	3014A07256	25-Jul-04
S A	HP	8566B	(AFC#1) Display Unit	3026A20026	25-Jul-04
S A	HP	85685A	(AFC#1) RF Preselector	3010A01085	25-Jul-04
S A	HP	85650A	(AFC#1) QPA	3107A01549	25-Jul-04
Mast & Turntable	Sunol Sciences	SC99V	Dual mast & turntable ctrl'r	120498-1	n/a

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.

5.5 Frequency Stability

5.5.1 Test Specification

The system was tested to the limits of the following requirements:

Table 5-18: Frequency Stability Requirement

Requirement	Part / Section
FCC	90.213, 2.1055
RSS-119	7.0

5.5.1.1 Limits

The specification levels are listed in Table 5-19.

Table 5-19: Frequency Stability Limits

Frequency Range (MHz)	Minimum Frequency Stability (ppm)
851 to 866	1.5
866 to 869 MHz	1.0

5.5.2 Test Facility Information

Location: Solectron Technical Centre Lab 9

Date tested: Sept. 2, 2003

Tested by: Denis Lalonde

5.5.3 Test Procedure

The unmodulated output of the power amplifier was connected trough attenuators into a spectrum analyzer with frequency counting capability. A 10 MHz rubidium frequency reference was used to provide improved frequency accuracy to the spectrum analyzer.

The base station was installed in an environmental chamber. The temperature was changed from – 30 degree Celsius up to 50 degree Celsius in 10 degree increments while the EUT was powered

off. The temperature was allowed to stabilize for 1 hour after changing the temperature. The measurement of frequency was done 5 minutes after the base station was powered on.

Frequency accuracy measurement were also performed at 25 degree Celsius while modifying the voltage of the AC mains from 85% (102 VAC) to 115% (138 VAC) of the nominal value (120 VAC).

5.5.4 Test Results

Table 5-20 lists the frequency stability measurement results:

Table 5-20: Frequency Stability Results

Temperature (degree. Celsius)	AC Voltage (V)	Frequency (MHz)	Frequency Error (ppm)
-30	120	860.000320	0.37
-20	120	860.000497	0.58
-10	120	860.000327	0.38
0	120	860.000053	0.06
10	120	859.999850	-0.17
20	120	859.999816	-0.21
30	120	859.999699	-0.35
40	120	859.999750	-0.29
50	120	859.999475	-0.61
25	102	859.999840	-0.19
25	120	859.999835	-0.19
25	138	859.999828	-0.20

5.5.5 Test Conclusion

The test results met the requirement.

5.5.6 Test Equipment List

Table 5-21: Test Equipment used for Signal Leads Conducted Emissions

Category	Manufacture	Model	Description	Serial Number	Cal. Due
Frequency Reference	UCT	2008	Rubidium 10 MHz	A1010	14/04/2004
Attenuator	Weinschel	53-10-33	10 dB, 500 W	KT039	6/02/2004
Attenuator	Weinschel	6070-20	20 dB, 25 W	BE0847	15/04/2004
Spectrum analyzer	HP	8562B	22 GHz	2913A00400	24/10/2003

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.

5.6 Audio Frequency Response

5.6.1 Test Specification

The system was tested to the limits of the following requirement:

Table 5-22: Frequency Response Requirement

Requirement	Part / Section
FCC	2.1047

5.6.1.1 Limits

The specification levels are listed in Table 5-23.

Table 5-23: Frequency Response Limit

Frequency Range (kHz)	TIA 603-b [11] Recommended Response (dB)
0.3 to 2.5	+1 dB or -3 dB from a true 6 dB per octave pre-emphasis characteristic as referenced to the 1000 Hz level. The exception is from 500 Hz to 300 Hz, where an additional 6 dB per octave rolloff is allowed.
2.5 to 3	An additional 6 dB per octave attenuation is allowed

5.6.2 Test Facility Information

Location: Solectron Technical Centre Lab 13

Date tested: Sept. 3, 2003

Tested by: Denis Lalonde

5.6.3 Test Procedure

The frequency deviation of the transmitter output was initially set to 20% of the rated system deviation at 1 kHz by varying the level in the audio input signal to the base station. The frequency of the input signal was then swept from 100 Hz to 5 kHz while keeping the input level constant. The frequency deviation was recorded as the input frequency was changed.

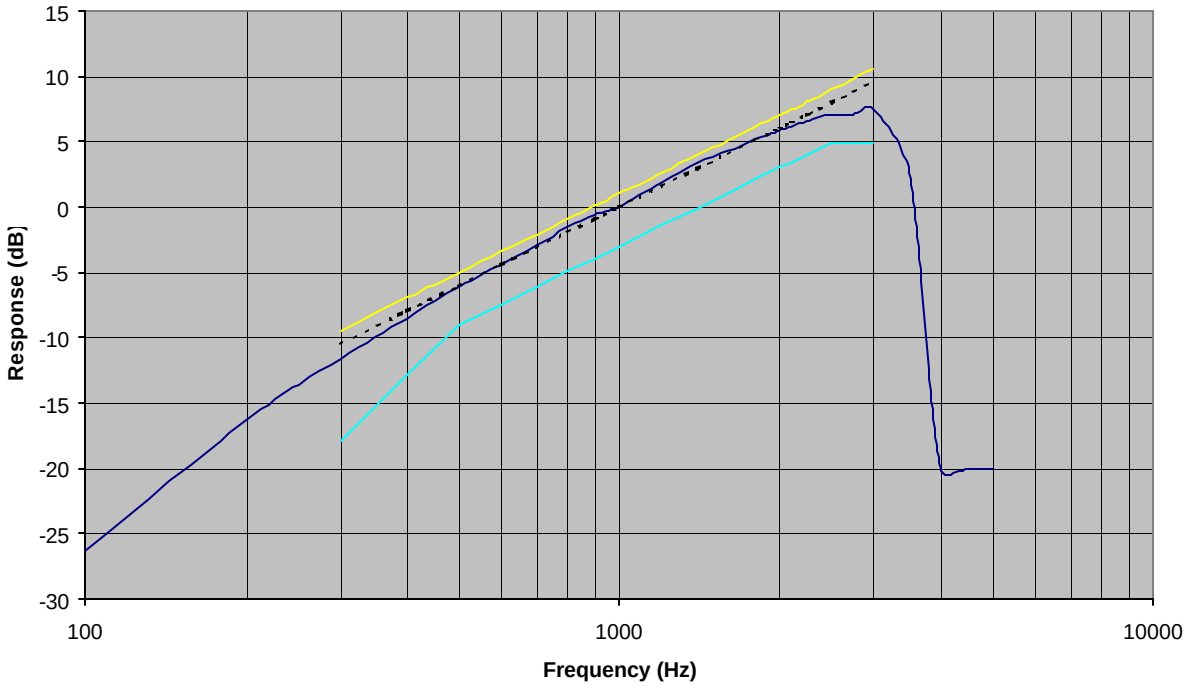
The frequency response was determined by the following formula.

Response (dB) = 20 log (measured frequency deviation/frequency deviation at 1 kHz)

5.6.4 Test Results

Figure 5-1 illustrates the frequency response of the system:

Figure 5-1: Frequency Response results



5.6.5 Test Conclusion

The test results met the requirement.

5.6.6 Test Equipment List

Table 5-24: Test Equipment used for Frequency Response Measurement

Category	Manufacture	Model	Description	Serial Number	Cal. Due
Modulation Domain analyzer	HP	53310A		3121A01217	14/08/2004
Transmission Test Set	HP	4934A		3547U12666	28/03/2004
Attenuator	Weinschel	53-10-33	10 dB, 500 W	KT039	6/02/2004
Attenuator	Weinschel	6070-20	20 dB, 25 W	BE0847	15/04/2004

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.

5.7 Audio Low Pass Filter Response

5.7.1 Test Specification

The system was tested to the limits of the following requirements:

Table 5-25: Audio Low Pass Filter Response Requirement

Requirement	Part / Section
FCC	2.1047
RSS-119	6.6

5.7.1.1 Limits

The specification levels are listed in Table 5-19.

Table 5-26: Audio Low Pass Filter Response Limit

Frequency Range (kHz)	RSS-119 Recommended Attenuation (dB)
3 to 20	60 log (freq.(Hz)/3000)
20 to 30	50

5.7.2 Test Facility Information

Location: Solectron Technical Centre Lab 13

Date tested: Sept. 3, 2003

Tested by: Denis Lalonde

5.7.3 Test Procedure

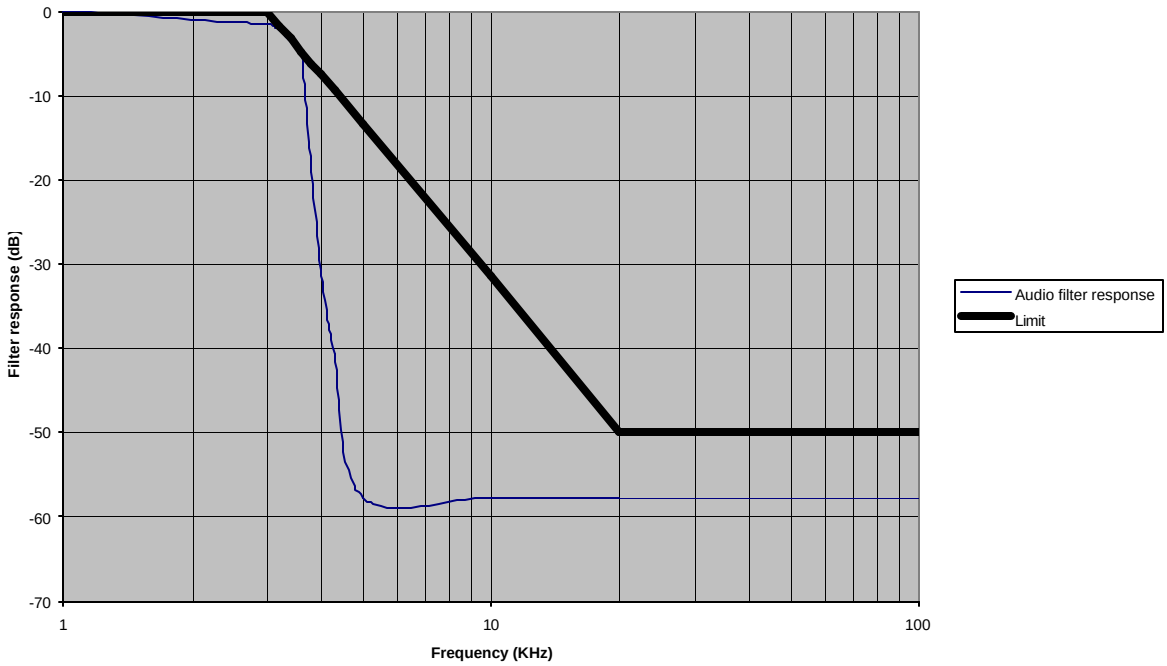
The system was initially set to transmit a signal with a deviation of 60% of the system rated deviation at 1 kHz. The output of the power amplifier was connected to a FM demodulator. The demodulated output was then fed into an audio signal analyzer. The audio signal analyzer measured the amplitude of the demodulated audio signal while the frequency of the transmitter

audio signal was increased from 1 kHz to 30 kHz. The measured amplitude of the audio signal amplitude was recorded for each frequency measurement.

5.7.4 Test Results

Figure 5-2 shows the low pass filter response measurement results.

Figure 5-2 Audio Low Pass Filter Response



5.7.5 Test Conclusion

The test results met the requirement.

