Certification Report for M/A-COM MASTRIII UHF Base Station with Data Module

FCC Part 22, 74, 90, & RSS-119

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Approvals

Function	Name	Job title	Signature
Document Release Approval	Simon Richardson	Project Manager	DEC 22 2004
Author	Denis Lalonde	Radio Compliance Discipline Leader	Dec. 22, 2004
Technical Reviewer	Jacques Rollin	EMC Advisor	Dec 22, 2004

Accreditations

Solectron EMS Canada 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.

The Solectron Design and Engineering 10-meter Ambient Free Chamber (AFC) complies with the Industry Canada (IC) requirements for Test Facilities and Test Methods [15] under reference file number 4180. Through IC MRAs, EMC measurements are accepted in the following countries: USA, Australia, Singapore, Chinese Taipei (Taiwan), and the Republic of Korea. Further information can be found at the IC Certification and Engineering Bureau web site http://strategis.ic.gc.ca/epic/internet/inceb-bhst.nsf/en/Home under the "conformity assessment bodies" link.

The VCCI [**12**] lab registration numbers associated with our test facilities are: R-1641, C-1749, C-1750, T-148, and T-149.

Solectron EMS Canada is ISO 9001:2000 and ISO-IEC 17025 certified and its processes are documented in the Solectron EMS Canada 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 UHF Base Station with Data Module as part of an Original Equipment application for FCC Part 22, 74, 90, and Industry Canada RSS-119 certifications.

On the basis of measurements performed during December 2004, the M/A-COM MASTRIII UHF Base Station with Data Module is verified to be compliant with FCC Part 22, 74, 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.

The frequency of the band of operation is 450 to 512 MHz.

The FCCID of the new equipment is OWDTR-0041-E.

The Industry Canada certification number is 3636B-0041.

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 UHF Base Station with Data Module and its compliance to FCC Part 22, 74, 90, and Industry Canada RSS-119.

Table 2-1: Compliance Results Summary

Product Summary			
Product Name:	M/A-COM MASTRIII UHF Base Station with Data Module	Project Manager:	Simon Richardson
Product Code:	TR-0041	Measurements by :	Denis Lalonde
Product Status:		Date:	December 22, 2004

Test Cases

Performed	**Description**	**Specification**	**Test Results**		**Notes**
			Pass	Fail	
■	RF Power	FCC Part 2.1046, 90.205, & 74.461 RSS-119 sect. 5.4	■	□	
■	Conducted Spurious Emissions	FCC Part 2.1051, 22.359, 74.462, & 90.210 RSS-119 sect. 6.3	■	□	
■	Emission Mask	FCC Part 2.1051, 22.359, 74.462, & 90.210 RSS-119 sect. 6.4	■	□	
■	Field Strength of Spurious Emissions	FCC Part 2.1053, 22.359, 74.462, & 90.210	■	□	
■	Frequency Stability	FCC Part 2.1055, , 22.355, 74.464, & 90.213 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	□	□	
■	Transient Frequency Behavior	FCC 74.462, 90.214 RSS-119 sect. 6.5	■	□	
■	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
■	Receiver Conducted Emissions	FCC Part 15.111 RSS-119 sect. 8	■	□	

3. Equipment Under Test (EUT)

3.1 Product Functional Description

The product trade name of the unit tested is "M/A-COM MASTRIII UHF Base Station with Data Module".

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

Figure 3-1 Product Description

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 UHF Base Station with Data Module

3.3 Transmitter Specifications

Table 3-1 lists the specifications of the transmitter under test. Operation over the full frequency band of operation is achieved through the use of 2 different sets of transmitter/receiver synthesizers and receive front end modules. The only differences between modules of different frequency bands are the values of passive tuning components.

Table 3-1: Transmitter Specifications

	Fundamental Characteristics
Tx power	10 to 100 W
Tx frequency	Configuration 1: 450 to 470 MHz Configuration 2: 470 to 512 MHz
Channel spacing	25 kHz

3.4 System Components

The system tested consists of the units shown in Table 3-2. The capability to operate over all the frequency bands identified in Table 3-1 was achieved by selecting a Tx Synthesizer, Rx Synthesizer, Rx Front End, and Power Amplifier modules which are dedicated for their respective frequency band.

Table 3-2: MASTRIII UHF BTS Components

Component	Model	Serial Number
MASTRIII shelf	SXGPNX	9861756
Tx Synthesizer module	EA101685V12	SLR 0438 1501
	EA101685V13	SLR 0438 1515
Rx Synthesizer module	EA101684V12	SLR 0438 1507
	EA101684V13	SLR 0438 0985
Rx Front End module	19D902782G4 (450 – 470 MHz)	06AQ9L
	19D902782G9 (470 – 492 MHz)	063KQK
	19D902782G10 (492 – 512 MHz)	067QRT
IF module	EA101401V1	SLR 03150255
System module	19D902590G6	SLR 0251 2492
Data module	19D504558 G1	SLR 04160954
Power module	19D902589G2	CKA 01390368
Power supply	PS103010V120	QG12659
RF Power Amplifier	EA101292V22	09430363

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
GE Digital Test Generator	19A149117P2

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

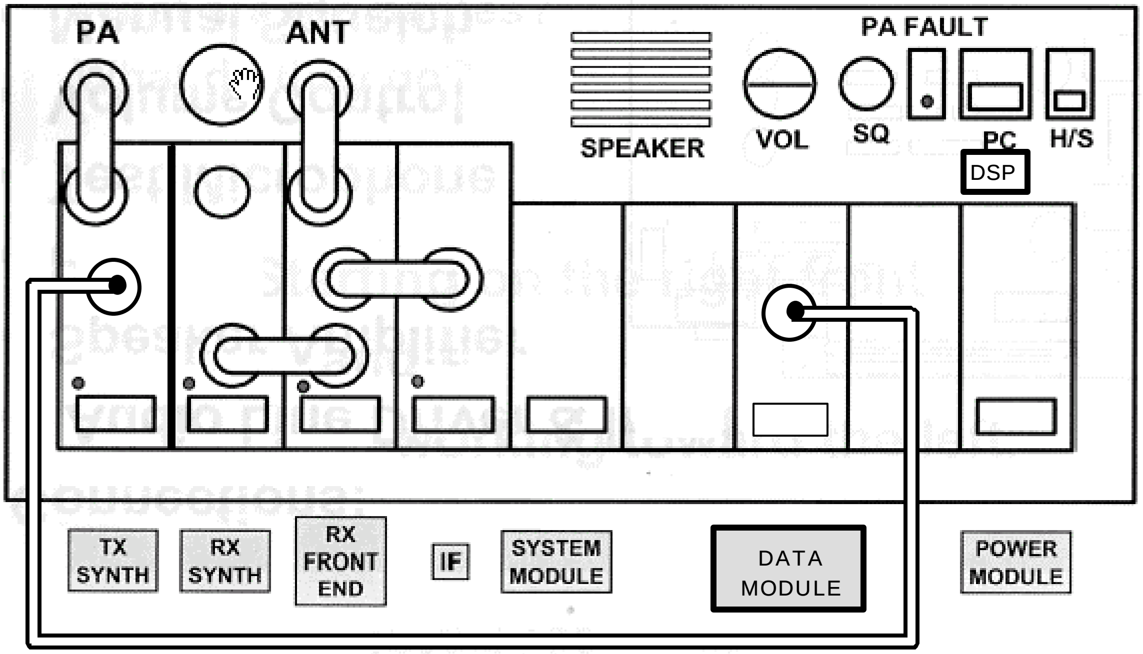
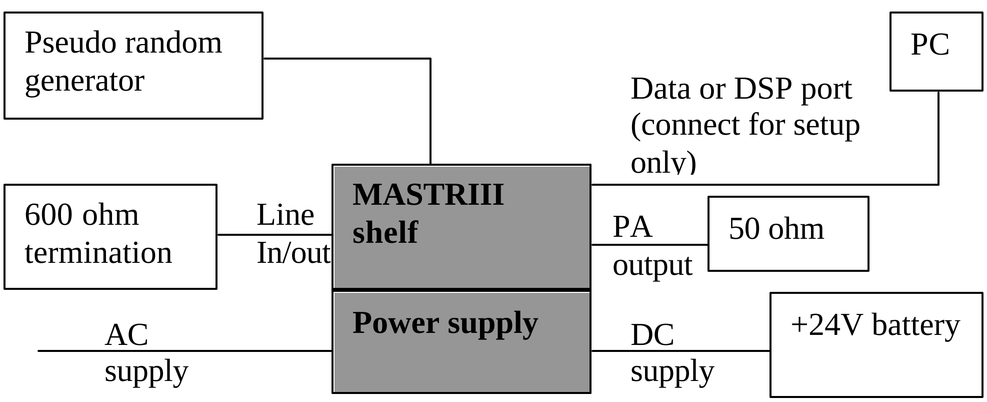


Figure 3-3: System Configuration



A photograph of the test setup used in this test report is presented in Appendix B: Test Set-up Photographs, on page 33.

3.7 EUT Interfaces and Cables

The system contains the following interfaces, as shown in Table 3-4.

Table 3-4: System Cables

Interface Type	EUT Connection	Description	Type	Length	Qty
AC Mains	AC power supply	3 wire AC cord	unshielded	6 feet	1
DC Mains	Battery connector of power supply	2 wire battery cable	unshielded	6 feet	1
Telephone line in/out	MASTRIII shelf	2 twisted pair	unshielded	6 feet	1

3.8 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	2.1046, 90.205, 74.461
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

Configuration	Frequency	Rated Power
1	450 to 470 MHz	10 to 100 W (40 to 50 dBm)
2	470 to 512 MHz	10 to 100 W (40 to 50 dBm)

5.1.2 Test Facility Information

Location: Solectron Design and Engineering Lab 1

Date tested: December 20, 2004

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 the bottom, middle, and top of the frequency band. The lowest and highest possible power levels were evaluated. Each of the 2 Tx/Rx Synthesizers were tested.

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)
450.025 (low freq. split)	40.1	50.0
470.025 (high freq. split)	40.1	50.0
511.975 (high freq. split)	40.0	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	53-20-33	20 dB, 500 W	KW975	22 April 2005
Attenuator	Weinschel	6070-10	10 dB, 25 W	BE0846	25 Oct. 2005
Power meter	Anritsu	M2438A	Power meter	SSG012588	27 April 2005
Power sensor	Anritsu	M2424A	Power sensor	SSG012587	27 April 2005

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	2.1051, 22.359, 74.462, 90.210,
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 5120	-13 dBm

The limit is calculated in section 5.4.

The worst case limit from the specification list shown in Table 5-5 is used.

5.2.2 Test Facility Information

Location: Solectron Design and Engineering Lab 1

Date tested: December 9, 2004

Tested by: Denis Lalonde

5.2.3 Test Procedure

Conducted spurious emissions were measured at the bottom and top of the frequency band. Two sets of synthesizers were tested at their maximum (100 W) and minimum power levels (10 W). The transmitter was modulated with a 2 level digital signal with 9600 bits/sec bit rate.

