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

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Approvals

Function	Name	Job title	Signature
Document Release Approval	Simon Richardson	Project Manager	S. Richardson SEPT 24, 2004
Author	Denis Lalonde	Radio Compliance Discipline Leader	Sept. 24, 2004
Technical Reviewer	Jacques Rollin	EMC Advisor	Sept 24, 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.

The Solectron Technical Centre 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 [11] lab registration numbers associated with our test facilities are: R-1641, C-1749, C-1750, T-148, and T-149.

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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Executive Summary

This report describes the test results of the FCC Part 15 Subpart B emissions tests performed on the new version of the M/A-COM MASTRIII 800 MHz Base Station. All measurements were performed in the Solectron Technical Centre laboratories in Kanata, Ontario, Canada.

A summary list of all the tests that were performed, including their results, is found in Sections 3. Complete details on each individual test are found in the body of the report.

On the basis of measurements performed in the period of August to September 2004, the M/A-COM MASTRIII 800 MHz Base Station is verified to be compliant with Class A emission requirements in accordance with FCC Part 15 Subpart B, ICES-003 and receiver emission requirements of RSS-119. The test data included in this report apply to the product titled above manufactured by M/A-COM, Inc.

1. Scope and Purpose

At the request of the Customer M/A-COM, C-MAC Engineering has evaluated the radiated and conducted emissions of the M/A-COM MASTRIII 800 MHz Base Station. This report describes the test results of the FCC Part 15 Subpart B, ICES-003, and receiver emission requirements of RSS-119 tests performed on the M/A-COM MASTRIII 800 MHz Base Station. All measurements were performed in the Solectron Technical Centre laboratories in Kanata, Ontario, Canada.

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 15 Subpart B, ICES-003, and receiver emission requirements of RSS-119.

Table 2-1: Compliance Results Summary

Product Summary			
Product Name:	M/A-COM MASTRIII 800 MHz Base Station	Project Leader:	Simon Richardson
Product Code:		EMC Engineer:	Denis Lalonde
Product Release:		Tester:	S. Cullen, R. Poirier
Product Status:	production	Date:	August 9 to Sept. 21, 2004

Test Cases[1]					
Completed	**Description**	**Specification**	**Test Results**		**Notes**
			Pass	**Fail**	
■	Radiated Emissions (E-field)	FCC Part 15 / B	■	☐	
		ICES-003	■	☐	
■	Conducted Emissions (AC Mains)	FCC Part 15 / B	■	☐	
		ICES-003	■	☐	
■	Conducted Emissions (Receive antenna port)	FCC Part 15 / B	■	☐	
		RSS-119 (sect. 8)	■	☐	

1. All the emission tests were performed at C-MAC Engineering Inc., Kanata, Ontario.

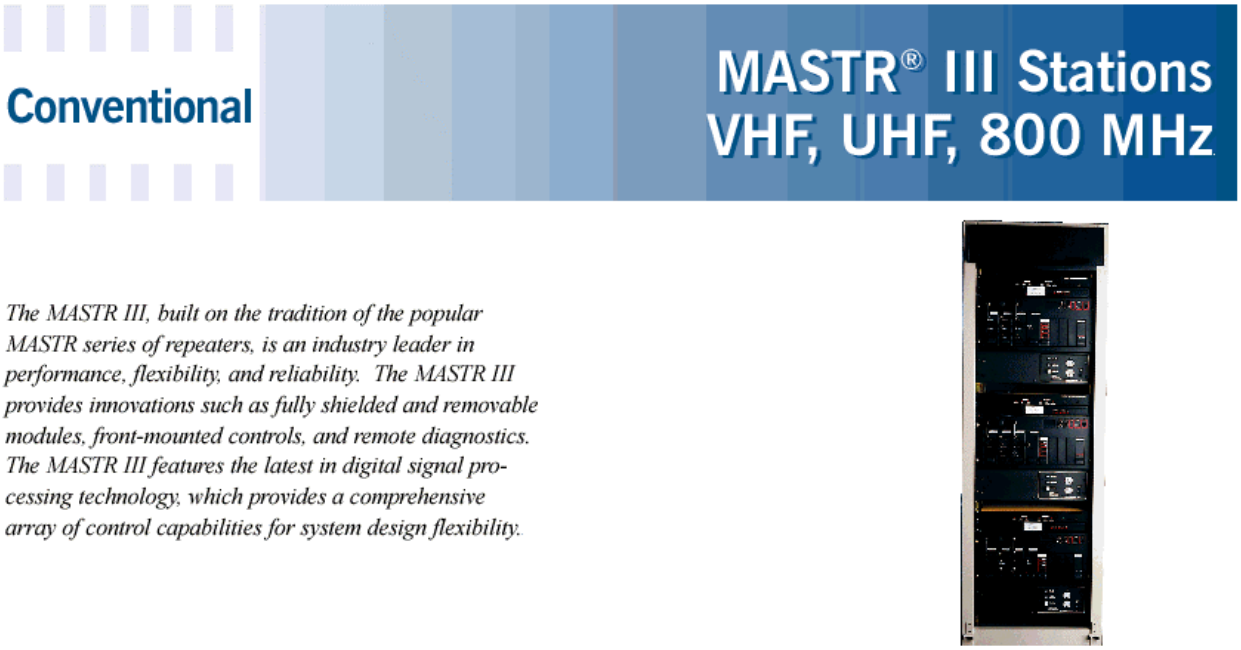
3. Equipment Under Test (EUT)