5.7.6 Test Equipment List

Table 5-27: Test Equipment used for Audio Low Pass Filter Response Measurement

Category	Manufacture	Model	Description	Serial Number	Cal. Due
Spectrum analyzer	HP	3585A	40 MHz, 1 Mohm IN	1750A02942	13/08/2004
Attenuator	Weinschel	53-10-33	10 dB, 500 W	KT039	6/02/2004
Attenuator	Weinschel	6070-20	20 dB, 25 W	BE0847	15/04/2004
Modulation Domain analyzer	HP	53310A		3121A01217	14/08/2004
Transmission Test Set	HP	4934A		3547U12666	28/03/2004

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.

5.8 Modulation Limiting

5.8.1 Test Specification

The system was tested to the limits of the following requirements:

Table 5-28: Modulation Limiting Requirement

Requirement	Part / Section
FCC	2.1047

5.8.1.1 Limits

The specification levels are listed in Table 5-19.

Table 5-29: Modulation Limiting Limit

Relative input signal level (dB)	Deviation (kHz)
-20 to 20	< rated deviation (5 kHz)

5.8.2 Test Facility Information

Location: Solectron Technical Centre Lab 13

Date tested: Sept. 3, 2003

Tested by: Denis Lalonde

5.8.3 Test Procedure

The system was initially set to transmit a signal with a deviation of 60% of the system rated deviation at 1 kHz. The input level required for this deviation was then recorded as the reference level. The positive peak and negative peak frequency deviation was then recorded while the input signal was changed from –20 dB to 20 dB relative to the reference level. This was repeated for an input signal of 300 Hz and 2500 Hz.

5.8.4 Test Results

Figure 5-3 and Figure 5-4 shows the modulation limiting measurement results:

Figure 5-3 Modulation Limiting, Positive Peak

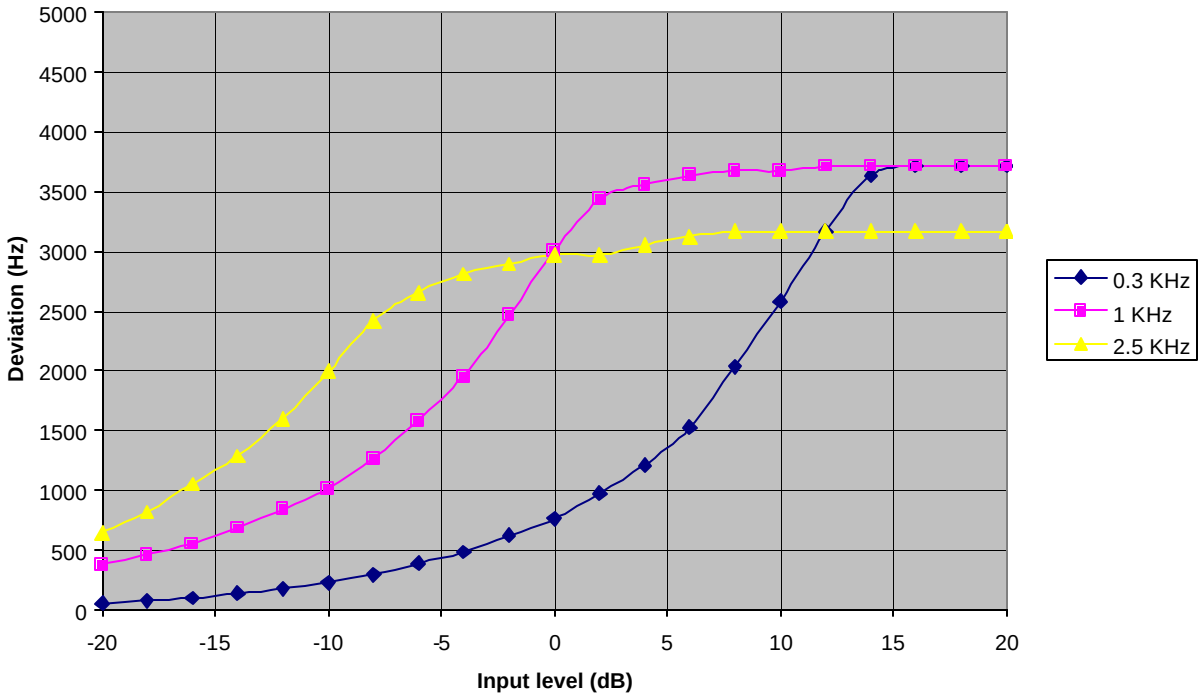
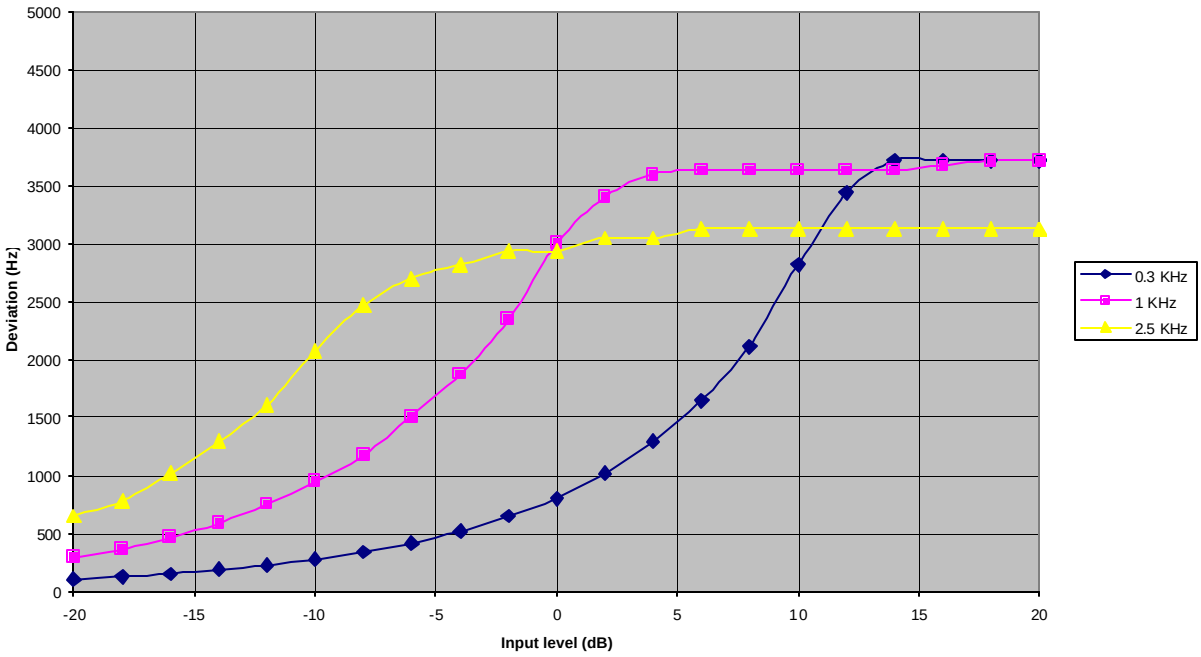


Figure 5-4 Modulation Limiting, Negative Peak



5.8.5 Test Conclusion

The test results met the requirement.

5.8.6 Test Equipment List

Table 5-30: Test Equipment used for Audio Low Pass Filter Response Measurement

Category	Manufacture	Model	Description	Serial Number	Cal. Due
Attenuator	Weinschel	53-10-33	10 dB, 500 W	KT039	6/02/2004
Attenuator	Weinschel	6070-20	20 dB, 25 W	BE0847	15/04/2004
Modulation Domain analyzer	HP	53310A		3121A01217	14/08/2004
Transmission Test Set	HP	4934A		3547U12666	28/03/2004

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.

5.9 Occupied Bandwidth

5.9.1 Test Specification

The system occupied bandwidth was evaluated according to the specifications listed in Table 5-10:

Table 5-31: Occupied Bandwidth

Requirement	Part / Section
FCC	2.202
RSP-100	7.2

5.9.2 Test Facility Information

Location: Solectron Technical Centre Lab 13

Date tested: Oct. 6, 2003

Tested by: Denis Lalonde

5.9.3 Test Procedure

Three occupied bandwidth measurements were performed at 860 MHz and one at 869.9875 MHz. Four different modulated signals were evaluated as follows:

1. Analog signal: the power amplifier output was modulated with a 2500 Hz signal which had a level 16 dB higher than what was required to produce a deviation of 50% of rated system deviation (5 kHz) at 1 kHz. Tested at 860 MHz.
2. Two 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 +/- 3 kHz deviation. Tested at 860 MHz.
3. C4FM modulation: the power amplifier output was modulated with a C4FM pseudo-random signal which had the level required for a maximum of +/- 2826 Hz deviation. Tested at 860 MHz.
4. NPSPAC modulation (9600 baud) : the power amplifier output was modulated with a 2 level 9600 baud pseudo-random signal which had the level required for +/- 2.4 kHz deviation.Tested at 869.9875 MHz.
5. NPSPAC modulation (analog) : the power amplifier output was modulated with a 2500 Hz signal which had a level 16 dB higher than what was required to produce a deviation of 50% of rated system deviation (4 kHz) at 1 kHz. Tested at 869.9875 MHz.

For all of these measurements, the power amplifier output was connected to the spectrum analyzer through a 10 dB and a 20 dB attenuator.

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

5.9.4 Test Results

Table 5-12 lists the occupied bandwidth calculated and measured:

Table 5-32: Occupied bandwidth values

Type of signal	Calculation	Measurement (kHz)	Emission designator
Audio	Max. modulation (M) = 3 kHz Max. deviation (D) = 5 kHz K = 1 Bn = 2M + 2DK Bn = 16 kHz	10.5 kHz Figure 7-29 (measured with 2.5 kHz tone)	16K0F3E
2 level 9600 baud / 3 KHz deviation	Max. modulation (B) = 9.6 kHz Max. deviation (D) = 3 kHz K = 1 Bn = B + 2DK Bn = 15.6 kHz	10.8 kHz Figure 7-30	10K8F1D 10K8F1E
C4FM	Max. modulation (B) = 4.8 kHz Max. deviation (D) = 2.826 kHz K = 1 Bn = B + 2DK Bn = 10.452 kHz	8.0 kHz Figure 7-31	8K0F1D 8K0F1D
NPSPAC (9600 baud)	Max. modulation (B) = 9.6 kHz Max. deviation (D) = 2.4 kHz K = 1 Bn = B + 2DK Bn = 14.4 kHz	10.4 kHz Figure 7-32	10K4F1D 10K4F1E
NPSPAC (analog)	Max. modulation (M) = 3 kHz Max. deviation (D) = 4 kHz K = 1 Bn = 2M + 2DK Bn = 14 kHz	10.2 kHz Figure 7-33 (measured with 2.5 kHz tone)	14K0F3E

5.9.5 Test Equipment List

Table 5-h33: Test Equipment used for Occupied bandwidth

Category	Manufacture	Model	Description	Serial Number	Cal. Due
Attenuator	Weinschel	53-10-33	10 dB, 500 W	KT039	6/02/2004
Attenuator	Weinschel	6070-20	20 dB, 25 W	BE0847	15/04/2004
Spectrum analyzer	HP	8564E	40 GHz	3835A01346	03/09/2004

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. RSS-119, Issue 6, “Land Mobile and Fixed Radio, Transmitters and Receivers, 27.41 to 960 MHz” March 25, 2000.
11. ANSI/TIA-603-B-2002, “Land Mobile FM or PM Communications Equipment Measurement and Performance Standards”, November 7, 2002