The measurement was separated in 2 frequency bands;

1. 30 MHz to 800 MHz: the power amplifier output is connected to the spectrum analyzer through a 10 dB and a 20 dB attenuator.
2. 800 MHz to 5.12 GHz: the power amplifier output is connected to the spectrum analyzer through a 20 dB and a 800 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)	Maximul level of spurious emission (dBm)		Reference
	Hi Power	Low Power	
450.025	-24.3	-33.7	Figure 7-2 to Figure 7-5
511.975	-24.2	-34.0	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	53-20-33	20 dB, 500 W	KW975	22/04/2005
Attenuator	Weinschel	6070-10	10 dB, 25 W	BE0846	13/10/2005
Spectrum analyzer	HP	8564A	40 GHz	SSG012069	28/04/2005
High Pass filter	Microwave Circuits	H8008501	800 MHz high pass	SSG012709	NR
Signal generator	HP	83732A	20 GHz	SSG012125	13/10/2005

NR: not required, calibrated using the signal generator and spectrum analyzer

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	2.1049, 22.359, 74.462, 90.210
RSS-119	6.4

5.3.1.1 Limits

The specification levels in Table 5-10 were used.

Table 5-10: Emission Mask Limits

Emission Type	Mask Requirement
2 level digital (25 kHz channel)	Part 90 Mask C (Part 74 is the same) Part 22.359 (same as Part 90 mask)

5.3.2 Test Facility Information

Location: Solectron Design and Engineering Lab 1

Date tested: December 20, 2004

Tested by: Denis Lalonde

5.3.3 Test Procedure

The emission mask measurements were performed at 470.025 MHz. The system was tested at its maximum (100 W) power level. The modulation of the transmitted signal was setup as follows:

1. 2 level 9600 baud modulation: The MASTRIII Base Station was modulated with a 2 level 9600 baud pseudo-random TTL-level signal. The Data Module was adjusted to produce +/- 3 kHz deviation at the power amplifier RF output.

For this measurement, 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 5-11 lists the modulation modes measured:

Table 5-11: Emission Mask Results

Measurement	Type of signal	Test result	Reference
470.025 MHz (Part 74, 90, RSS-119)	2 level 9600 baud / +/- 3 KHz deviation	Pass	Figure 7-10

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	53-20-33	20 dB, 500 W	KW975	22/04/2005
Attenuator	Weinschel	6070-10	10 dB, 25 W	BE0846	13/10/2005
Spectrum analyzer	HP	8564A	40 GHz	SSG012069	28/04/2005

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 5-13: Field Strength of Spurious Emissions Requirement

Requirement	Part / Section
FCC	2.1053, 90.210, 22.359, 74.462

5.4.1.1 Limits

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

Table 5-14: Field Strength of Spurious Emissions Limit

Frequency Range (MHz)	ERP Limit (dBm)
30 to 5120	-13

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

Attenuation = 43 + 10 log (P) dB
= 43 + 10 log (100)
= 63 dB

ERP limit = 10 log (100 W) – 63 dB
= -13 dBm

When operating at 10 W, the ERP limit for spurious emissions is – 13 dBm.

5.4.2 Test Facility Information

Location: Solectron Design and Engineering 10m Ambient Free Chamber

Date tested: December 13 & 14, 2004

Tested by: S. Cullen and D. 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-01-01 [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 5.12 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 5.12 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 minimum power output (10 W) and its maximum power output (100 W). A 2 level 9600 baud wideband signal tuned at 450.025 MHz and 511.975 MHz was used for this test. A 50 ohm load was connected to the power amplifier output.

5.4.4 Test Results

Table 5-15 lists the highest emissions measured, all other emission had more than 20 dB margin:

Table 5-15: Field Strength of Spurious Emissions

Tx Channel	Freq. of Emission (MHz)	Signal Generator Level Hi Power (dBm)	Antenna Gain (dBi)	Cable losses (dB)	ERP Low Power (dBm)	ERP Hi Power (dBm)	Margin (dB)	Reference
450.025 MHz	1350.075 (3Tx)	-43.3	7.6	1.3	-61.1	-39.2	26.2	Figure 7-11 to Figure 7-14
511.975 MHz	1023.95 (2Tx) 2047.9 (4Tx) 3583.825 (7 Tx) 4095.8 (8Tx)	-41.4 -50.6 -50.2 -50.9	6.1 8.7 9.7 9.8	1.1 1.5 2.1 2.3	-49.2 -59.6 -58.2 -56.3	-36.4 -45.6 -44.8 -45.6	23.4 32.6 31.8 32.6	Figure 7-15 to Figure 7-18

5.4.5 Test Conclusion

The test results met the requirement.

5.4.6 Test Equipment List

Table 5-16: Test Equipment used for Field Strength of Spurious Emissions

Description	Manufacturer	Model	Serial Number	Cal. Due
Bilog Antenna	Antenna Research	LPB 2520A	SSG012299	3/2/2005
Double Ridged Horn	Emco	3115	SSG012298	12/29/2004
Pre-Amplifier	BNR	LNA	SSG012360	2/11/2005
Quasi-Peak Adapter, HP85650A, (EMI # 2)	HP	85650A	SSG013046	10/13/2005
RF Amplifier, HP8447 # 1	Agilent	8447D	SSG013045	10/13/2005
Spec. A, RF PreSelector, HP85685A (AFC #1)	HP	85685A	SSG012010	4/29/2005
Spectrum Analyzer Display, HP 85662A	HP	85662A	SSG012433	4/29/2005
Spectrum Analyzer, HP8566B, (AFC #1)	HP	8566B	SSG012521	4/29/2005
Sucoflex Cable, EMC Cable # 1	Huber & Suhner	106A	SSG012454	2/12/2005
Sucoflex Cable, EMC Cable # 2	Huber & Suhner	106A	SSG012453	2/12/2005
Sucoflex Cable, EMC Cable # 5	Huber & Suhner	104PEA	SSG012359	2/11/2005
Sucoflex Cable, EMC Cable # 6	Huber & Suhner	106A	SSG012456	2/12/2005
Utiflex Cable, EMC Cable # 4	Micro-Coax	UFA 147B-1-0300-70X70	SSG012309	10/13/2005

Description	Manufacturer	Model	Serial Number	Cal. Due
Signal generator	HP	83732A	SSG012125	13/10/2005
Horn Antenna	EMCO	3115	2703	24/02/05

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 5-17: Frequency Stability Requirement

Requirement	Part / Section
FCC	2.1055, 90.213, 22.355, 74.464
RSS-119	7.0

5.5.1.1 Limits

The specification levels are listed in Table 5-18.

Table 5-18: Frequency Stability Limits

Frequency Range (MHz)	Bandwidth (kHz)	Minimum Frequency Stability (ppm)
421 to 512	25	2.5

5.5.2 Test Facility Information

Location: Solectron Design and Engineering Lab 9

Date tested: December 16, 2004

Tested by: Denis Lalonde

5.5.3 Test Procedure

The 470.025 MHz unmodulated output of the power amplifier was connected through attenuators into a frequency counter. A 10 MHz rubidium frequency reference was used to provide improved frequency accuracy to the frequency counter.

Frequency measurements were performed with 1 configuration of the base station frequency reference. A 12.8 MHz internal frequency reference is used when the base station is deployed with 25 kHz bandwidths.

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 20 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

The table below lists the frequency stability measurement results:

Table 5-19: Frequency Stability Results (470.025 MHz)

Temperature (degree. Celsius)	AC Voltage (V)	Internal 12.8 MHz Frequency Reference (Used for 25 kHz Bandwidths)	
		Frequency (MHz)	Frequency Error (ppm)
-30	120	470.024697	-0.64
-20	120	470.024741	-0.55
-10	120	470.024984	-0.03
0	120	470.024968	-0.07
10	120	470.025067	0.14
20	102	470.02499	-0.02
20	120	470.02499	-0.02
20	138	470.02499	-0.02
30	120	470.024868	-0.28
40	120	470.024632	-0.78
50	120	470.024466	-1.14

5.5.5 Test Conclusion

The test results met the requirement.

5.5.6 Test Equipment List

Table 5-20: Test Equipment used for Frequency Stability

Category	Manufacture	Model	Description	Serial Number	Cal. Due
Frequency Reference	UCT	2008	Rubidium 10 MHz	A1010	27/04/2005
Attenuator	Weinschel	53-20-33	20 dB, 500 W	KW975	22/04/2005
Attenuator	Weinschel	6070-10	10 dB, 25 W	BE0846	13/10/2005
Digital Multimeter	Fluke	83		SSG012586	20/04/2005
Frequency Counter	HP	5385A		SS013044	12/07/2005

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 Transient Frequency Behavior

5.6.1 Test Specification

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

Table 5-21: Transient Frequency Behavior Requirement

Requirement	Part / Section
FCC	90.214, 74.462
RSS-119	6.5

5.6.1.1 Limits

The specification levels are listed in Table 5-22.

Table 5-22: Transient Frequency Behavior Limit

Channel Spacing (kHz)	Time Interval (ms)	Maximum Frequency Difference (kHz)
25	T1 = 10	+/- 25
	T2= 25	+/- 12.5
	T3= 10	+/- 25

Note:

T1 is the time period immediately following Txon

T2 is the time period immediately following T1.

T3 is the time period from the instant when the transmitter is turned off until Txoff.

5.6.2 Test Facility Information

Location: Solectron Design and Engineering Lab 1

Date tested: December 20, 2004

Tested by: Denis Lalonde

5.6.3 Test Procedure

The test procedure of ANSI/TIA-603B-2002 [11] section 2.2.19 (modulation domain analyzer method) was used.

5.6.4 Test Results

Table 5-23 shows the transient frequency behavior measurement results. Each graph shows the transmitted signal frequency at the center of the +/- 5 kHz frequency scale over 35 msec.

Table 5-23: Transient Frequency Behavior Test Results

Channel	Channel Spacing (kHz)	Time Interval (ms)	Maximum Frequency Difference (kHz)	Measured Frequency Difference (kHz)	Measurement reference
470.025 MHz	25	T1 = 10	+/- 25	< 1	Figure 7-19
		T2= 25	+/-12.5	< 1	Figure 7-19 & Figure 7-20
		T3= 10	+/- 25	< 1	Figure 7-20

T1 is the time period immediately following Txon

T2 the time period immediately following T1.

T3 is the time period from the instant when the transmitter is turned off until Txoff.

5.6.5 Test Conclusion

The test results met the requirement.

5.6.6 Test Equipment List

Table 5-24: Test Equipment used for Transient Frequency Behavior Measurement

Category	Manufacture	Model	Description	Serial Number	Cal. Due
Attenuator	Weinschel	53-20-33	20 dB, 500 W	KW975	22/04/2005
Attenuator	Weinschel	6070-10	10 dB, 25 W	BE0846	13/10/2005
Modulation Domain analyzer	HP	53310A		3121A01217	27/04/2005

Calibration of the measurement instrumentation is maintained in accordance with the supplier's recommendations, or as necessary to ensure its accuracy.

5.7 Occupied Bandwidth

5.7.1 Test Specification

The system occupied bandwidth was evaluated according to the specifications listed in Table 5-25:

Table 5-25: Occupied Bandwidth

Requirement	Part / Section
FCC	2.202
RSP-100	7.2

5.7.2 Test Facility Information

Location: Solectron Design and Engineering Lab 1

Date tested: December 20, 2004

Tested by: Denis Lalonde

5.7.3 Test Procedure

The occupied bandwidth measurement was performed at 470.025 MHz.

1. 2 level 9600 baud modulation: The MASTRIII Base Station was modulated with a 2 level 9600 baud pseudo-random TTL-level signal. The Data Module was adjusted to produce +/- 3 kHz deviation at the power amplifier RF output.

For this measurement, 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.

5.7.4 Test Results

The table below lists the calculated and measured occupied bandwidth.