3.1 Product Functional Description

The product trade name of the unit to be tested is "M/A-COM MASTRIII 800 MHz Base Station".

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

Figure 3-1: Product Description



3.2 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 Power Requirements

For the purposes of EMC testing, the power requirements were as follows:

Table 3-1: Power Requirements

Voltage	Current
24 VDC	15 A
120 VAC	5 A max

3.4 Clocks / Oscillators / Switching Power Supply Frequencies

Table 3-2 lists the highest frequency clock sources (e.g. discrete crystals and VCXOs) used in the configurations under test and, where appropriate, the sub-multiples when clock division has been employed for distribution to other circuit packs.

Table 3-2: EUT Fundamental Frequencies

Circuit Pack	Fundamental Frequencies (MHz)
Digital board clocks	100
Rx Freq.	820.9875
Rx RF L0	750.7875
Rx IF	70.2

3.5 EUT Interfaces and Cables

The system contained the following interfaces, as shown in Table 3-3:

Table 3-3: 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 (only on the new version of the supply)	Battery connector of power supply	2 wire battery cable	unshielded	12 feet	1
Ethernet link	SitePro Ethernet 0 and 1 ports	Category 5 twisted pairs	unshielded	50 feet	2
Telephone line in/out	MASTRIII shelf	2 twisted pair	unshielded	6 feet	1

3.6 Support Equipment

The support equipment required for the testing is described in Table 3-4

Table 3-4: Support equipment

Equipment	Manufacturer	Model number
Desktop PC	DELL Optiplex	GXpro
Laptop PC	IBM Thinkpad	600E