7. Appendices

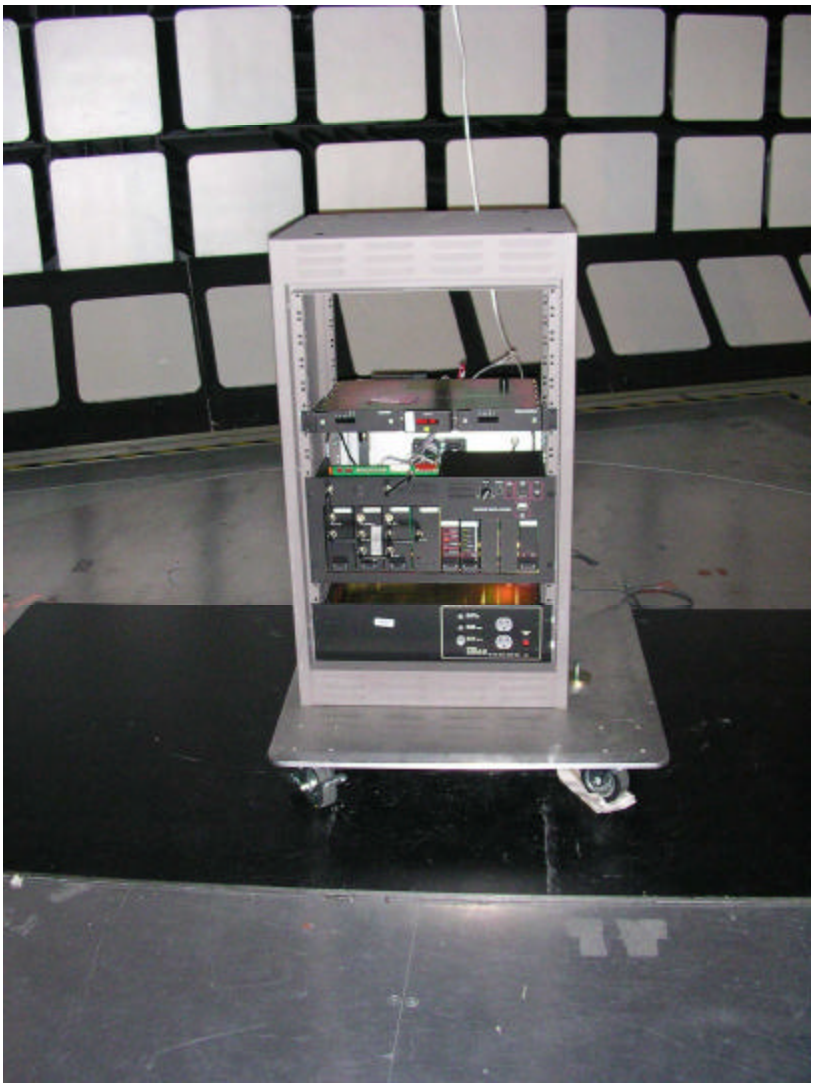
7.1 Appendix A: Glossary

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 800 MHz Base Station radiated emissions set-up