Table 5-26: Occupied Bandwidth Value (470.025 MHz)

Type of signal	Calculation	Measurement	Emission designator
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	10.7 kHz Figure 7-21	15K6F1D 15K6F1E

5.7.5 Test Equipment List

Table 5-27: Test Equipment used for Occupied bandwidth

Category	Manufacture	Model	Description	Serial Number	Cal. Due
Attenuator	Weinschel	53-20-33	20 dB, 500 W	KW975	22/04/2005
Attenuator	Weinschel	6070-10	10 dB, 25 W	BE0846	13/10/2005
Spectrum analyzer	HP	8564A	40 GHz	SSG012069	28/04/2005

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.

5.8 Receive Antenna Port Conducted Emissions

These tests are performed to assure that the product does not produce excessive conducted emissions on the receive antenna port.

5.8.1 Test Specification

The system was tested to the requirements listed in Table 5-28:

Table 5-28: Receive Port Conducted Emissions Requirement

Requirement	Section	Country of Application
RSS-119	8	Canada
FCC Part 15, Subpart B	15.111	USA

5.8.1.1 Limits

The specification levels in Table 5-29 are worst-case limits taken from all test specifications.

Table 5-29: Receive Antenna Port Conducted Emissions Limits

Frequency Range (MHz)	FCC Part 15 / RSS-119 (dBm)
30 - 2560	-57

5.8.2 Test Facility Information

Location: Solectron Design and Engineering Lab 1

Date tested: December 20, 2004

Tested by: Denis Lalonde

5.8.3 Test Configurations

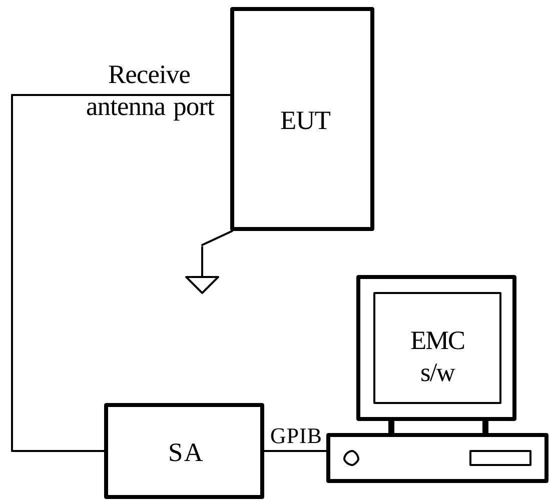
For conducted emissions test cases, the EUT hardware configuration / software load used is described in sections 3.6 (see Figure 3-2).

5.8.4 Test Procedure

Verifications of the test equipment were performed prior to the installation of the EUT in accordance with the quality assurance procedures in KP000270-LP-EMC-01-01 [7]. The test was performed as per the relevant Test procedures: ANSI C63.4 [4], RSS-119[10].

The test method shown in Figure 5-1 was used for conducted emission measurements on the receive antenna port.

Figure 5-1: Rx Antenna Port Test Method



Abbreviations used in the above figures:

EUT	Equipment under test
SA	Spectrum Analyzer

- The connection of the antenna port cable was representative of installation practice as shown in the figure above.
- Conducted emissions were measured by connecting the spectrum analyzer input to the antenna port of the Receiver Front End Module
- A pre-scan was taken for all the frequency range from the requirement, using a peak detector on the spectrum analyzer. The pre-scan data was then compared to the specification limits. All emissions within 10 dB from the limit lines were recorded.

5.8.5 Test Results:

This section presents the conducted emissions on the receive antenna port test results. Graphical representations of the measurements taken appear in Appendix H: Conducted Receiver Emissions Plots.

All emissions had more than 10 dB margin.

5.8.6 Test Conclusion

The EUT has passed the Receive Antenna Port Conducted Emissions tests with respect to FCC Part 15 and RSS-119 with more than 10 dB of margin.

5.8.7 Test Equipment List

Table 5-30: Test Equipment used for Conducted Spurious Emissions

Category	Manufacture	Model Number	Description	Serial Number	Cal. Due
Spectrum analyzer	HP	8564A	40 GHz	SSG012069	28/04/2005

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.

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. Solectron EMS Canada Inc. Quality Manual, K0000608-QD-QM-01-07, 2004.
3. Solectron EMS Canada Inc. Lab Operations Manual KG000347-QD-LAB-01-05, 2004.
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. Solectron EMS Canada Inc., EMC General Lab Test Procedure, KP000270-LP-EMC-01-01, February 2004.
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
12. VCCI, V-3/02.04 16th edition, April 2002.Title: AGREEMENT OF VOLUNTARY CONTROL COUNCIL FOR INTERFERENCE BY INFORMATION TECHNOLOGY EQUIPMENT
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/
15. Industry Canada, RSS 212, Test Facilities and Test Methods for Radio Equipment, Issue 1 (Provisional), February 27, 1999.

7. Appendices

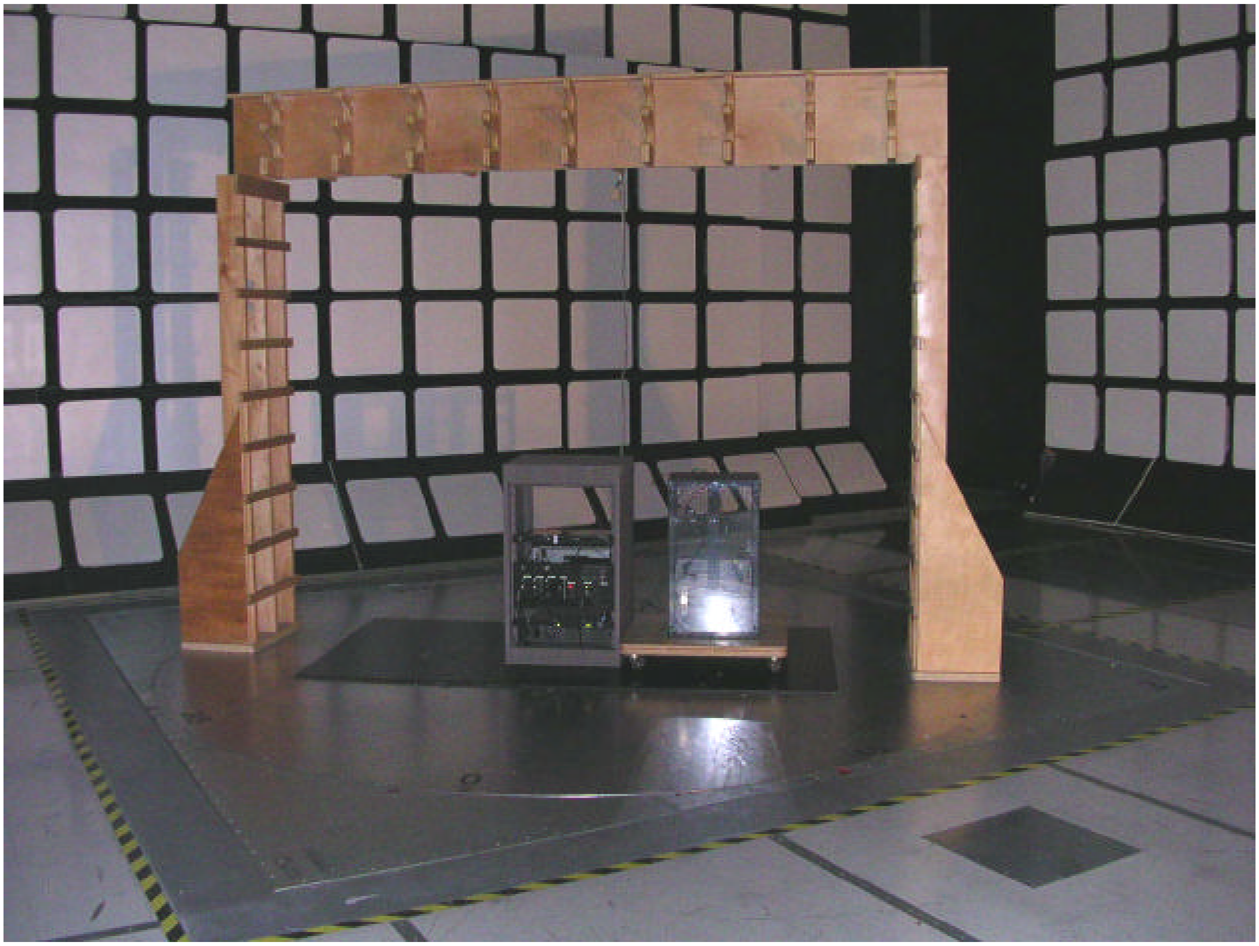
7.1 Appendix A: Glossary

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 UHF Base Station with Data Module Radiated Emissions Set-up