3.7 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

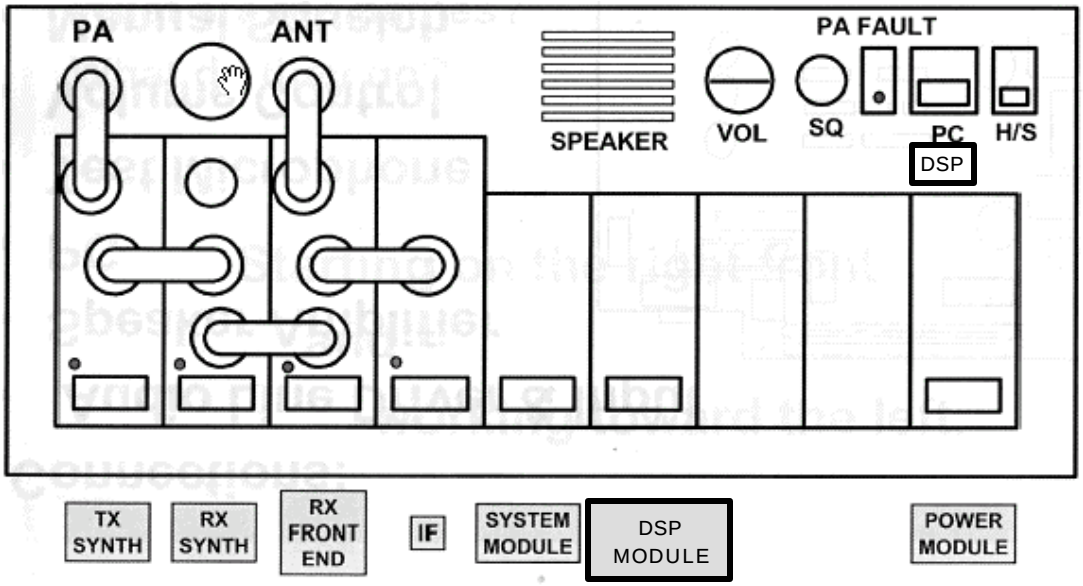
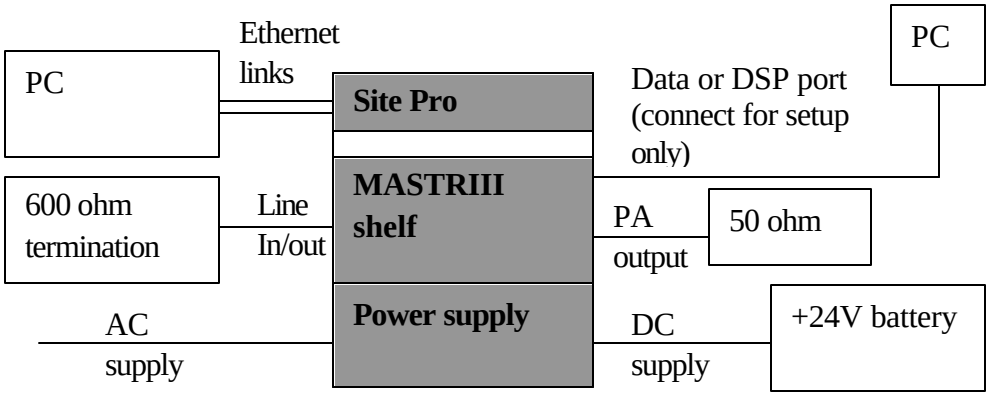


Figure 3-3: System Configuration



The Tx Synthesizer was disconnected for radiated and conducted emissions tests. A 50 ohm termination was connected to the Receiver Front End input.

The BTS can be installed with 2 types of power supplies.

1. A switching mode power supply which includes a +24 V DC port for battery backup.
2. A linear power supply with no battery backup capability.

Both types of power supplies were evaluated for conducted emissions on the AC port. Radiated emissions were evaluated with the following power scheme:

1. AC operation using the switching mode power supply
2. DC operation using the switching mode power supply
3. Linear power supply

The emission on the receiver antenna port were done using the power supply which had the highest radiated emissions levels.

3.8 EUT Operations and Software

The tests were performed with the base station receiver tuned at 820.9875 MHz.

A PC was used to exercise both Ethernet ports of the BTS.

3.9 System Modifications

No modifications were required to pass the requirements.

3.10 System Inventory List

The EUT configuration is described in Table 3-5.

Table 3-5: MASTRIII 800 MHZ BTS Components

Component		Model	Serial Number
MASTRIII shelf		SXGPNX	9861756
Tx Synthesizer module (disconnected)		EA101685V5	SLR 04111439
Rx Synthesizer module		EA101684V5	SLR 04111322
Rx Front End module		19D902782G5	SLR 03182064
IF module		EA101794V1	SLR 03190963
System module		19D902590G6	SLR 02512492
DSP module		EA101800V1	SLR 03084077
Power module		19D902589G2	CKA 01390368
12 V Battery		Dynasty TEL 12-125	NR
Switching Power supply		PS103010V120	QG12659
Linear Power supply		19A149979P1	31725690
SitePro shelf		EA101209V1 R1B	SLR 02190892
	SSI	CB101869V1/R1A	NR
	Controller board	CB101069V2 P3A	NR
	Analog board	CB10170V1 R6A	NR
RF Power Amplifier		EA101292V1	05322580

1. NR: not required

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 Emissions Test Results

Emissions from telecommunication systems manifest themselves in two forms: conducted emissions on cables and radiated emissions from the entire system (i.e., electronic modules, hardware, and cables). Emissions standards restrict these different forms of radiation from the system.

5.1 E-field Radiated Emissions

E-field Radiated Emissions tests are performed to assure that that the product does not produce excess amounts of radiated emissions that could interfere with licensed radiators.

5.1.1 Test Specification

The system was tested to the Class A limits of the requirements listed in Table 5-1:

Table 5-1: E-field Radiated Emissions Requirements

Requirement	Section	Method / Limits	Country of Application
ICES 003	-	CISPR 22	Canada
FCC Part 15, Subpart B	15.109	ANSI C63.4	USA

5.1.1.1 Limits

The specification levels in Table 5-2 were used.