7.3 Appendix C: Conducted Spurious Emissions Plots

Figure 7-2: Tx at 851.0125 MHz, 100 W power, 30 MHz to 1 GHz

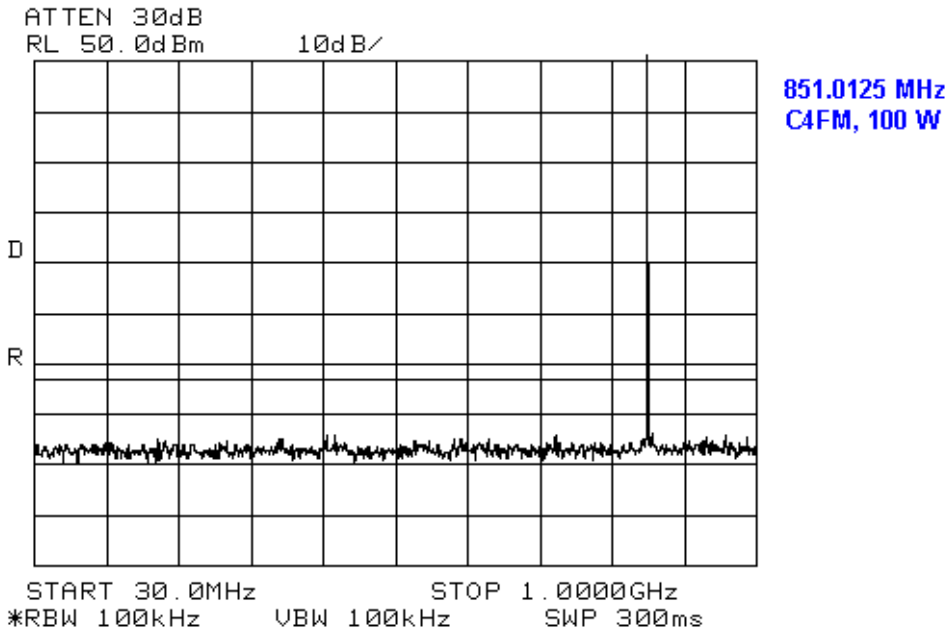


Figure 7-3: Tx at 851.0125 MHz, 100 W power, 1 GHz to 2.75 GHz

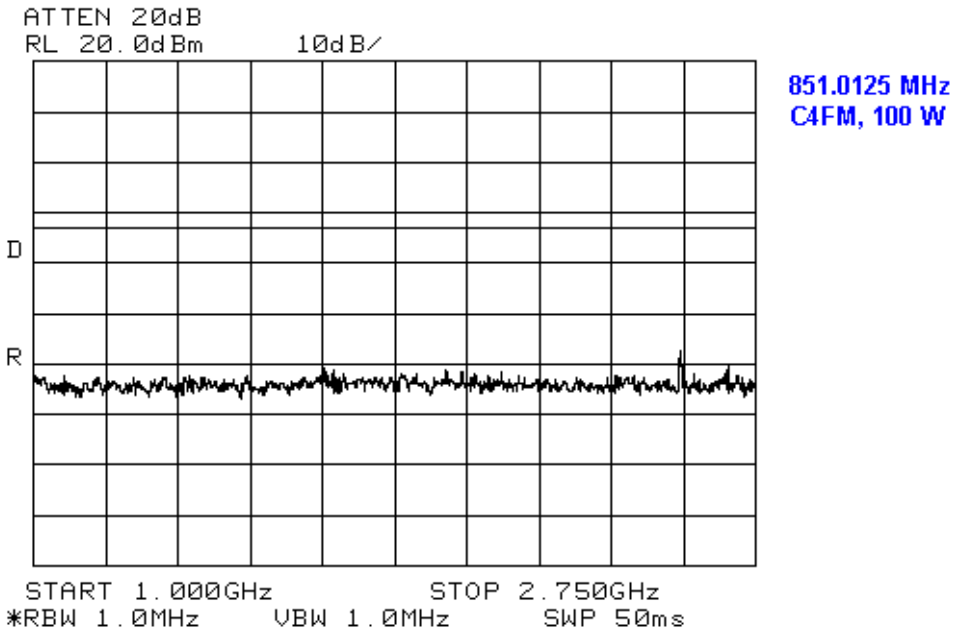


Figure 7-4: Tx at 851.0125 MHz, 100 W power, 2.75 GHz to 8.7 GHz

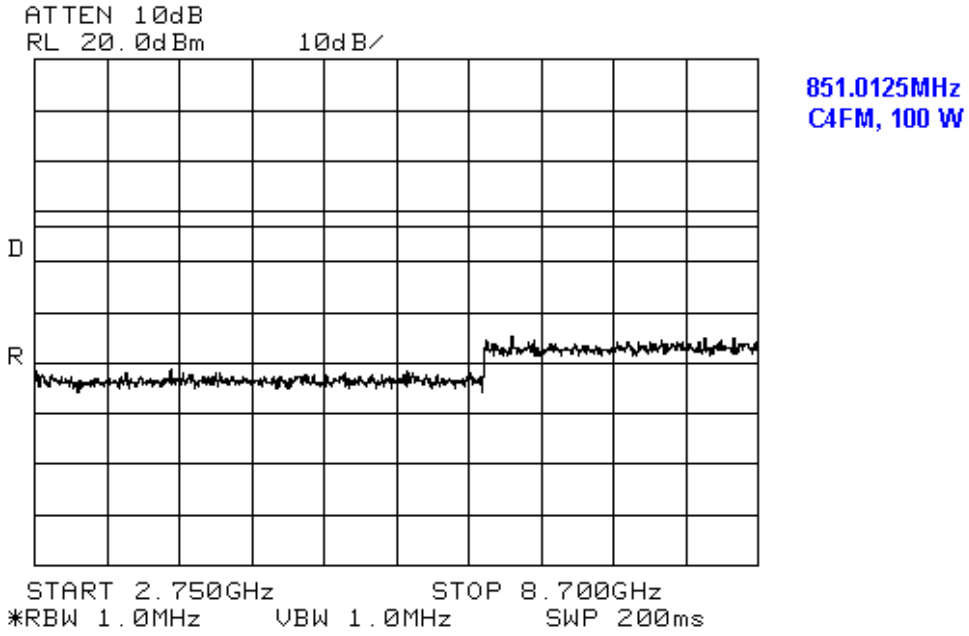


Figure 7-5: Tx at 851.0125 MHz, 10 W power, 30 MHz to 1 GHz

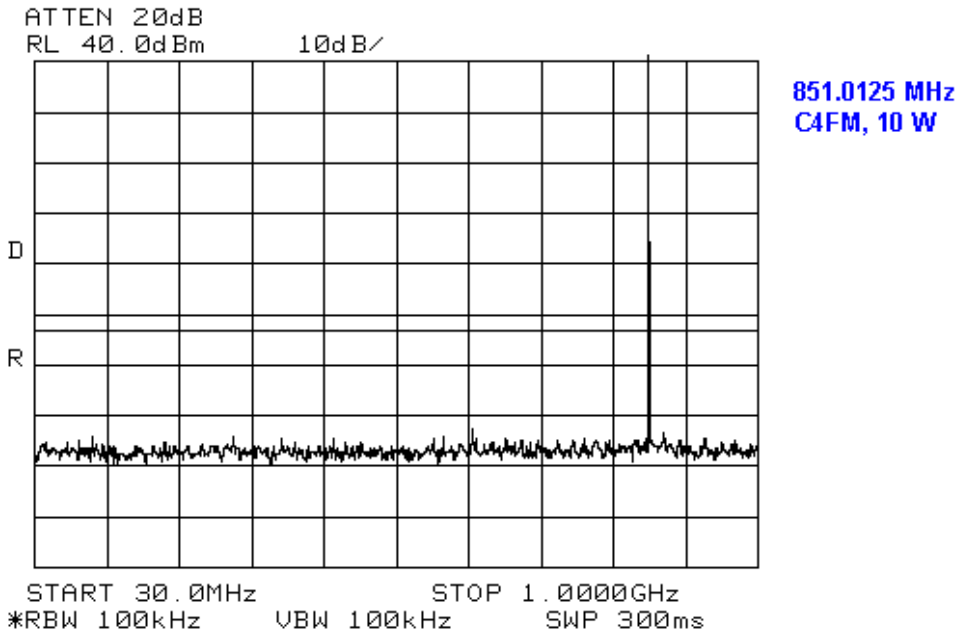


Figure 7-6: Tx at 851.0125 MHz, 10 W power, 1 GHz to 2.75 GHz

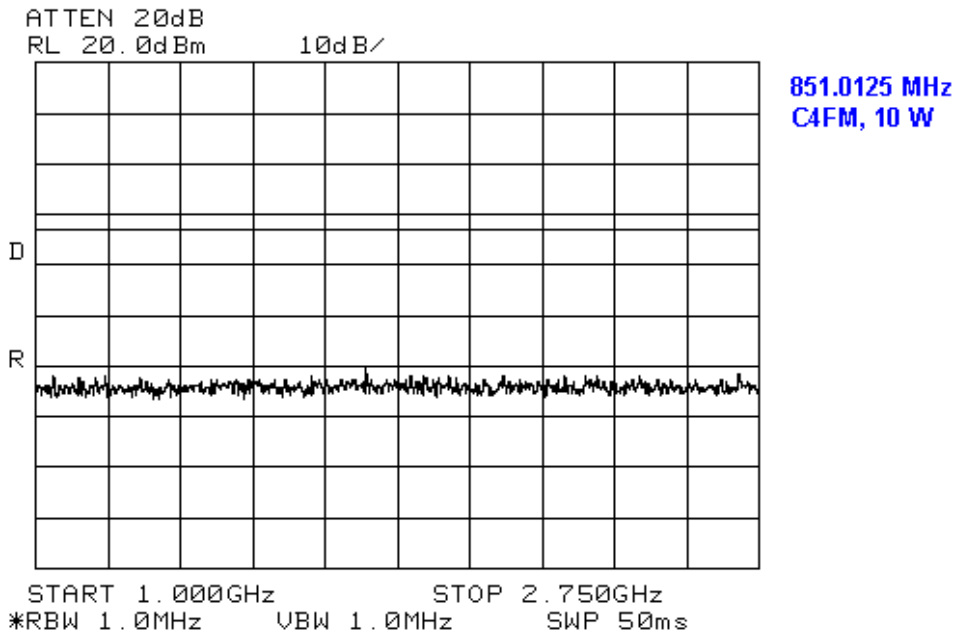


Figure 7-7: Tx at 851.0125 MHz, 10 W power, 2.75 GHz to 8.7 GHz

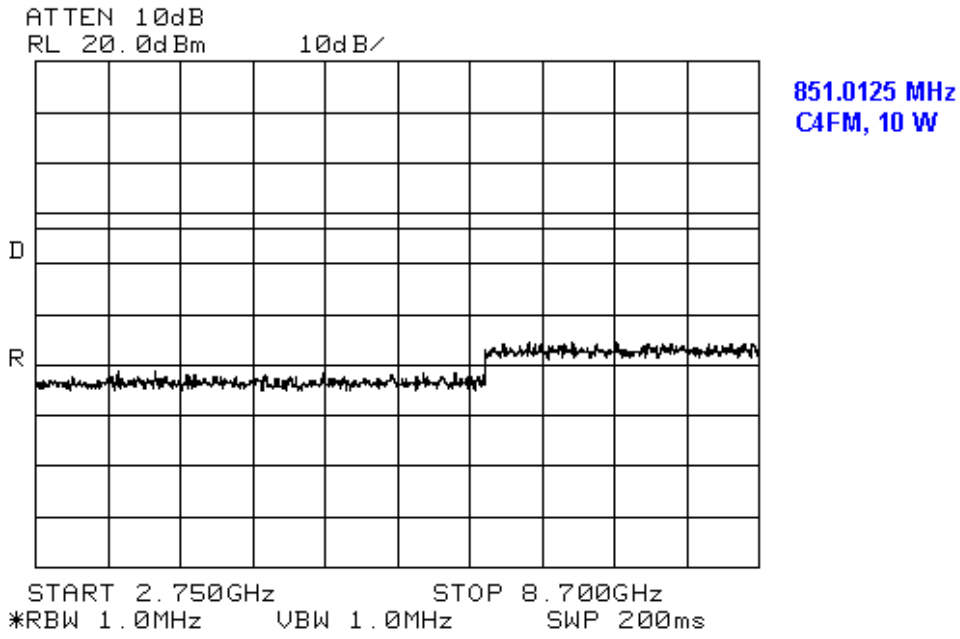