7.3 Appendix C: Conducted Spurious Emissions Plots

Figure 7-2: Tx at 450.025 MHz, 100 W Power, 30 MHz to 800 MHz

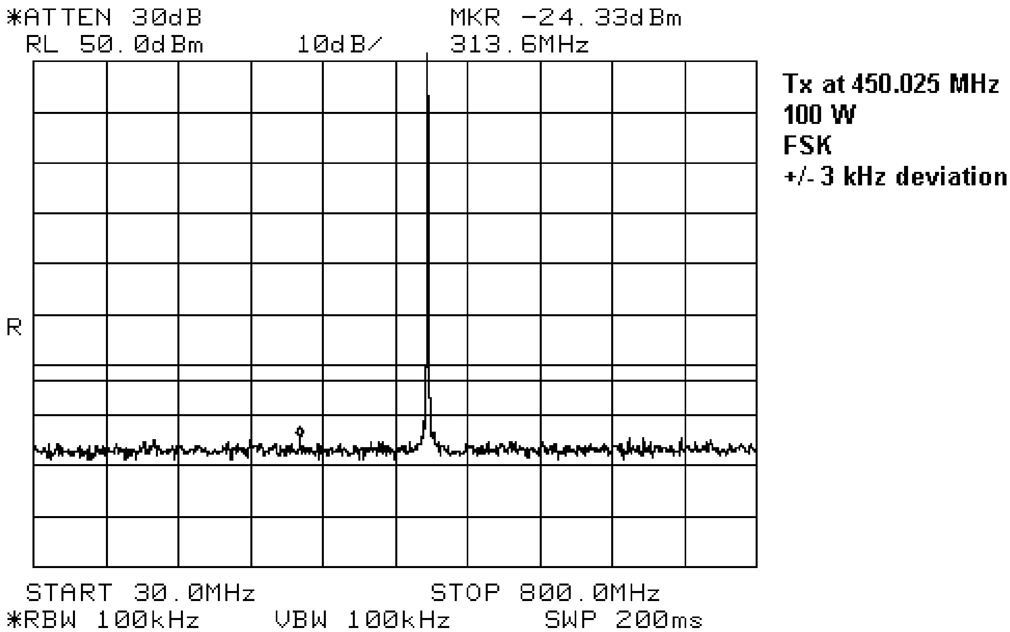


Figure 7-3: Tx at 450.025 MHz, 100 W Power, 800 MHz to 5.12 GHz

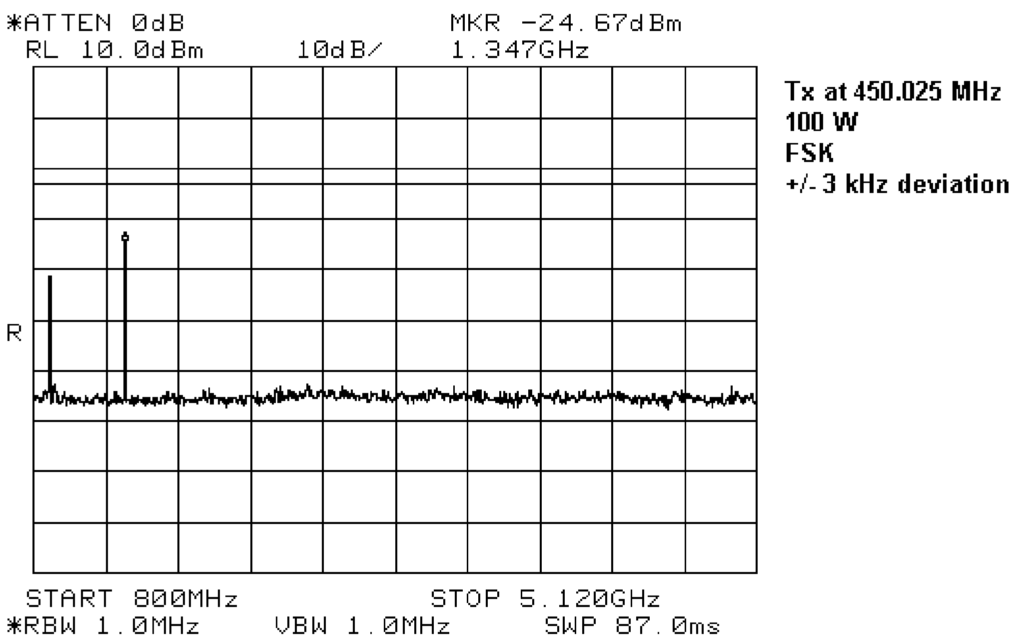


Figure 7-4: Tx at 450.025 MHz , 10 W Power, 30 MHz to 800 MHz

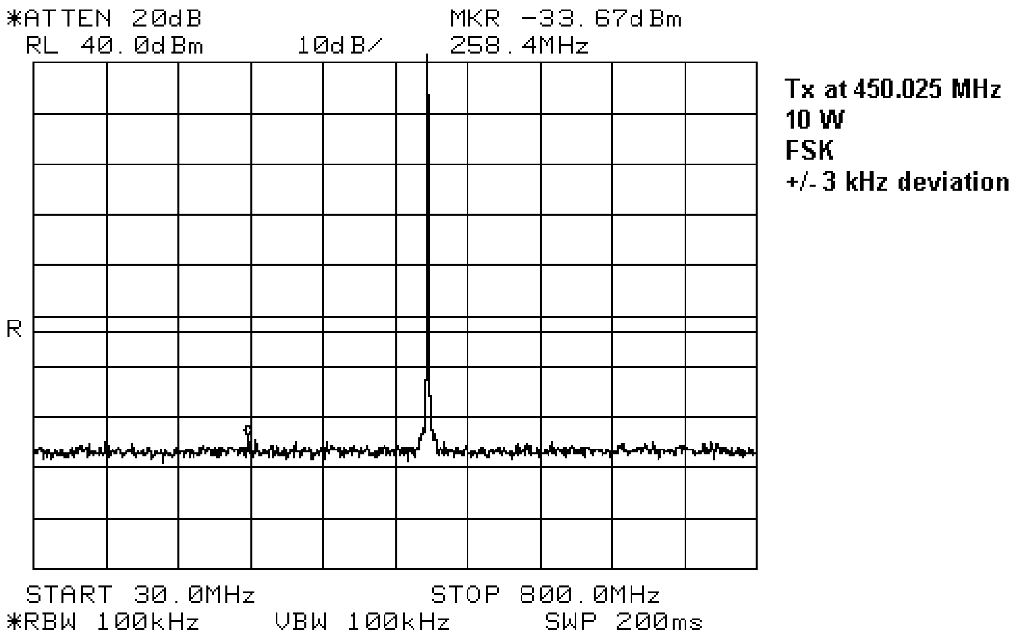


Figure 7-5: Tx at 450.025 MHz , 10 W Power, 800 MHz to 5.12 GHz

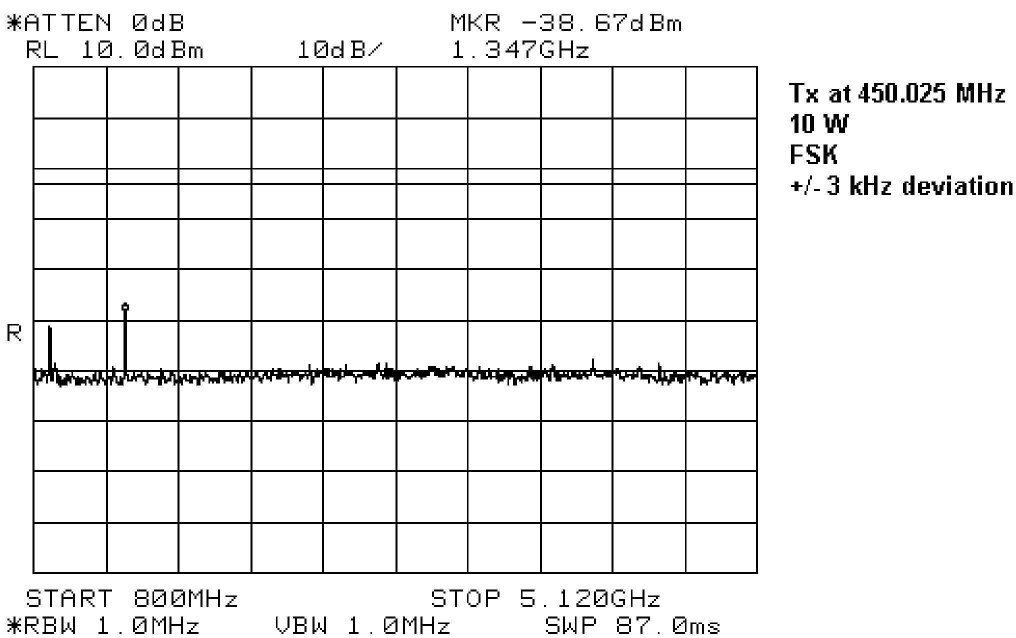


Figure 7-6: Tx at 511.975 MHz, 100 W Power, 30 MHz to 800 MHz

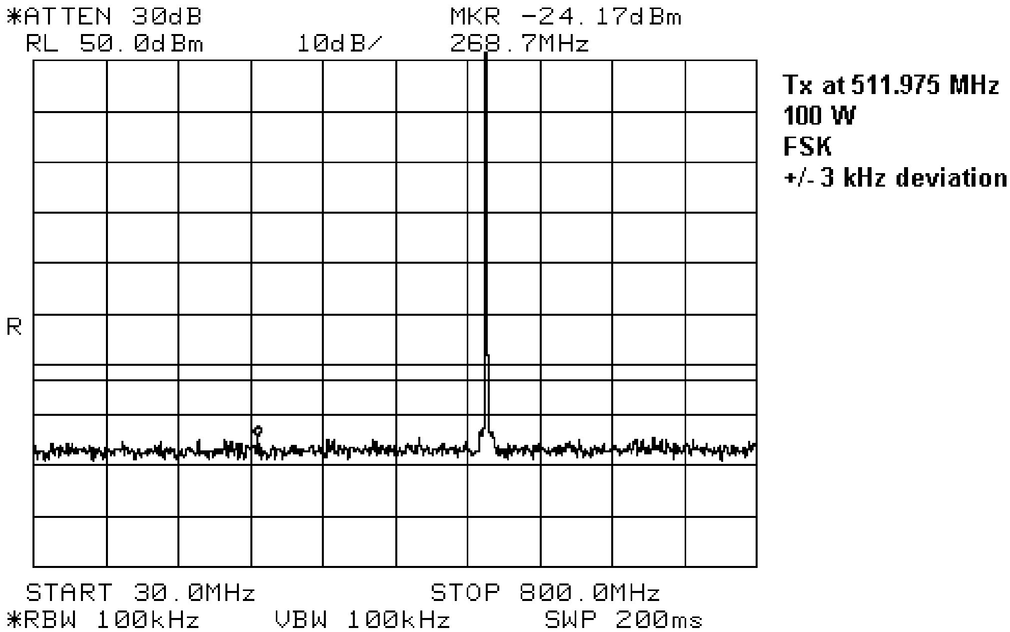


Figure 7-7: Tx at 511.975 MHz, 100 W Power, 800 MHz to 5.12 GHz

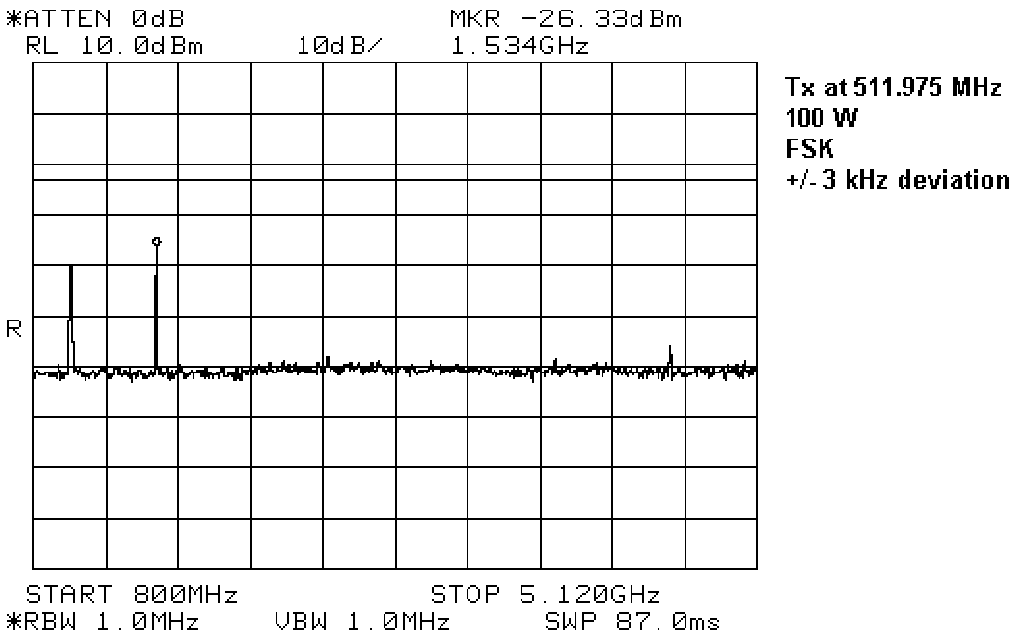


Figure 7-8: Tx at 511.975 MHz , 10 W Power, 30 MHz to 800 MHz