Table 5-2: Regulatory E-field Radiated Emissions Limits at 10 meters, Class A

Frequency Range (MHz)	FCC Part 15 / ICES-003 (dBmV/m)
30 – 88	39.1
88 – 216	43.5
216 – 960	46.4
960 – 1000	49.5
1000 – 4350	49.5

5.1.2 Test Facility Information

Location: Solectron Technical Centre 10m Ambient Free Chamber

Date tested: August 21, 2004

Tested by: Stirling Cullen

5.1.3 Test Configurations

For radiated emissions test cases, the EUT hardware configuration/software load used are described in Sections 3.7 and 3.8.

5.1.4 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-01-04 [7]. The test was performed as per the relevant Test procedure: 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 of 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 above 1 GHz.
- A pre-scan was performed to find emissions (frequencies) requiring detail measurement. The pre-scan 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).
- Optimization was performed based on the pre-scan data. All frequencies, having emission levels within 6 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 4.35 GHz.
- Between 30 MHz and 1 GHz, a resolution bandwidth of 120 kHz was used. For measurements at discrete frequencies the detector mode was always quasi-peak (QP) unless otherwise noted.
- Above 1 GHz, a 1 MHz resolution bandwidth and average (AVG) detection (video bandwidth of 100 Hz) were used.

5.1.5 Test Results: E-field Radiated Emissions

This section presents the E-field radiated emissions results for all the test cases considered. These measurements were taken using a peak detector and compared to the specification limit lines; all emissions within 6 dB from the limit lines were optimized using an average or a quasi-peak detector, as appropriate (AVG detector below 150 kHz and above 1 GHz and QP detector within 150 kHz – 1 GHz). All optimized emissions are presented in the table below, while graphical representations of the measurements taken appear in Appendix C: Radiated Emissions Plots.

Note that a positive margin value in the "E-field Radiated Emissions Test Results" table below indicates a PASS and a negative margin value indicates a FAILURE.

Table 5-3 and Table 5-4 lists the highest emissions measured:

Table 5-3: E-field Radiated Emissions Test Results (Switching Power Supply)

Parameter	Unit	AC Operation Emission 1	AC Operation Emission 2	DC Operation Emission 1	DC Operation Emission 2	DC Operation Emission 3	DC Operation Emission 4
Frequency	(MHz)	2237.841	2982.678	55.6857	86.4602	2237.841	2982.678
Azimuth	(deg)	145	329	2	77	145	118
Height	(cm)	101	101	99	199	100	101
Polarization		Horz	Vert	Vert	Vert	Horz	Vert
Meter Reading	(dBµV)	45.7	46.3	47.3	47.6	45.6	46.5
Detector	(Pk,QP,Av)	pk	pk	pk	pk	pk	pk
Gain / Loss Factor	(dB)	-35	-34.3	-27.3	-26.9	-35	-34.3
Transducer Factor	(dB)	28.1	29.9	10	9.3	28.1	29.9
Level	(dBµV/m)	38.8	41.9	30	30	38.7	42.1
Margin to FCC Part 15	(dB)	10.7	7.6	9.1	9.1	10.8	7.4

Table 5-4: E-field Radiated Emissions Test Results (Linear Power Supply)

Parameter	Unit	AC Operation Emission 1	AC Operation Emission 2	AC Operation Emission 3	AC Operation Emission 4	AC Operation Emission 5
Frequency	(MHz)	55.6857	59.3205	80.1599	2237.841	2982.678
Azimuth	(deg)	246	11	350	125	329
Height	(cm)	300	300	199	99	99
Polarization		Vert	Vert	Vert	Vert	Vert
Meter Reading	(dBµV)	46.8	47.5	47.8	46.6	47.9
Detector	(Pk,QP,Av)	pk	pk	pk	pk	pk
Gain / Loss Factor	(dB)	-27.3	-27.2	-27	-35	-34.3
Transducer Factor	(dB)	10	9.2	8.6	28.1	29.9
Level	(dBµV/m)	29.5	29.5	29.4	39.7	43.5
Margin to FCC Part 15	(dB)	9.6	9.6	9.7	9.8	6

Pre-scan plots of the radiated E-field emissions measured are included in Appendix C: Radiated Emissions Plots.

All other emissions had more than 6 dB margin.