Figure 7-8: Tx at 860.0 MHz, 100 W power, 30 MHz to 1 GHz

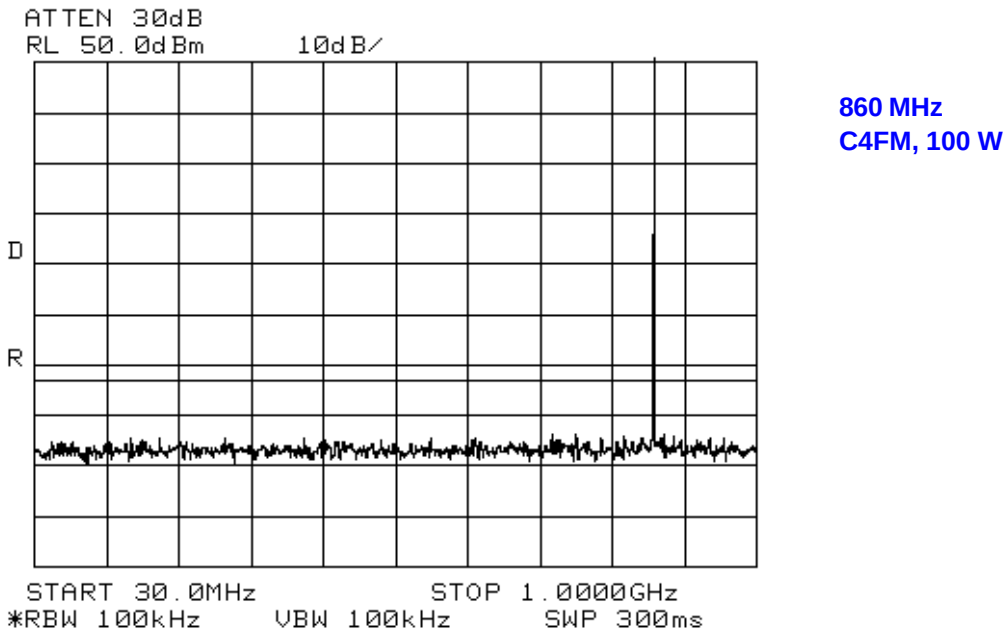


Figure 7-9: Tx at 860.0 MHz, 100 W power, 1 GHz to 2.75 GHz

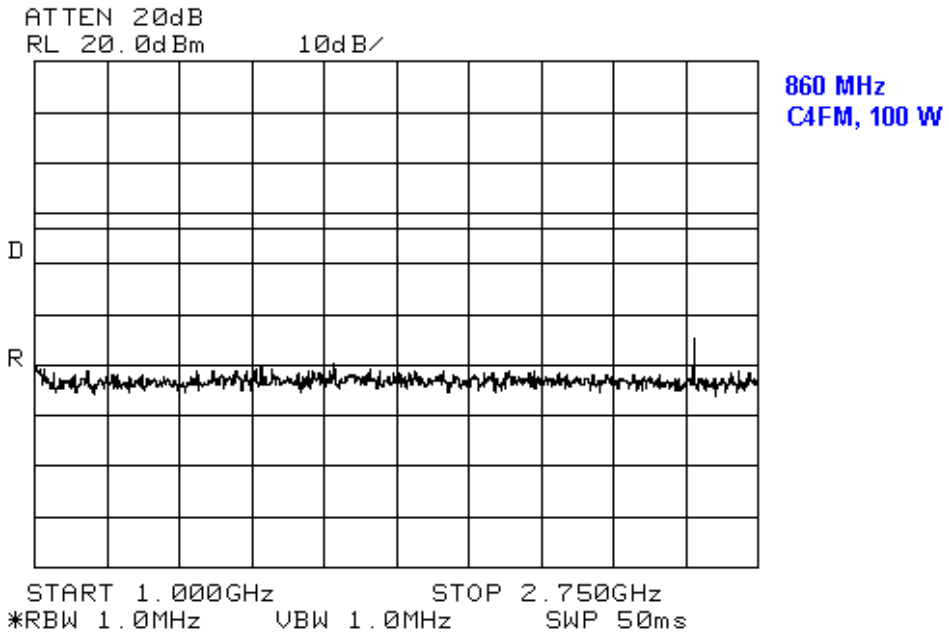


Figure 7-10: Tx at 860.0 MHz, 100 W power, 2.75 GHz to 8.7 GHz

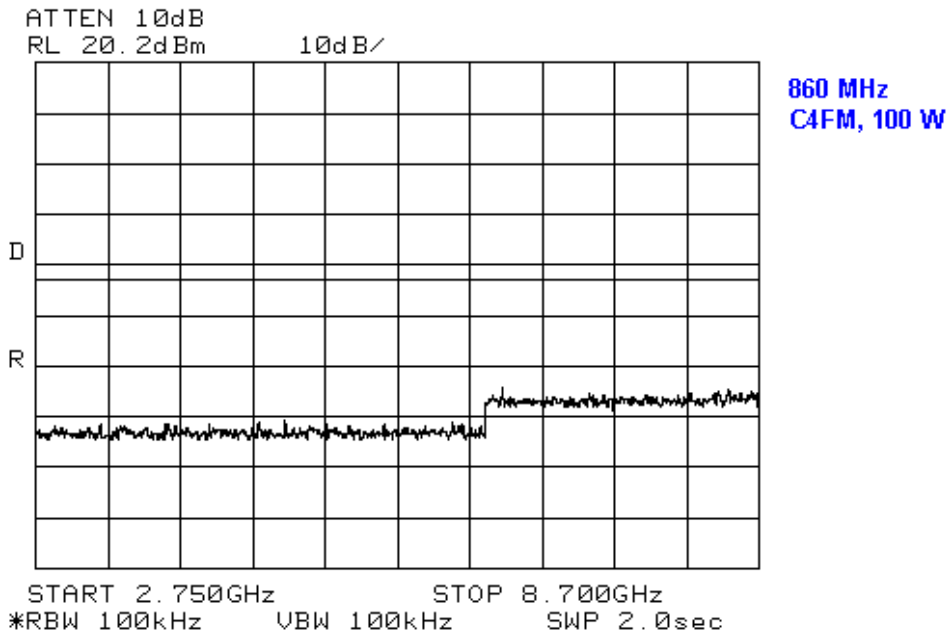


Figure 7-11: Tx at 860.0 MHz, 10 W power, 30 MHz to 1 GHz

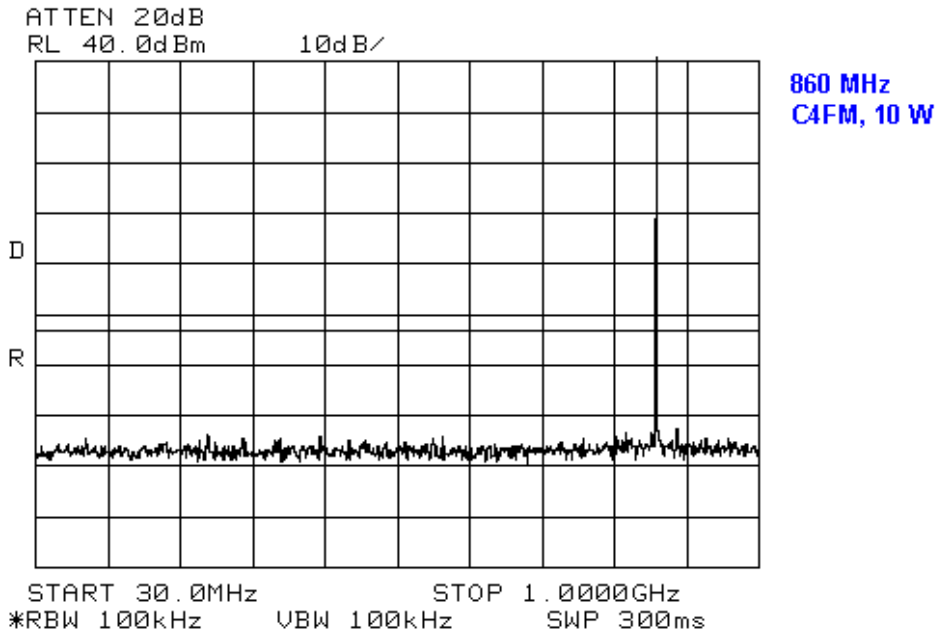


Figure 7-12: Tx at 860.0 MHz, 10 W power, 1 GHz to 2.75 GHz

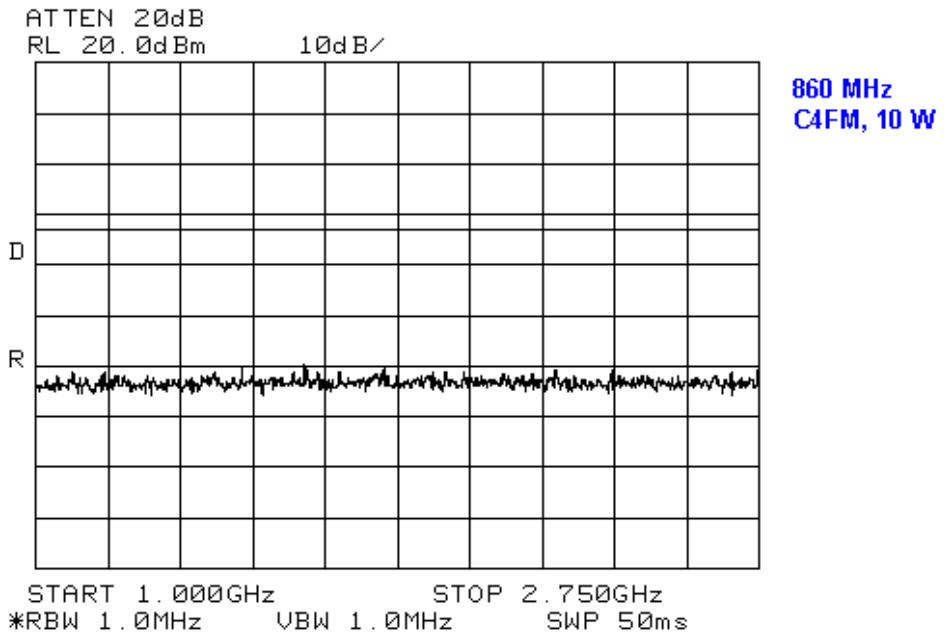


Figure 7-13: Tx at 860.0 MHz, 10 W power, 2.75 GHz to 8.7 GHz

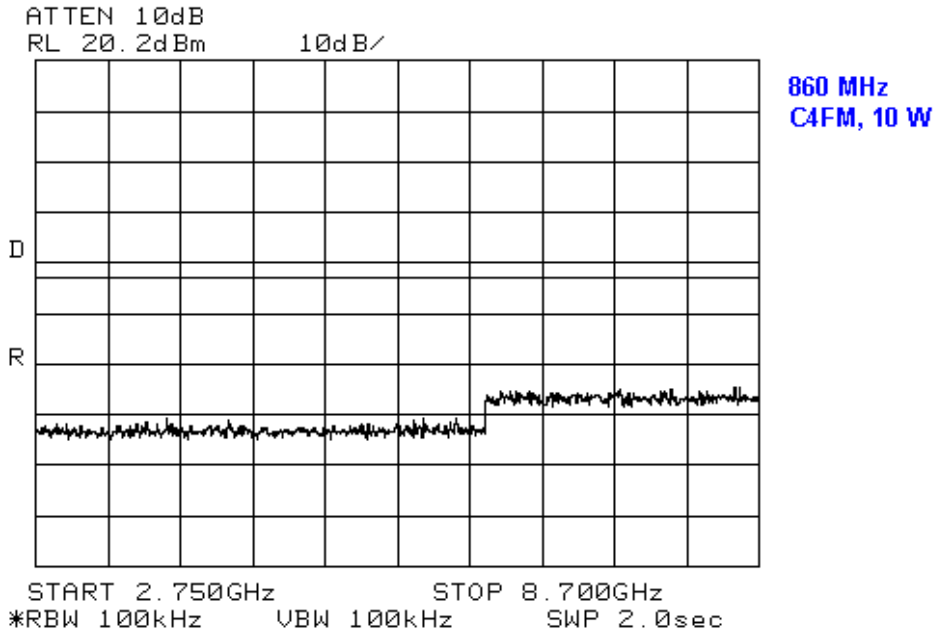
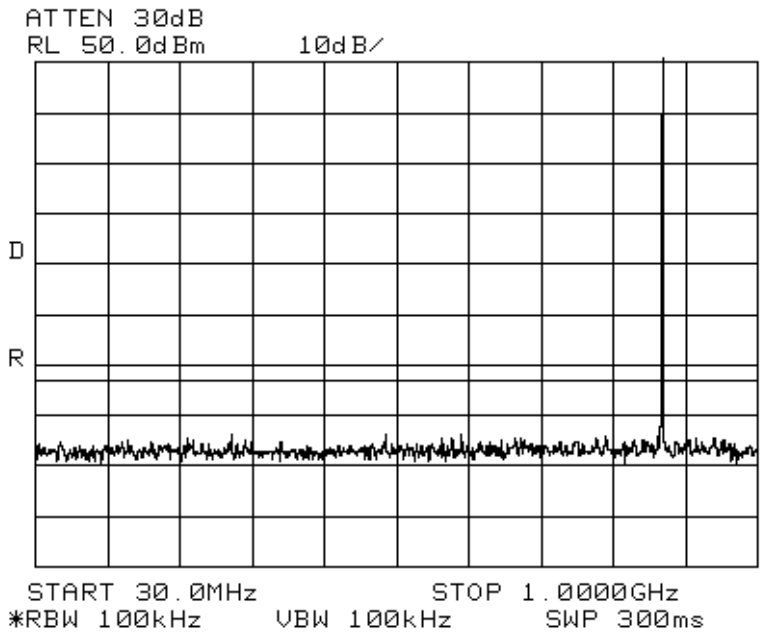
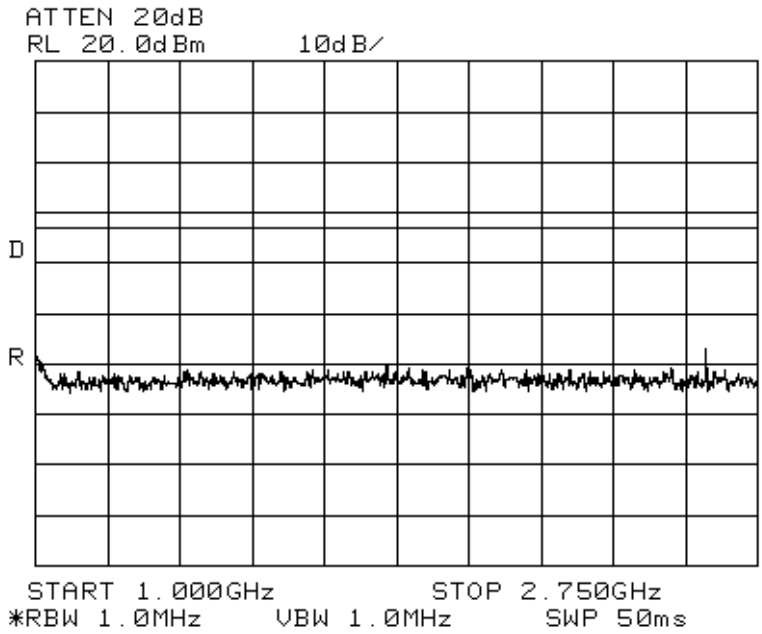