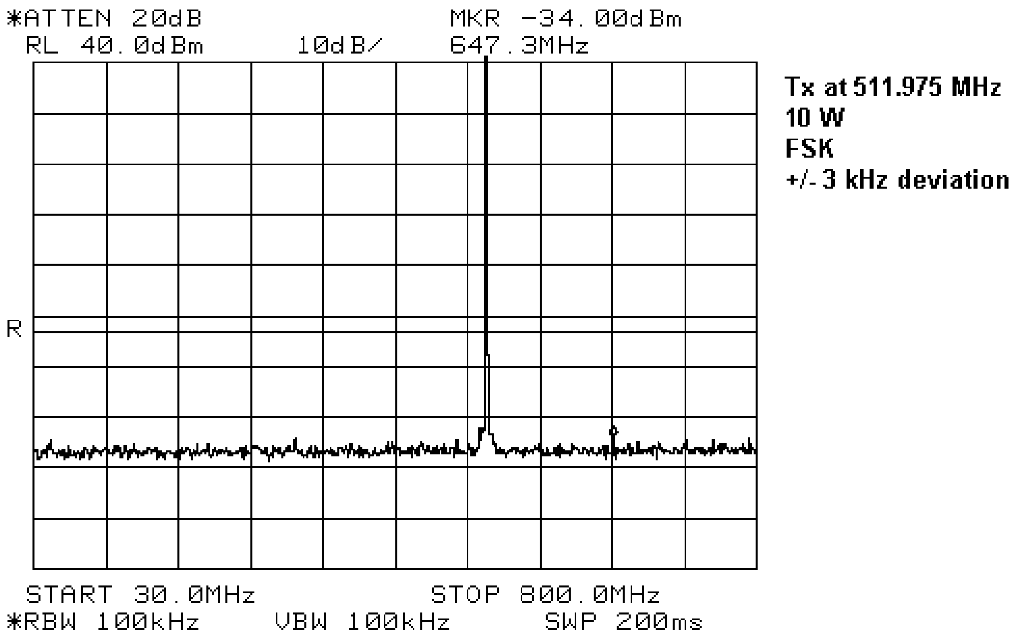
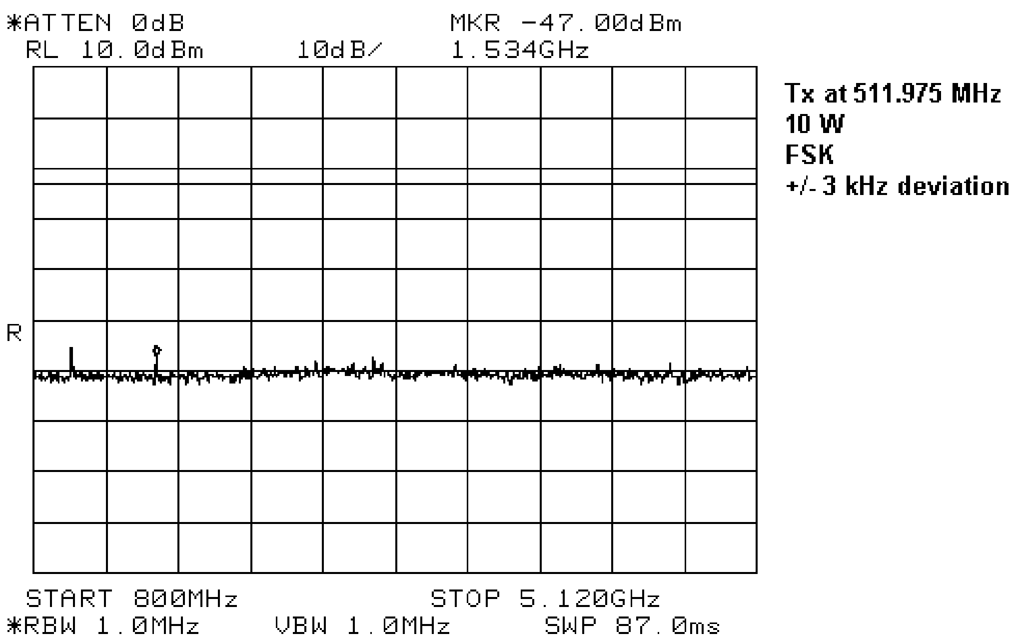


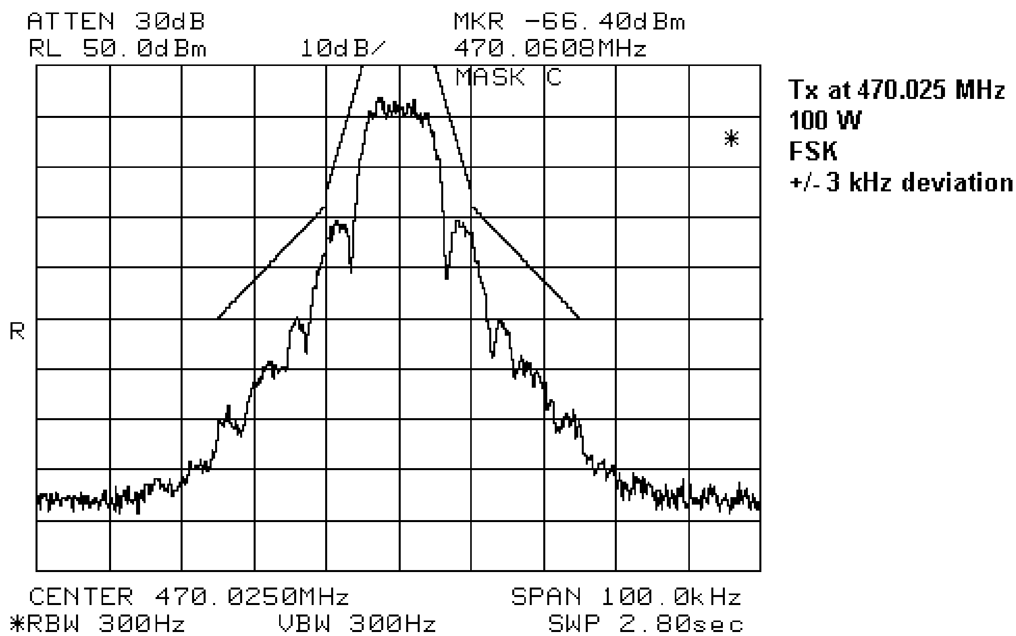
Figure 7-9: Tx at 511.975 MHz , 10 W Power, 800 MHz to 5.12 GHz



7.4 Appendix D: Emission Mask Plots

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

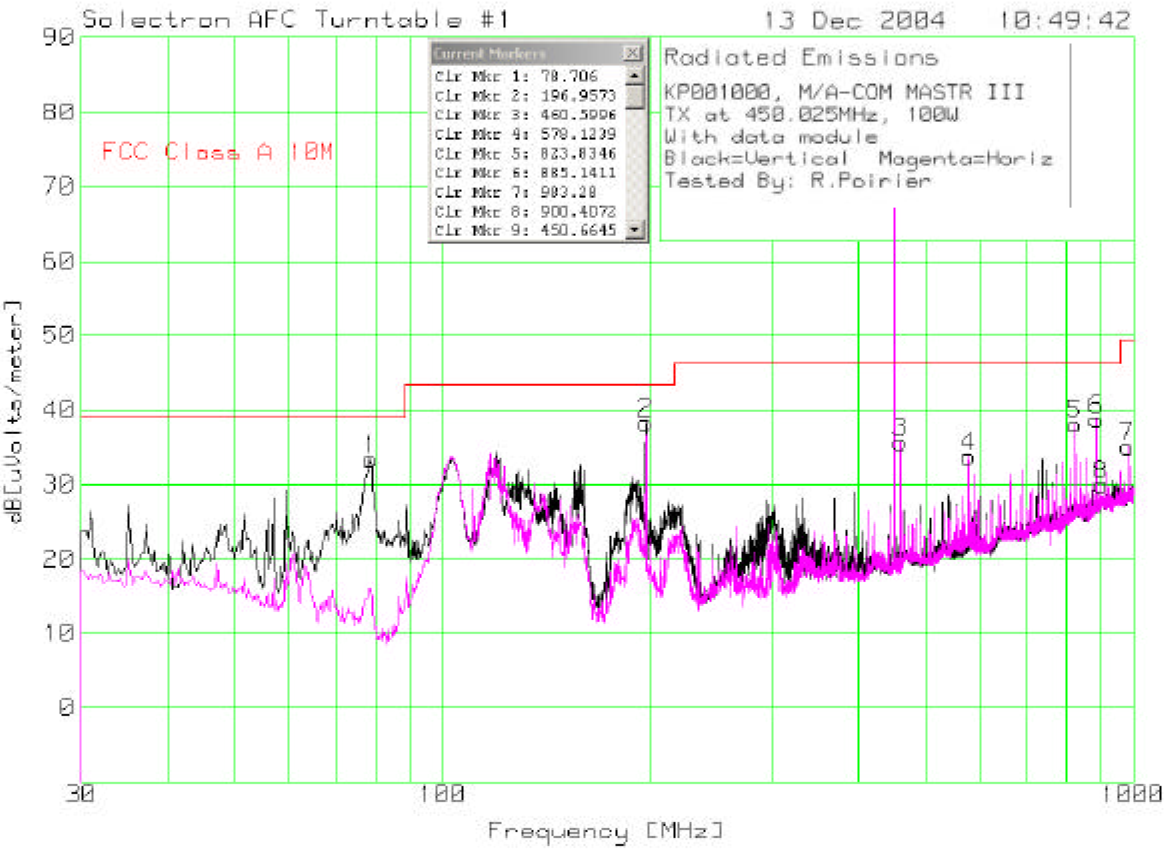
Figure 7-10: 2 Level 9600 baud Signal with +/- 3 kHz Deviation, 470.025 MHz, FCC Part 90, 74, and 22 Mask



7.5 Appendix E: Field Strength of Spurious Emissions Plots

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

Figure 7-11: Field Strength with 100 W Tx, 30 MHz to 1 GHz (Tx at 450.025 MHz)



Note: the emissions at 450.025 MHz is leakage of the transmitted signal.

Figure 7-12: Field Strength with 100 W Tx, 1 GHz to 5.12 GHz (Tx at 450.025 MHz)