5.1.6 Measurement Uncertainties

The measurement uncertainty (with a 95% level of confidence) on E-field radiated emissions measurements is: ± 5.0 dB between 30 MHz and 1000 MHz, ± 5.6 dB between 1GHz and 10 GHz.

Uncertainty evaluation has been calculated according to the method described in NAMAS NIS 81 (May 1994), "The Treatment of Uncertainty in EMC Measurements" [16].

5.1.7 Calculation of the Compliance Margin

The following example illustrates the manner in which the compliance margin is calculated in the "E-field Radiated Emissions Test Results" table(s) from Section 5.1.5 above.

The rows in these tables are defined as follows:

Meter Reading (dBmV) = Voltage measured using the spectrum analyzer with quasi-peak adapter

Gain/Loss Factor (dB) = Cumulative gain or loss of pre-amplifier and cables used in the measurement path (a negative value indicates gain)

Transducer Factor (dB) = Antenna factor

Level (dBmV/m) = Corrected value or field strength, i.e., the parameter of interest that is compared to the limit

Margin (dB) = Level with respect to the appropriate limit (a positive **Margin** indicates that the **Level** is below the limit and that the measurement is a PASS)

The values in the **Level** row are calculated as follows:

Level = Meter Reading + Gain/Loss Factor + Transducer Factor

The values in the **Margin** row are calculated as follows:

Margin = Limit – Level

5.1.8 Test Conclusion

The worst-case margin to the FCC Part 15, Class A limit line is 6.0 dB at 2982.7 MHz when the linear power supply was used.

Test result rating for E-field radiated emissions: PASS.

5.1.9 Test Equipment List

Table 5-5: Test Equipment used for Radiated Emissions

Description	Manufacture	Model	Serial Number	Cal. Due
Bilog Antenna	Antenna Research	LPB 2520A	SSG012299	2-Mar-05
Double Ridged Horn	Emco	3115	SSG012298	29-Dec-04
Pre-Amplifier	BNR	LNA	SSG012360	11-Feb-05
Quasi-Peak Adapter, HP85650A, (EMI # 2)	HP	85650A	SSG013046	25-Nov-04
RF Amplifier, HP8447 # 1	Agilent	8447D	SSG013045	25-Oct-04
Signal Generator	Anritsu	68247B	SSG012401	13-Feb-05
Spec. A, RF PreSelector, HP85685A (AFC #1)	HP	85685A	SSG012010	29-Apr-05
Spectrum Analyzer Display, HP 85662A	HP	85662A	SSG012433	29-Apr-05
Spectrum Analyzer, HP8566B, (AFC #1)	HP	8566B	SSG012521	29-Apr-05
Sucoflex Cable	Huber & Suhner	104PEA	SSG012219	6-Nov-04

Description	Manufacture	Model	Serial Number	Cal. Due
Sucoflex Cable, EMC Cable # 5	Huber & Suhner	104PEA	SSG012359	11-Feb-05
Sucoflex Cable, EMC Cable # 8	Huber & Suhner	104	SSG012302	29-Dec-04
Synthesized Function Generator	Hewlett Packard	3325A	SSG012664	9-Jun-05
Utiflex Cable, EMC Cable # 4	Micro-Coax	UFA 147B-1-0300-70X70	SSG012309	24-Jan-05

The measurement instrumentation conforms to ANSI C63.2 [5], 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 AC Leads Conducted Emissions

These tests are performed to assure that the product does not produce excessive conducted emissions on the AC mains power leads.

5.2.1 Test Specification

The system was tested to the Class A limits of the requirements listed in Table 5-6:

Table 5-6: AC Power Leads Conducted Emissions Requirement

Requirement	Section	Country of Application
ICES 003	-	Canada
FCC Part 15, Subpart B	15.107	USA

5.2.1.1 Limits

The specification levels in Table 5-7 are worst-case limits taken from all test specifications.