Figure 7-14: Tx at 869.9875 MHz, 100 W power, 30 MHz to 1 GHz



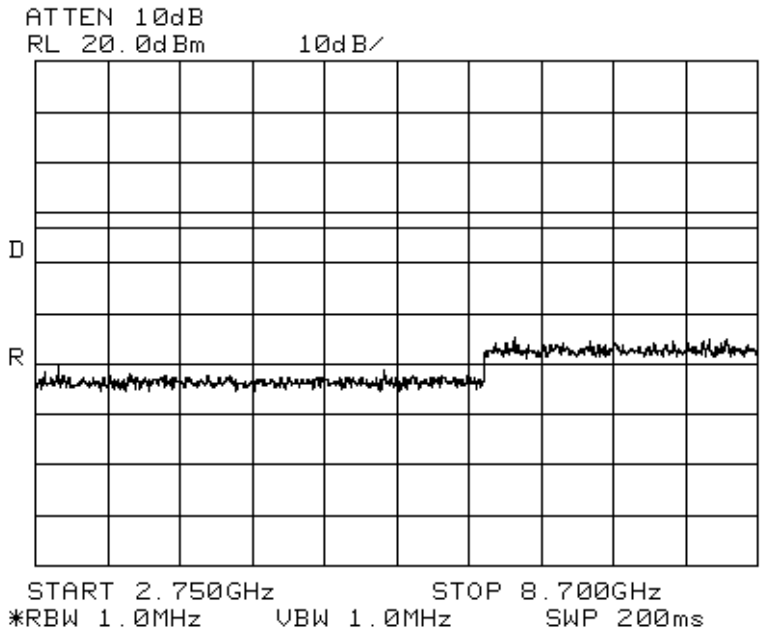
869.9875 MHz
NPSPAC, 100 W

Figure 7-15: Tx at 869.9875 MHz, 100 W power, 1 GHz to 2.75 GHz



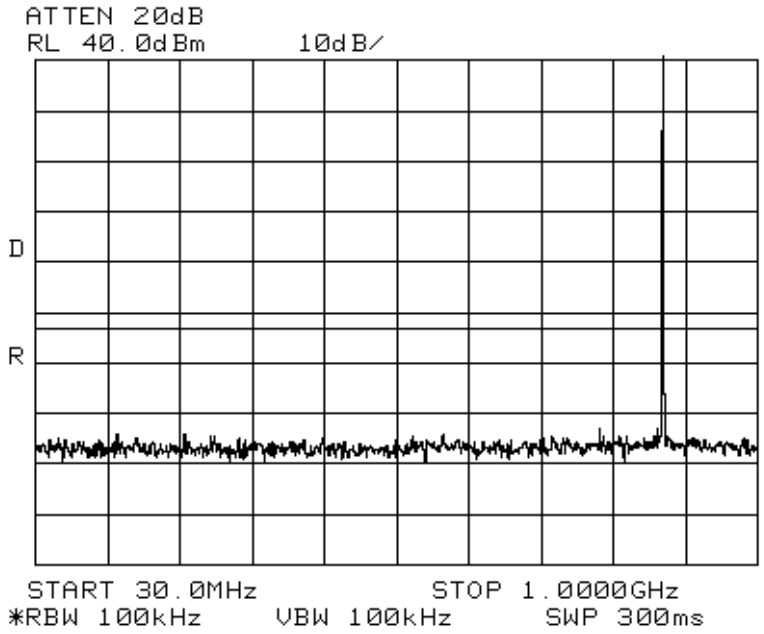
869.9875 MHz
NPSPAC, 100 W

Figure 7-16: Tx at 869.9875 MHz, 100 W power, 2.75 GHz to 8.7 GHz



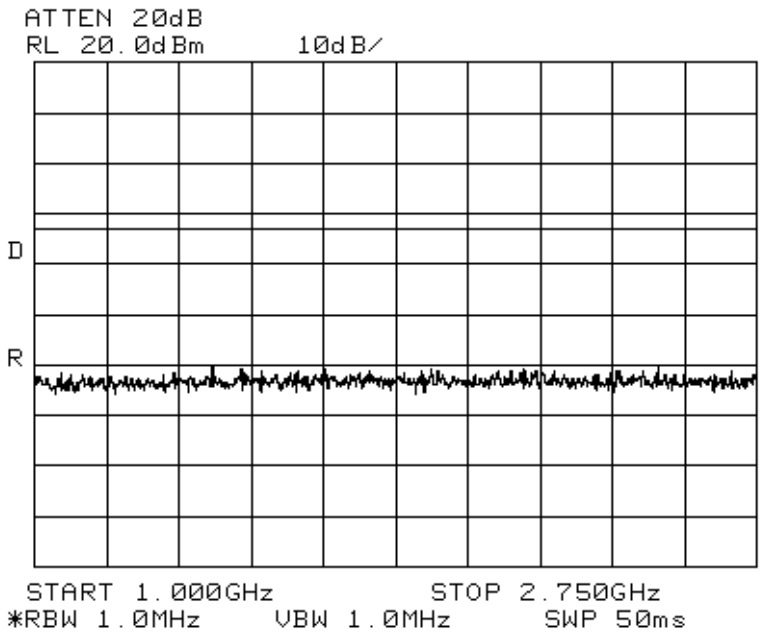
869.9875 MHz
NPSPAC, 100 W

Figure 7-17: Tx at 869.9875 MHz, 10 W power, 30 MHz to 1 GHz



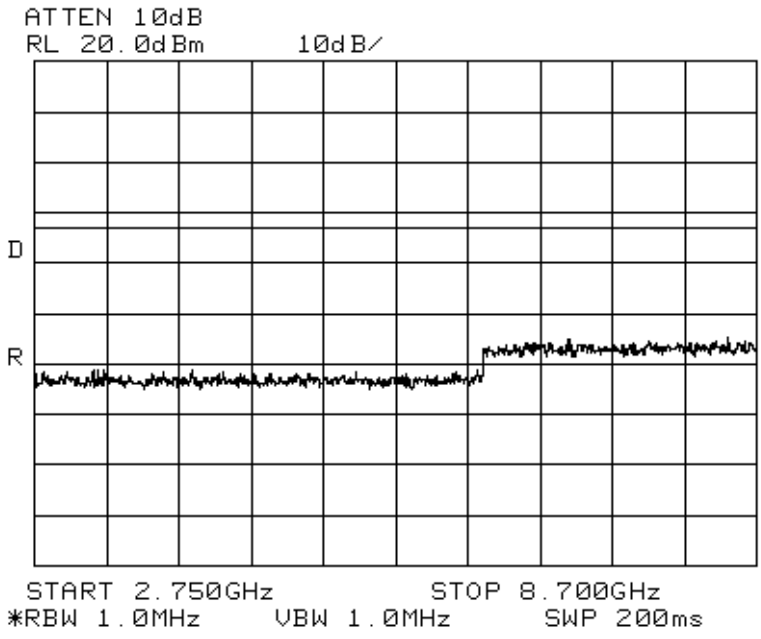
869.99875 MHz
NPSPAC, 10 W

Figure 7-18: Tx at 869.9875 MHz, 10 W power, 1 GHz to 2.75 GHz



869.9875 MHz
NPSPAC, 10 W

Figure 7-19: Tx at 869.9875 MHz, 10 W power, 2.75 GHz to 8.7 GHz

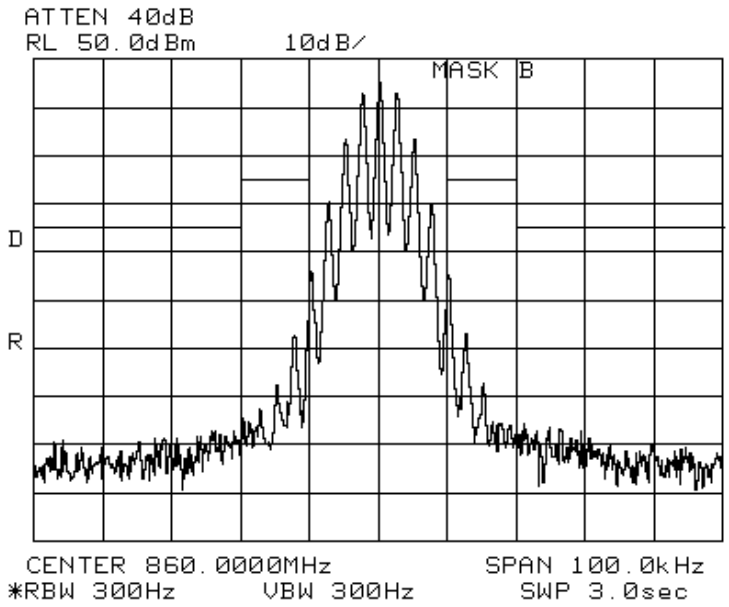


869.9875 MHz
NPSPAC, 10 W

7.4 Appendix D: Emission Mask Plots

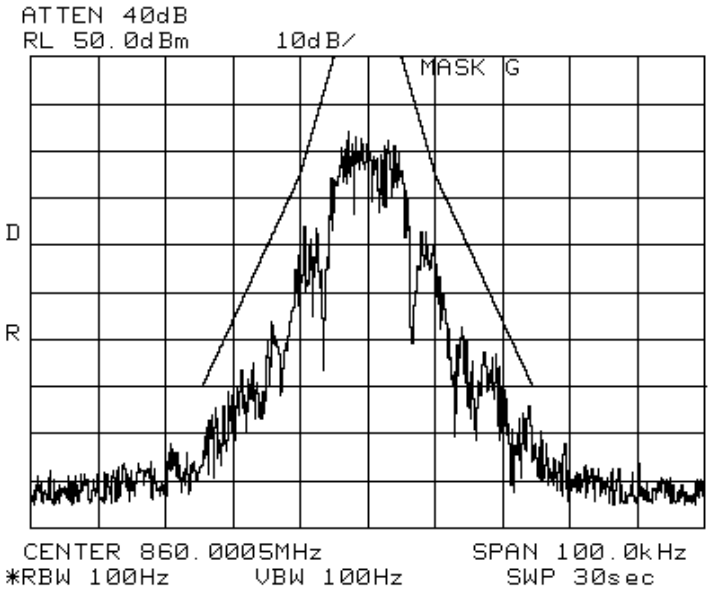
This appendix presents all emission mask plots for the test cases measured.

Figure 7-20: 2500 Hz audio signal



860 MHz
2500 Hz audio signal
level 16 dB higher than
level required for 50%
deviation at 1 KHz

Figure 7-21: 2 level 9600 baud signal with 3 kHz deviation



860 MHz
2 level
modulation
9600 bits/sec

Figure 7-22: C4FM signal

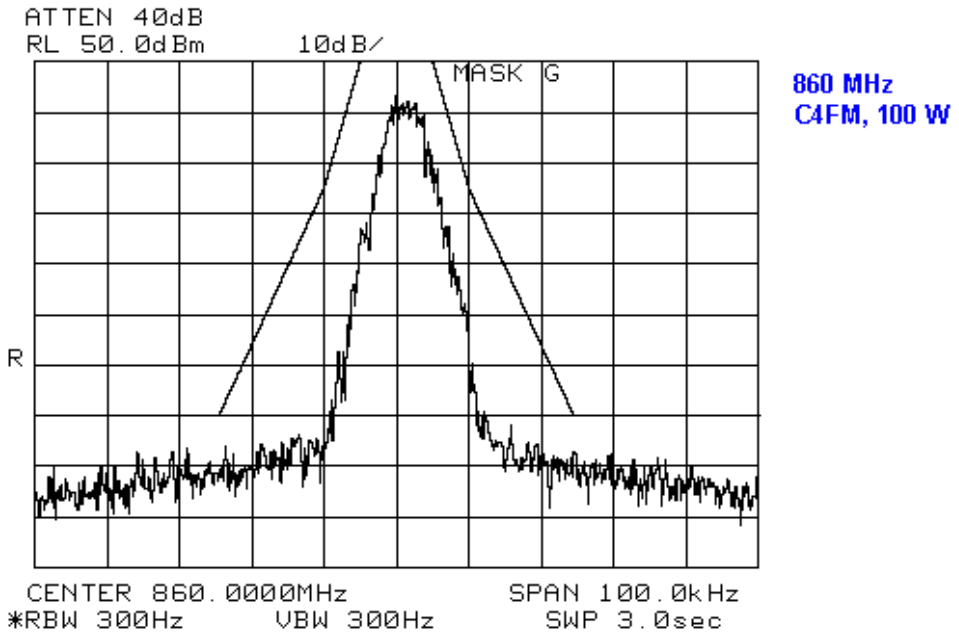


Figure 7-23: NPSPAC (9600 baud) signal

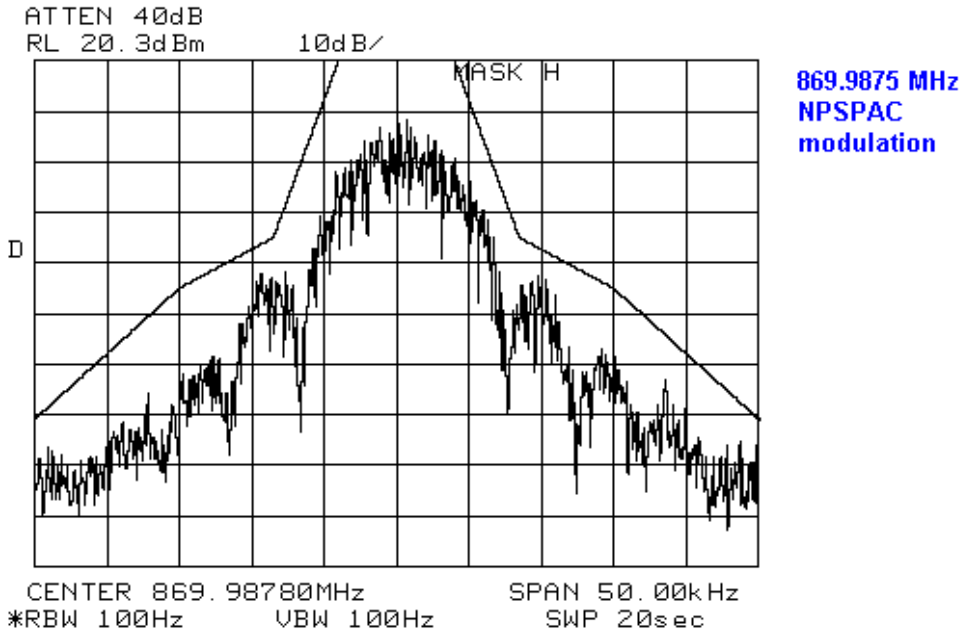
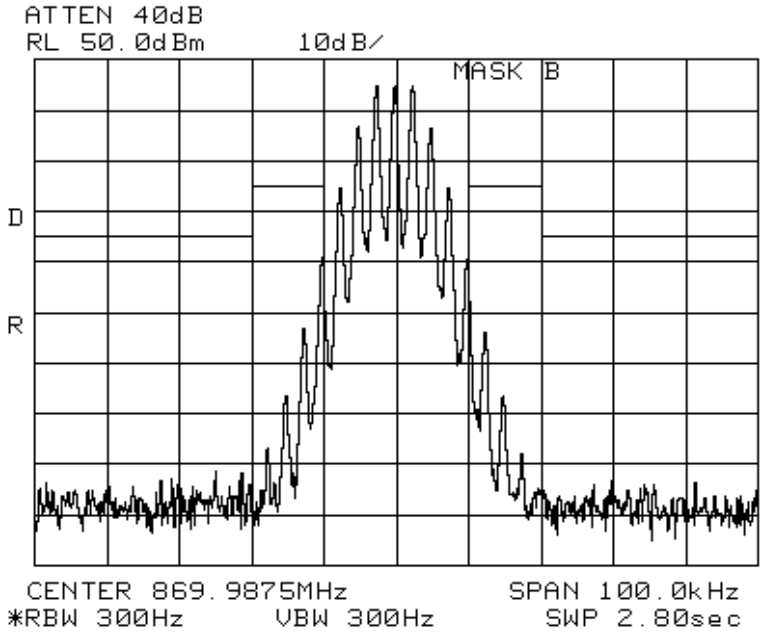