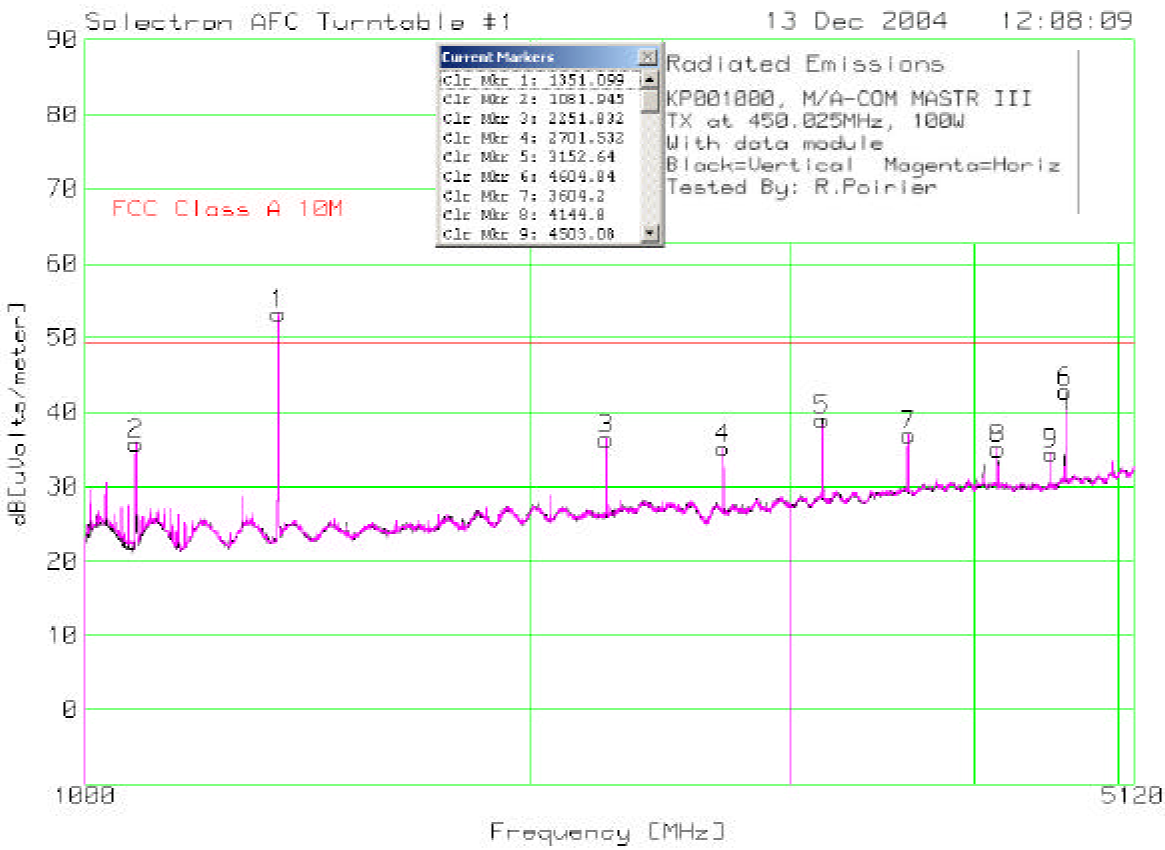
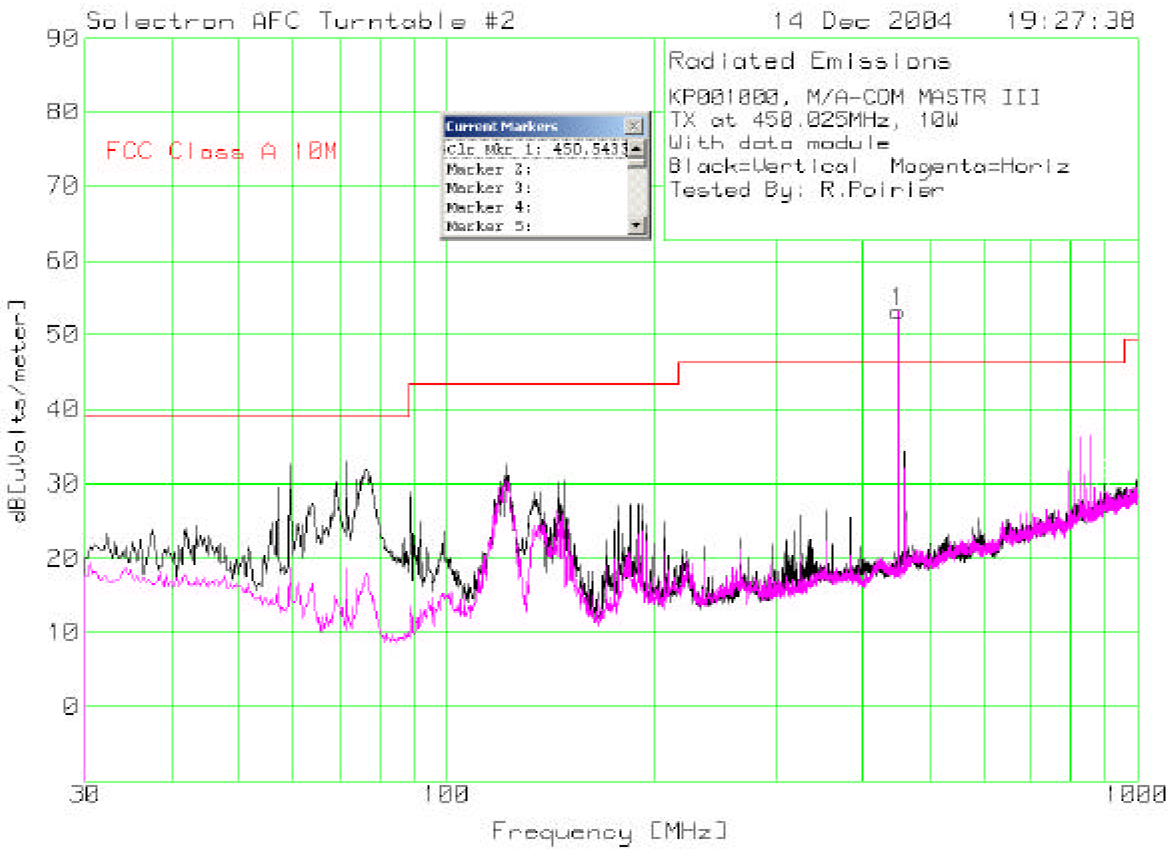


Figure 7-13: Field Strength with 10 W Tx, 30 MHz to 1 GHz (Tx at 450.025 MHz)



Note: the emissions at 450.025 MHz is leakage of the transmitted signal.

Figure 7-14: Field Strength with 10 W Tx, 1 GHz to 5.12 GHz (Tx at 450.025 MHz)

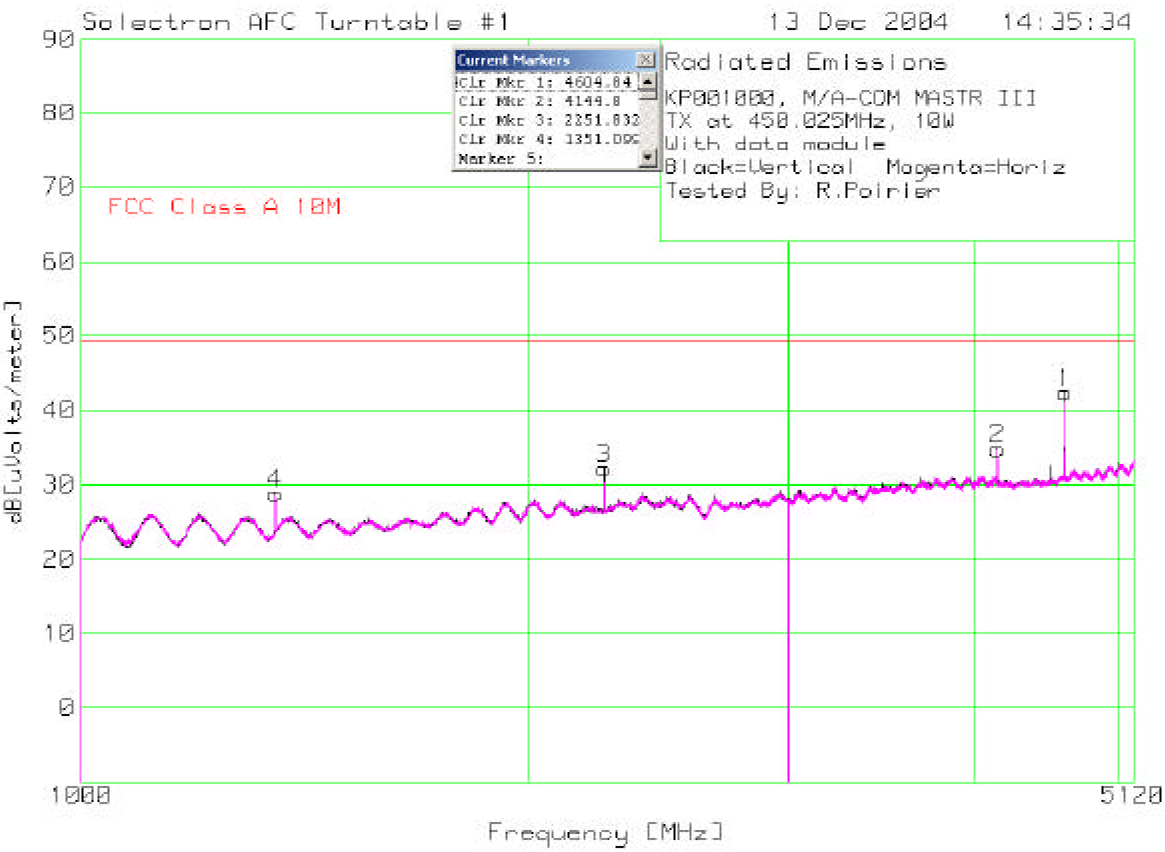
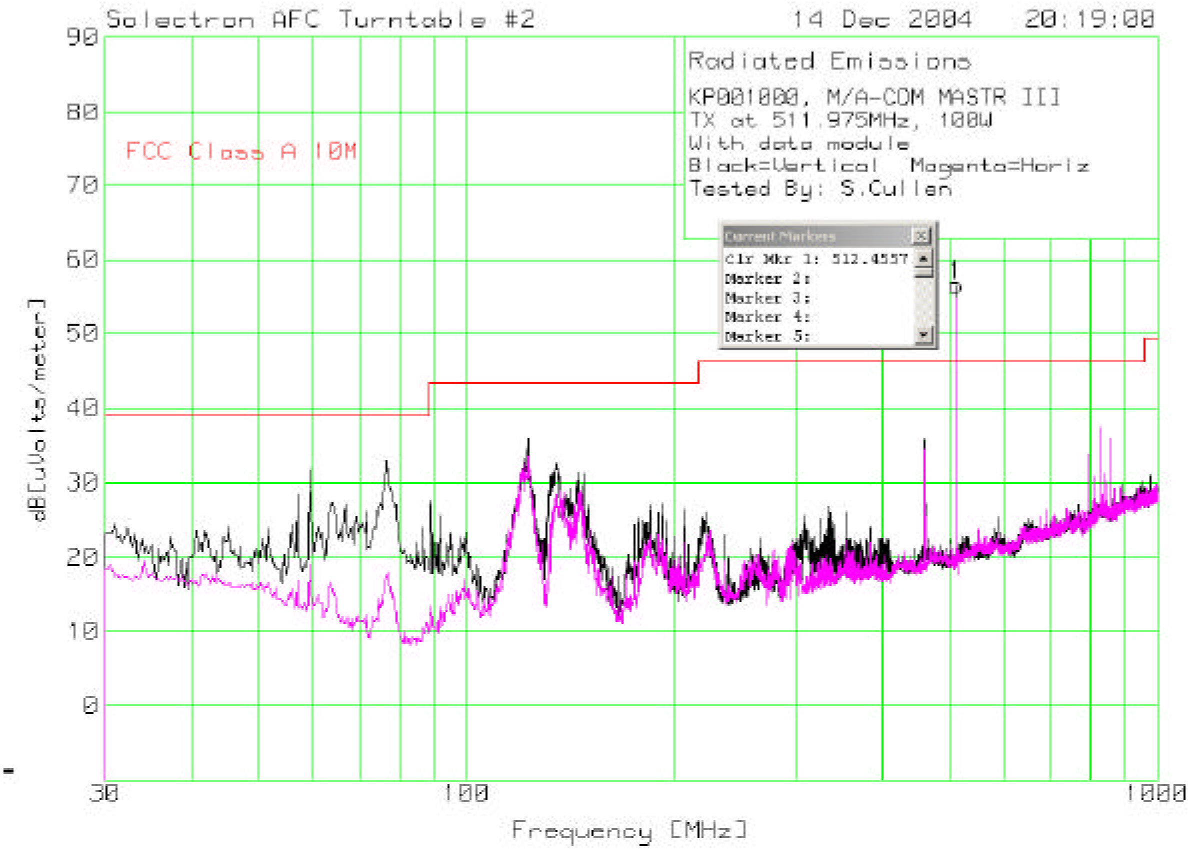


Figure 7-15: Field Strength with 100 W Tx, 30 MHz to 1 GHz (Tx at 511.975 MHz)



Note: the emissions at 511.975 MHz is leakage of the transmitted signal.