Table 5-7: AC Power Leads Conducted Emissions Class A Limits

Frequency Range (MHz)	FCC Part 15 AVERAGE LIMIT (dBmV)	FCC Part 15 QP Limit (dBmV)
0.15 – 0.5	66	79
0.5 – 30	60	73

5.2.2 Test Facility Information

Location: Solectron Technical Centre Ground Plane

Date tested: August 9 & 13, 2004

Tested by: Richard Poirier

5.2.3 Test Configurations

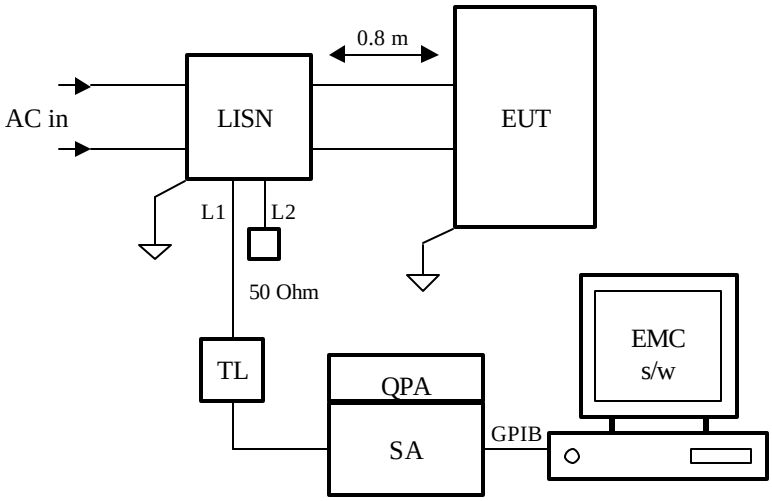
For conducted emissions test cases, the EUT hardware configuration / software load used is described in sections 3.7 and 3.8 (see Figure 3-2).

5.2.4 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-01-04 [7]. The test was performed as per the relevant Test procedures: FCC Part 15 [9], ANSI C63.4 [4], CISPR 22 [17], and ICES-003 [10].

The test method shown in Figure 5-1 was used for conducted emission voltage measurements on AC Leads.

Figure 5-1: LISN Voltage Method



Abbreviations used in the above figures:

EUT	Equipment under test
SA	Spectrum Analyzer
QPA	Quasi-peak Adapter
TL	Transient Limiter

CP	RF Current Probe
LISN	Line Impedance Stabilizing Network (50Ω/50µH as per CISPR 16-1)
EMC s/w PC	PC controller with UL software

- The EUT was arranged and connected according to its functional requirements on a metallic ground plane, the points of contact being consistent with normal use, but not in metallic contact with the ground plane. The EUT and all cables were insulated (up to 15 cm) from the ground plane. A distance of minimum 1m was provided between the EUT and the walls of the laboratory and any other metallic structures. The ground plane extended at least 0.5 m beyond the boundaries of the EUT.
- The positioning of the power and signal cables was representative of installation practice as shown in the figure above.
- Sufficient optical/electrical attenuation was included in all optical/electrical interconnections so as to simulate realistic operating conditions.
- Both the EUT shelf and the LISN were bonded to the ground plane; the distance between the boundary of the EUT and the closest surface of the LISN was 0.8 m. The mains cable between the EUT and the LISN were 1 m long, or if in excess of 1 m, the excess cable was folded back and forth as far as possible to form a bundle not exceeding 0.4 m in length. The safety ground connection of the EUT was connected to the reference ground point of the network and, where not otherwise provided or specified by the manufacturer, was 1 m long and run parallel to the mains connection at a distance of not more than 0.1 m.
- Voltage conducted emissions were measured by connecting the spectrum analyzer input, through the transient limiter, to the LISN outputs, L1 and L2 (the unused LISN output was terminated with a coaxial 50 ohms termination); these outputs correspond to the two AC lines to be measured, Phase and Neutral.
- For each line, 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; if they were below the AVG limit, no further measurement was required and the test was considered a pass; if not, the respective emission was measured using a QP and / or an AVG detector. All emissions within 10 dB from the limit lines were recorded.

5.2.5 Test Results: AC Power Leads Conducted Emissions

This section presents the test results for the conducted emissions tests on the AC power leads. These measurements were taken using a peak detector and compared to the specification limit. All emissions within 10 dB from the limit lines were further investigated using a QP and / or AVG detector and they are presented in the tables below; graphical representations of the measurements taken appear in Appendix D: AC Mains Conducted Emissions Plots.

Positive margin value below indicates a PASS and a negative margin value indicates a FAILURE.

The BTS was tested with both the switching and linear power supplies. The switching power supply was tested while it was charging the 24 V battery bank.