Figure 7-24: NPSPAC (analog) signal



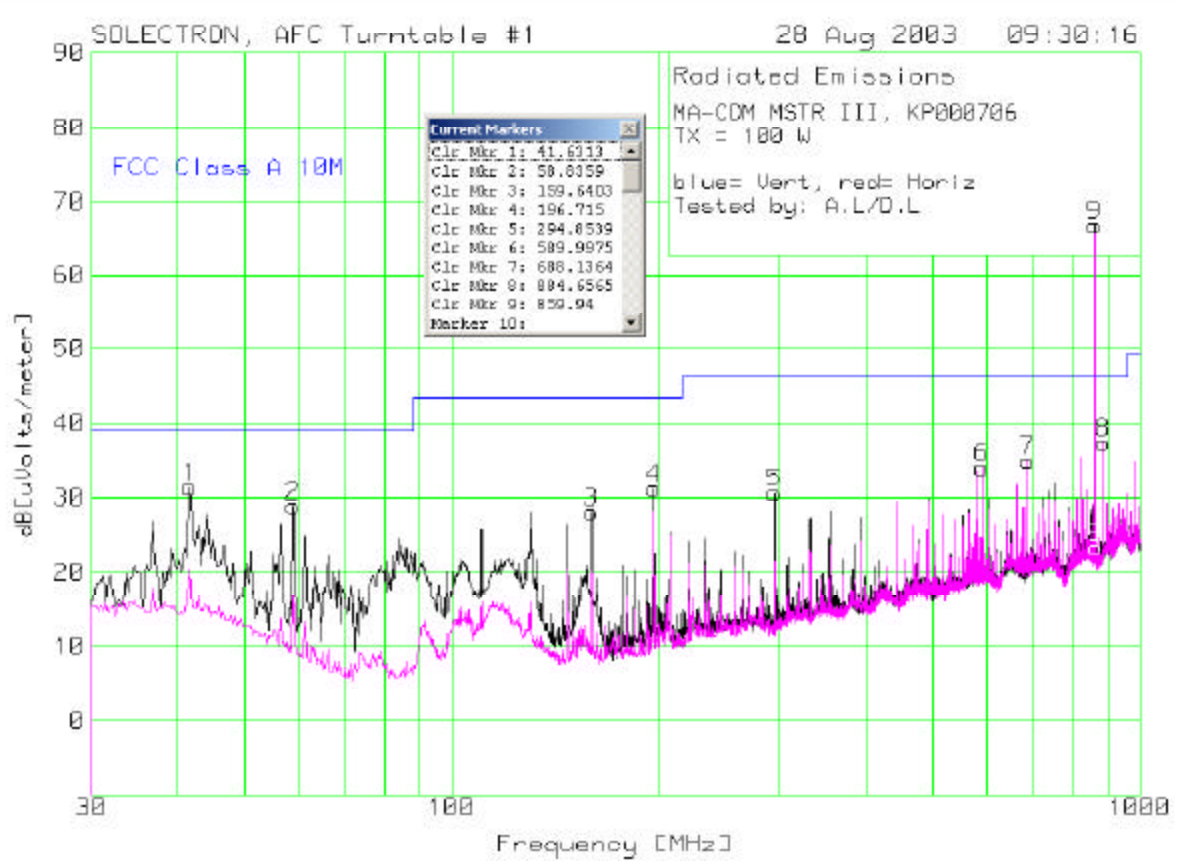
NPSPAC / analog
100 W
modulated with 2500 Hz

level is 16 dB higher than required for 50% deviation at 1 kHz

7.5 Appendix E: Field Strength of Spurious Emissions Plots

This appendix presents all field strength plots for the test cases measured.

Figure 7-25: Field strength with 100 W Tx, 30 MHz to 1 GHz



Note: the emissions at 860 MHz is leakage of the transmitted signal

Figure 7-26: Field strength with 100 W Tx, 1 GHz to 10 GHz

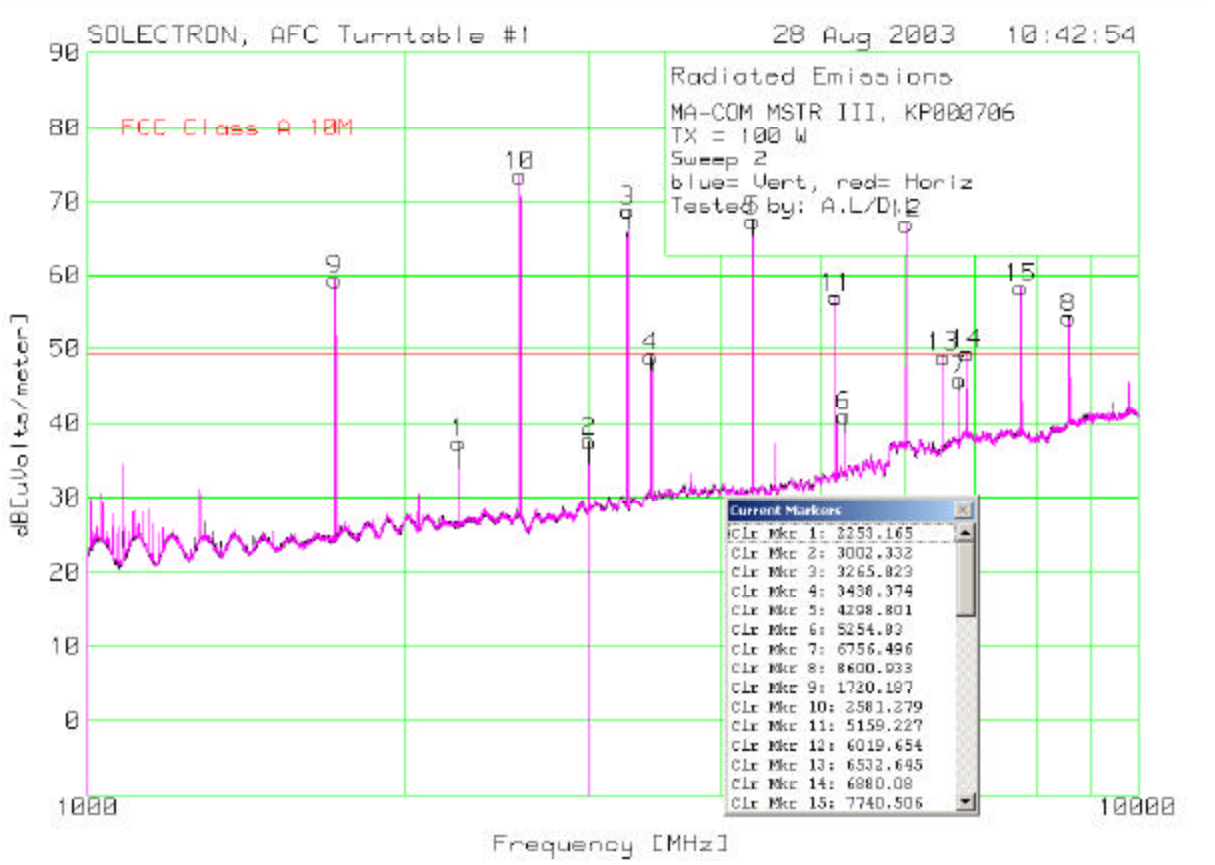
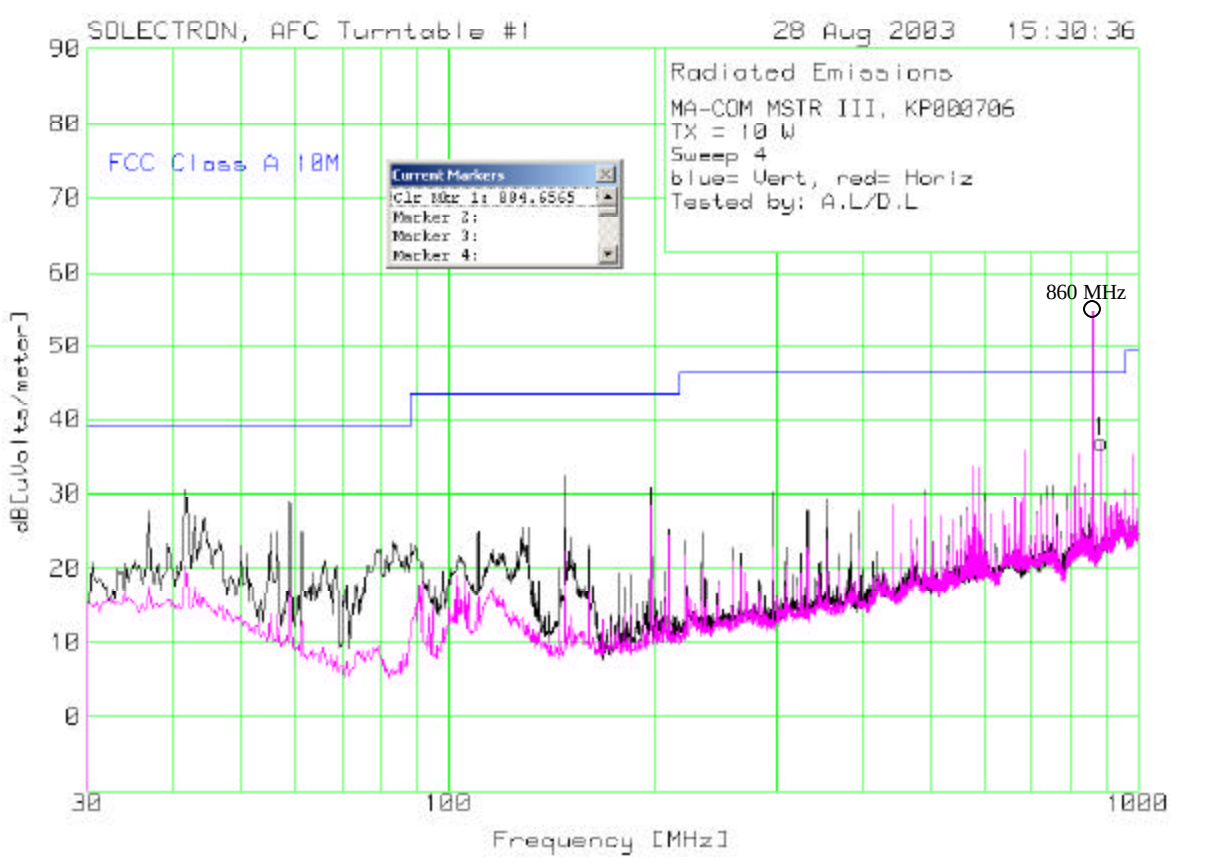
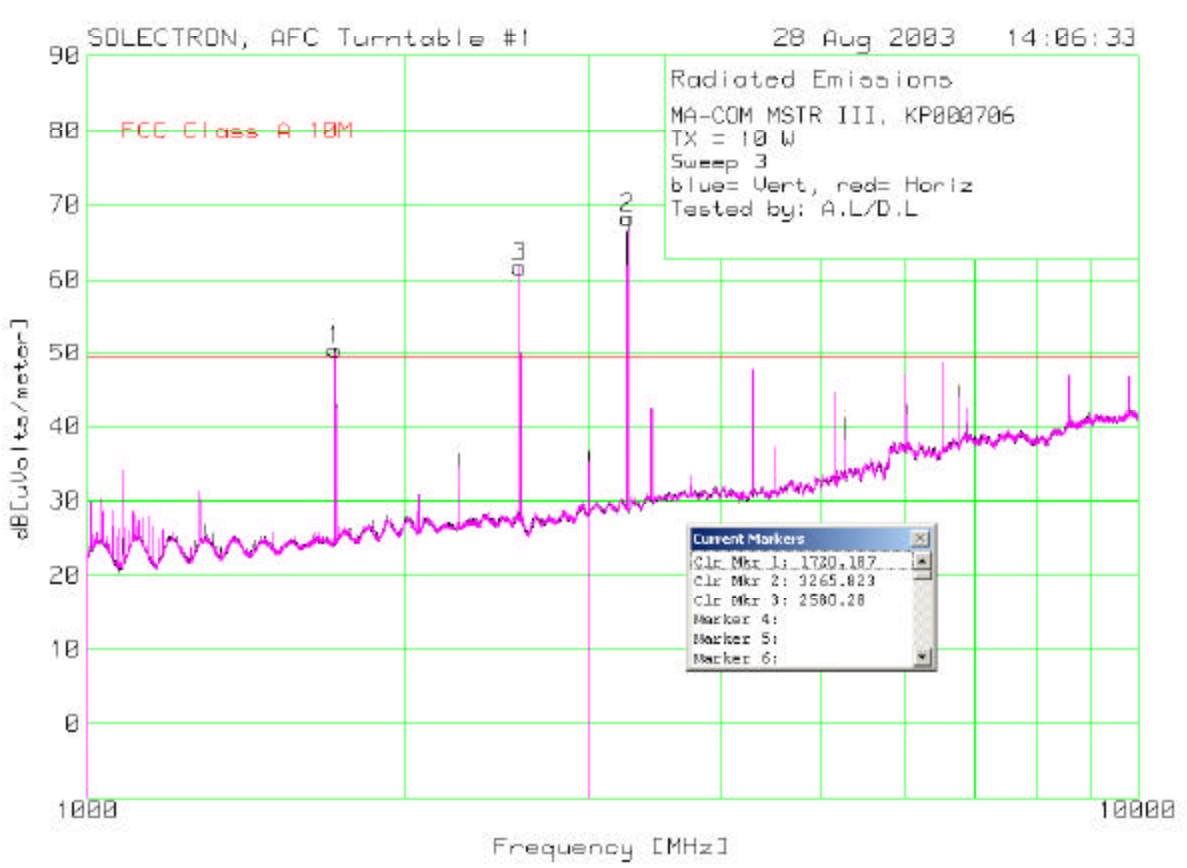