Figure 7-16: Field Strength with 100 W Tx, 1 GHz to 5.12 GHz (Tx at 511.975 MHz)

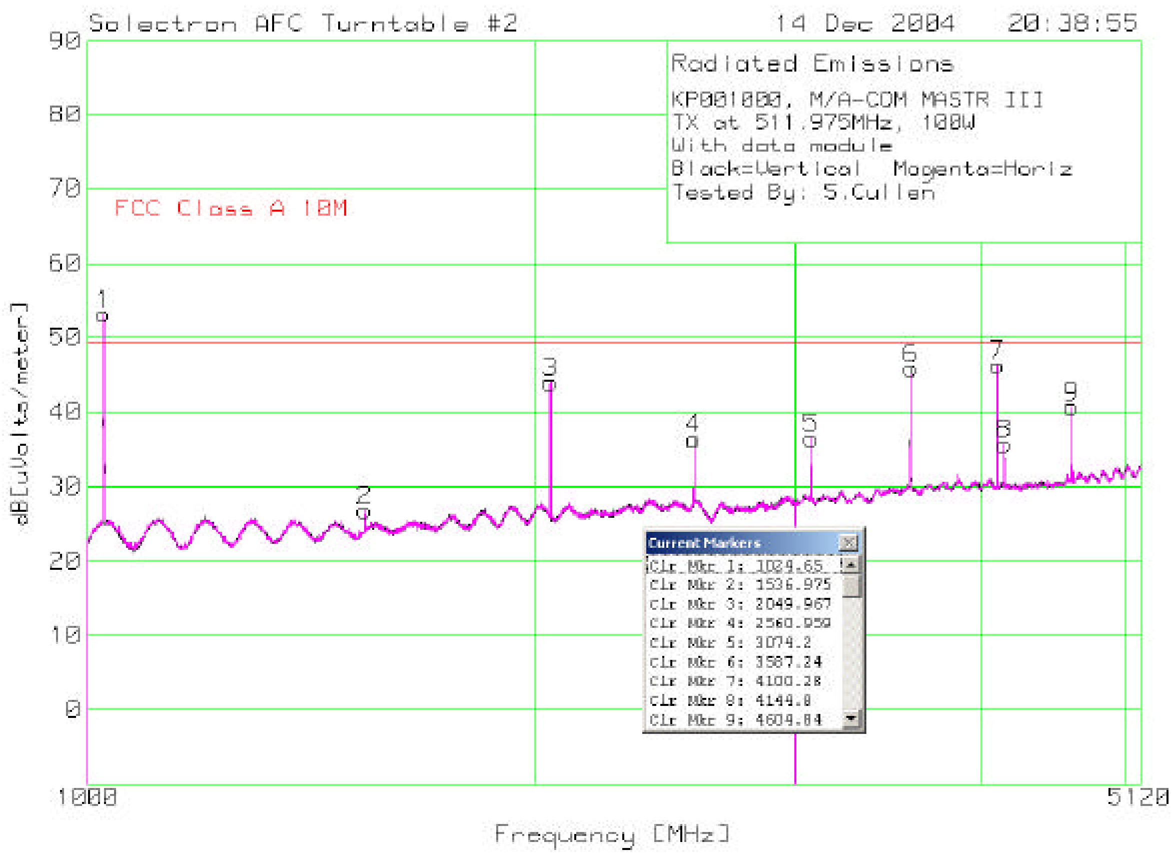
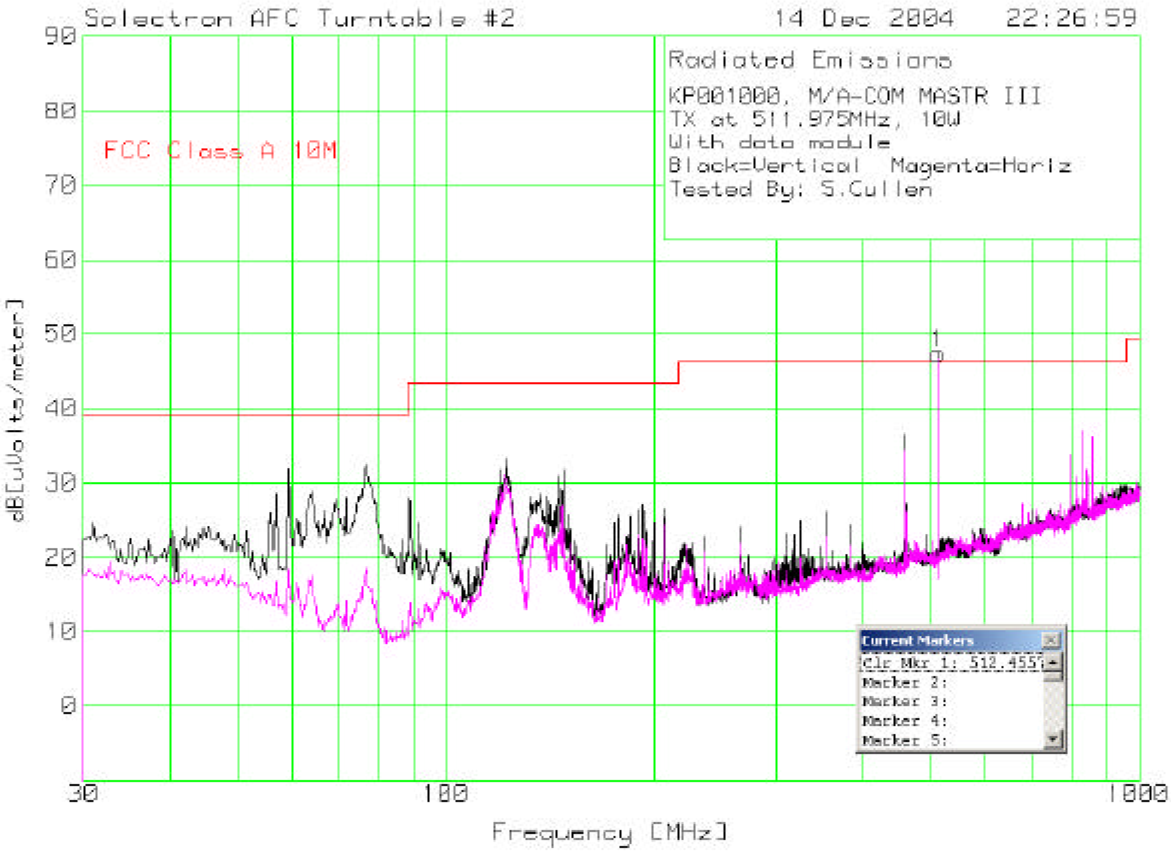
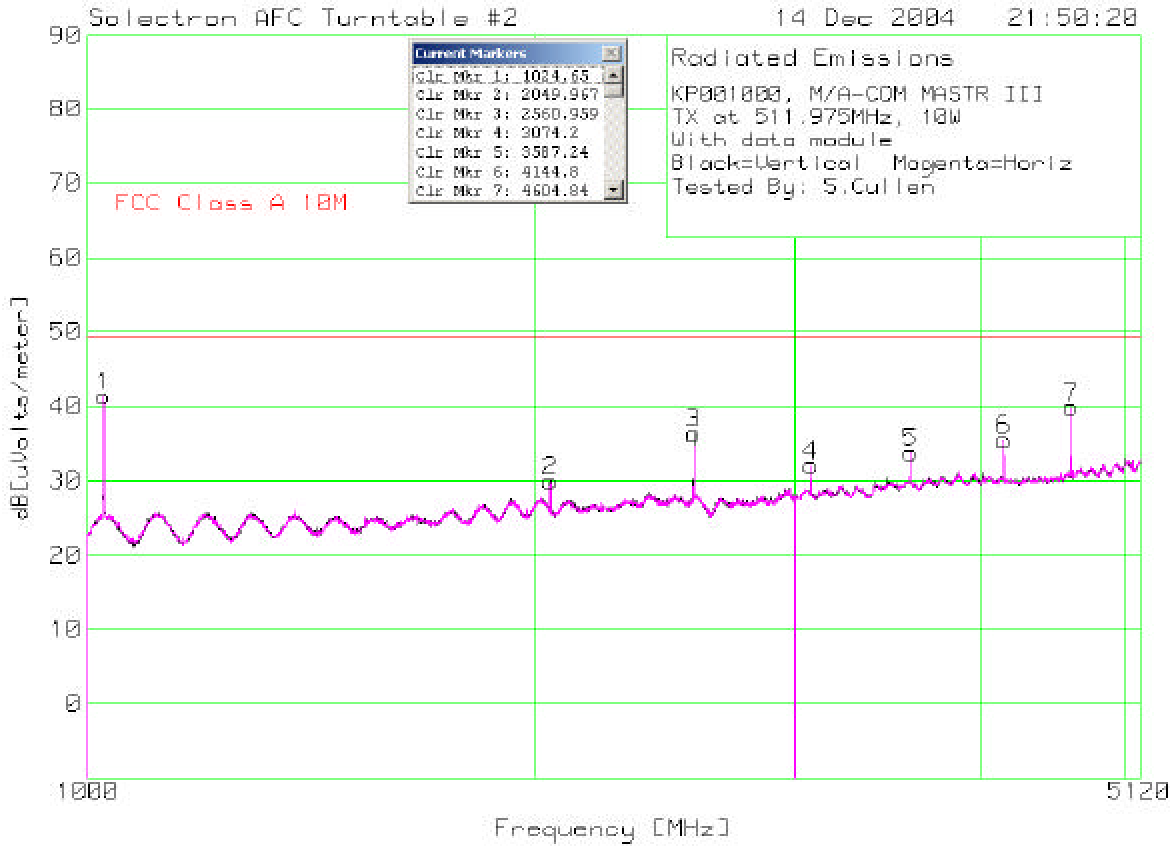


Figure 7-17: Field Strength with 10 W Tx, 30 MHz to 1 GHz (Tx at 511.975 MHz)



Note: the emissions at 511.975 MHz is leakage of the transmitted signal.