Figure 7-27: Field strength with 10 W Tx, 30 MHz to 1 GHz



Note: the emissions at 860 MHz is leakage of the transmitted signal

Figure 7-28: Field strength with 10 W Tx, 1 GHz to 10 GHz



7.6 Appendix D: Occupied Bandwidth Plots

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

Figure 7-29: 2500 Hz audio signal

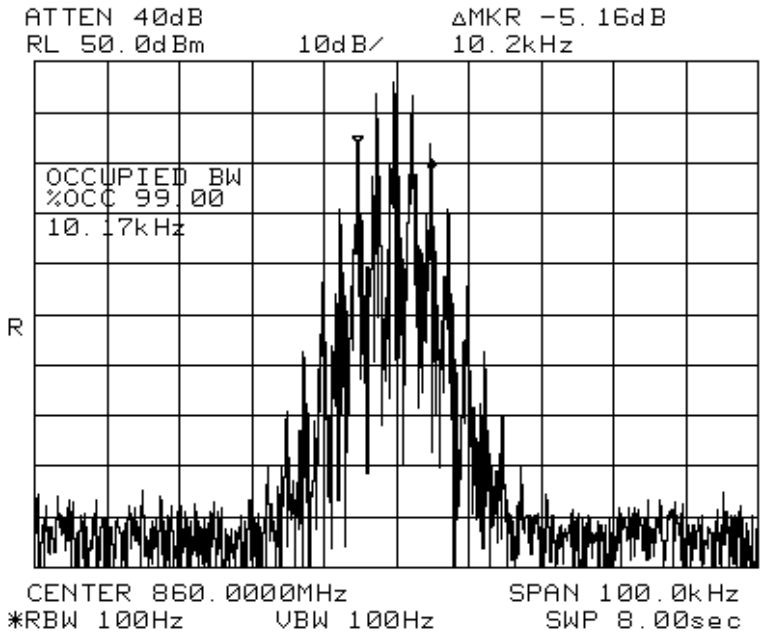
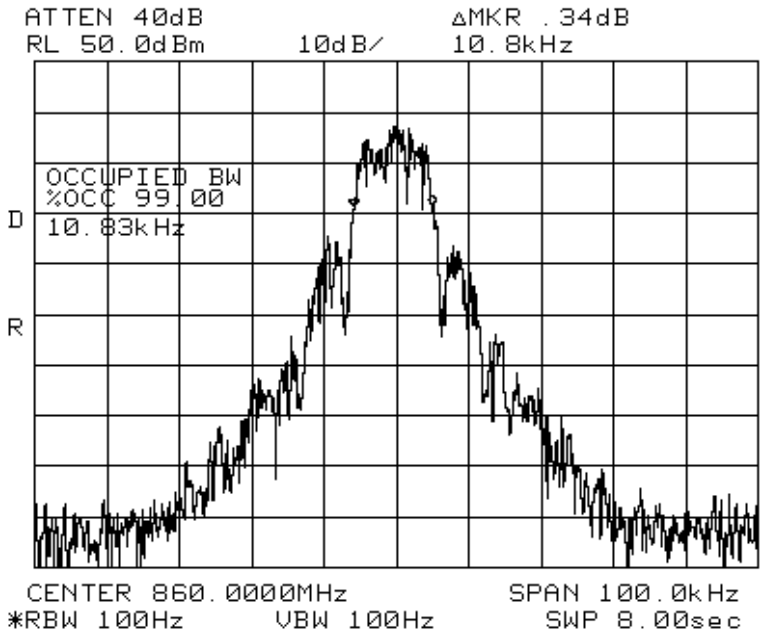


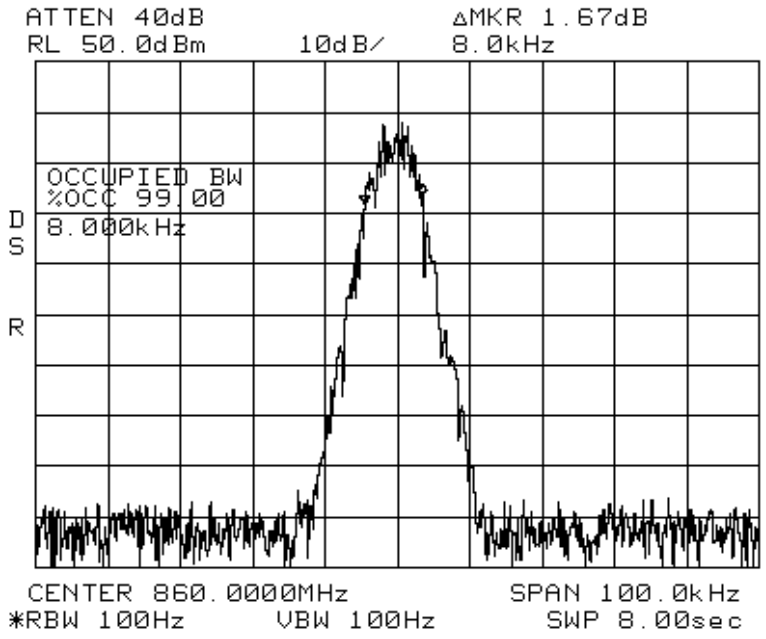
Figure 7-30: 2 level 9600 baud signal with 3 kHz deviation



860 MHz
2 level modulation
9600 bits/sec

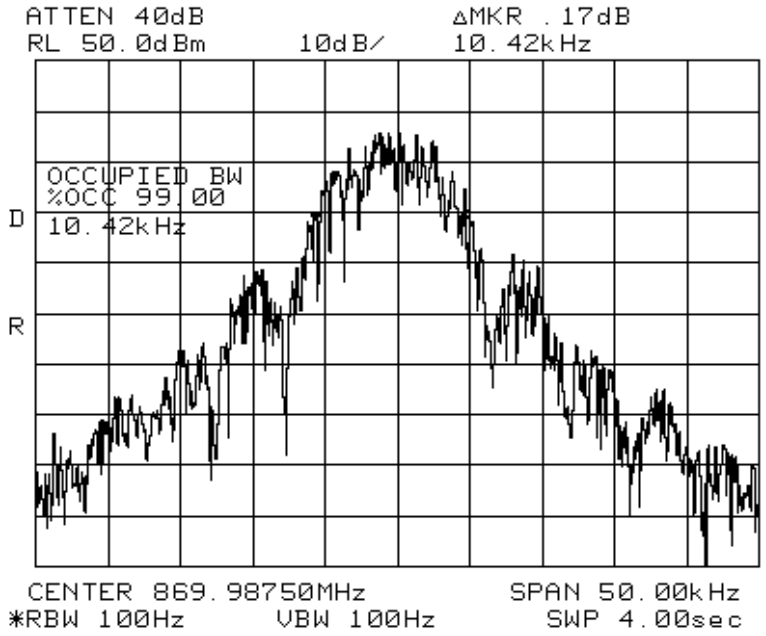
100 W

Figure 7-31: C4FM signal



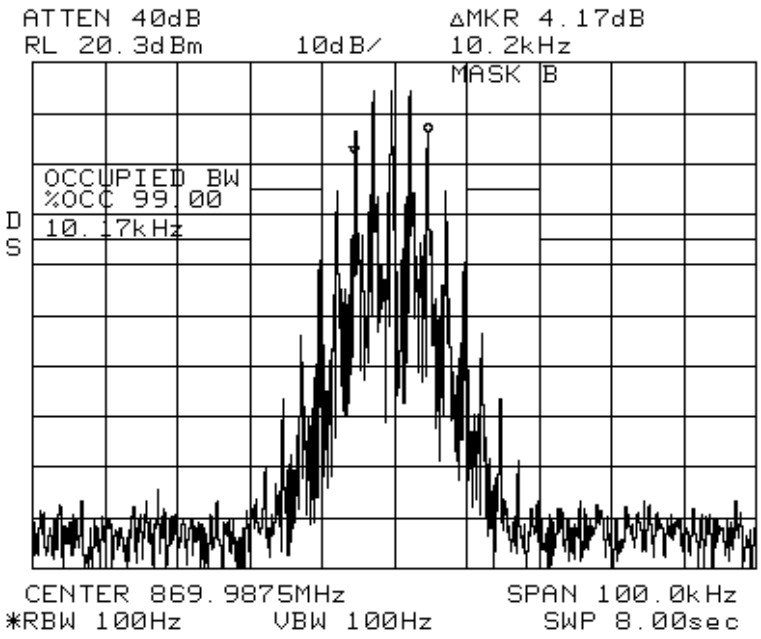
860 MHz
C4FM, 100 W

Figure 7-32: NPSPAC (9600 baud) signal



869.9875 MHz
100 W
NPSPAC modulation

Figure 7-33: NPSPAC (analog) signal



NPSPAC / analog
100 W
modulated with 2500 Hz signal
level is 16 dB higher than required for 50% deviation at 1 kHz

C-MAC ENGINEERING INC.

A Solectron Company

Certification Report for M/A-COM MASTRIII 800 MHz Base Station

FCC Part 90 & Industry Canada RSS-119