Figure 7-18: Field Strength with 10 W Tx, 1 GHz to 5.12 GHz, (Tx at 511.975 MHz)



7.6 Appendix F: Transient Frequency Behavior Plots

This appendix presents all the transient frequency behavior plots for the test cases measured

Figure 7-19 Transient Frequency Behavior, Tx at 470.025 MHz, Wideband, Transmitter on

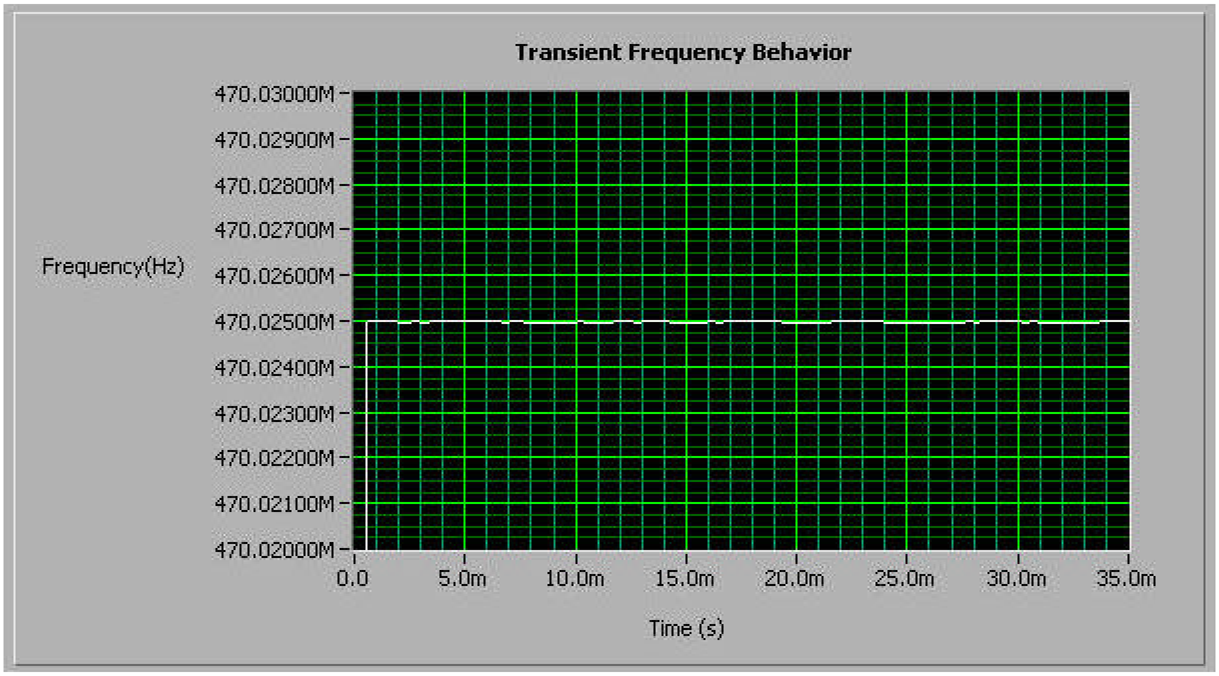
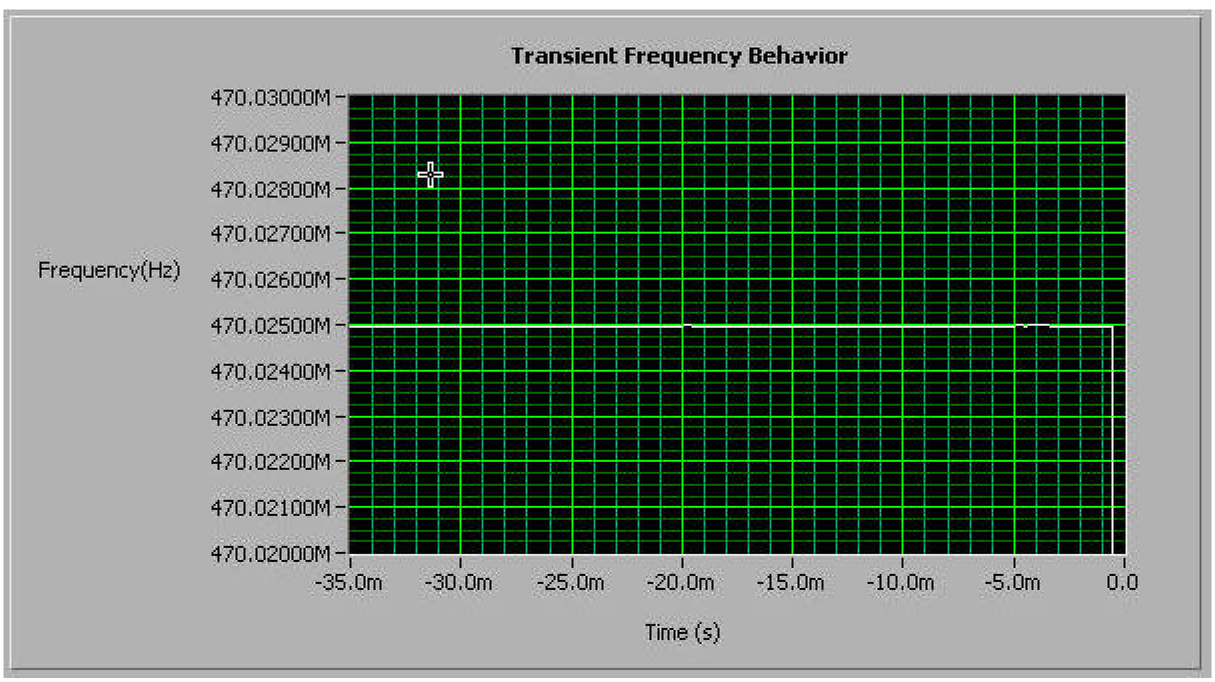


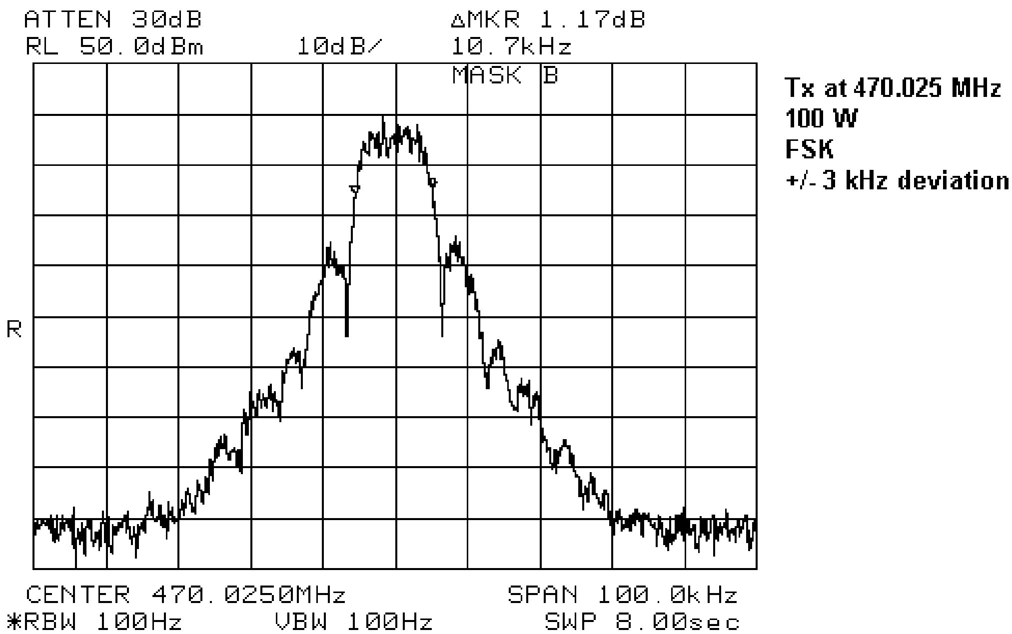
Figure 7-20 Transient Frequency Behavior, Tx at 470.025 MHz, Wideband, Transmitter off



7.7 Appendix G: Occupied Bandwidth Plots

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

Figure 7-21: 2 Level 9600 baud Signal with +/- 3 kHz Deviation, 470.025 MHz



7.8 Appendix H: Conducted Receiver Emissions Plots

Figure 7-22: Rx at 481.525 MHz, 30 MHz to 1GHz

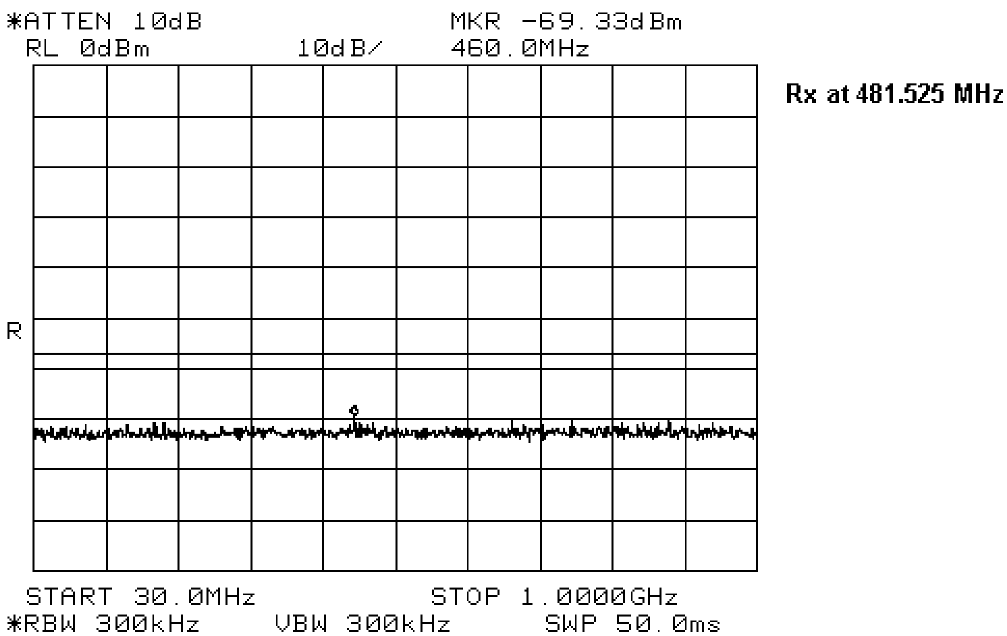
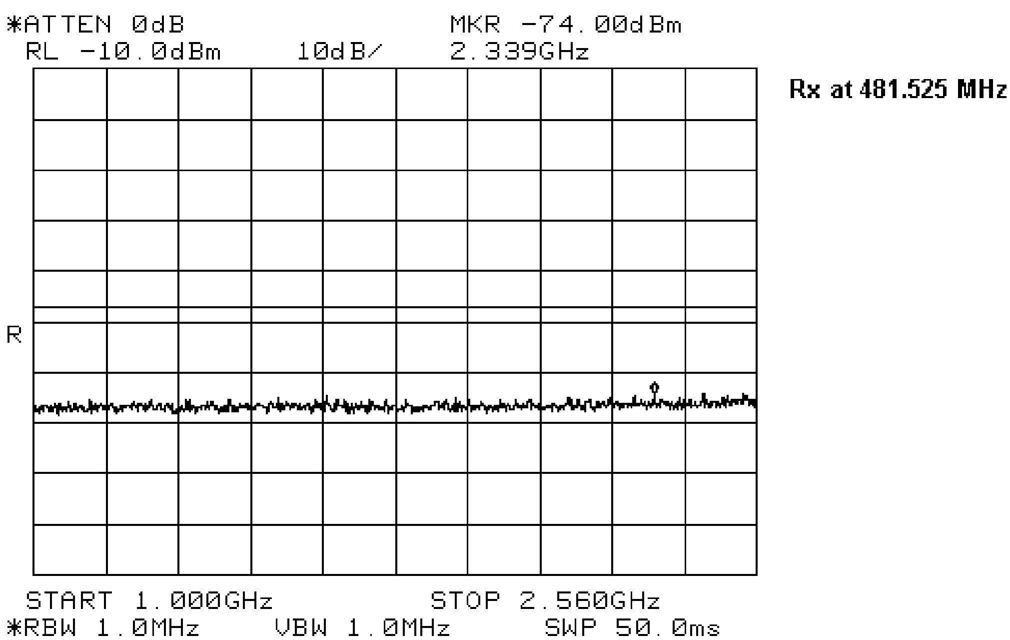


Figure 7-23: Rx at 481.525 MHz, 1 GHz to 2.56 GHz



SOLECTRON EMS CANADA INC.

Certification Report for M/A-COM MASTRIII UHF Base Station with Data Module

FCC Part 22, 74, 90, & RSS-119