Table 5-8 and Table 5-9 list the highest emissions measured:

Table 5-8: AC Power Leads Conducted Emissions Test Results (Switching Power Supply)

Freq. (MHz)	Meter Reading (dBmV)	Det.	Gain / Loss Factor (dB)	Trans-ducer Factor (dB)	Level (dBmV)	Margin to Class A FCC Part 15 (dB)	Plot no.	Test Result
						AVG		
Line L1: Phase								
21.3919	40.62	av	10.3	0.4	51.32	8.68	Figure 10-1	Pass
21.4942	40.39	av	10.3	0.4	51.09	8.91		Pass
21.5862	41.24	av	10.3	0.4	51.94	8.06		Pass
21.6916	41.01	av	10.3	0.4	51.71	8.29		Pass
21.7846	41.74	av	10.3	0.4	52.44	7.56		Pass
21.8843	41.86	av	10.3	0.4	52.56	7.44		Pass
21.9819	41.53	av	10.3	0.4	52.23	7.77		Pass
22.074	41.7	av	10.3	0.4	52.4	7.6		Pass
22.1743	41.19	av	10.3	0.4	51.89	8.11		Pass
22.1756	40.98	av	10.3	0.4	51.68	8.32		Pass
22.4691	39.71	av	10.3	0.4	50.41	9.59		Pass
Line L2: Neutral								
21.3849	40.13	av	10.3	0.4	50.83	9.17	Figure 10-2	Pass
21.4832	40.52	av	10.3	0.4	51.22	8.78		Pass
21.5824	41.37	av	10.3	0.4	52.07	7.93		Pass
21.6782	41.73	av	10.3	0.4	52.43	7.57		Pass
21.777	41.57	av	10.3	0.4	52.27	7.73		Pass
21.8751	41.77	av	10.3	0.4	52.47	7.53		Pass
21.9762	41.12	av	10.3	0.4	51.82	8.18		Pass
22.0726	41.59	av	10.3	0.4	52.29	7.71		Pass
22.1734	41.25	av	10.3	0.4	51.95	8.05		Pass
22.2709	40.85	av	10.3	0.4	51.55	8.45		Pass
22.3675	40.3	av	10.3	0.4	51	9		Pass

Table 5-9: AC Power Leads Conducted Emissions Test Results (Linear Power Supply)

Freq. (MHz)	Meter Reading (dBmV)	Det.	Gain / Loss Factor (dB)	Trans-ducer Factor (dB)	Level (dBmV)	Margin to Class A FCC Part 15 (dB)		Plot no.	Test Result
						AVG	QP		
Line L1: Phase									
		PK				>10	>10	Figure 10-3	Pass
Line L2: Neutral									
		PK d				>10	>10	Figure 10-4	Pass

5.2.6 Measurement Uncertainties

The measurement uncertainty (with a 95% level of confidence) on conducted emissions measurements is of ± 2.3 dB.

Uncertainty evaluation has been calculated according to the method described in NAMAS NIS 81 [16].

5.2.7 Calculation of the Compliance Margin

The compliance margin is computed in a similar way as for E-field radiated emissions (see Section 5.1.7).

5.2.8 Test Conclusion

The EUT has passed the AC Power Leads Conducted Emissions tests with respect to FCC Part 15 [9] and ICES-003 [10] with a margin of 7.4 dB.

5.2.9 Test Equipment List

Table 5-10: Test Equipment used for Conducted Emissions

Description	Manufacture	Model	Serial Number	Cal. Due
LISN # 5	Emco	3825/2	SSG012040	28-Apr-05
Quasi-Peak Adapter, HP85650A, (AFC # 2)	HP	85650A	SSG012620	20-Apr-05
Spectrum Analyzer Display, HP 85662A	HP	85662A	SSG012246	25-Nov-04
Spectrum Analyzer, HP8568B, (EMI # 2)	HP	8568B	SSG012615	25-Nov-04
Sucoflex Cable, EMC Cable # 10	Huber & Suhner	104PEA	SSG012218	6-Nov-04

Description	Manufacture	Model	Serial Number	Cal. Due
Sucoflex Cable, EMC Cable # 9	Huber & Suhner	104PEA	SSG013007	25-Oct-04
Termination	Narda	379BNM	SSG013012	6-Nov-04
Transient Limiter	HP	11947A	SSG012142	25-Oct-04

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 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.

5.3.1 Test Specification

The system was tested to the requirements listed in Table 5-11:

Table 5-11: Receive Antenna Port Conducted Emissions Requirement

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

5.3.1.1 Limits

The specification levels in Table 5-12 are worst-case limits taken from all test specifications.

Table 5-12: Receive Antenna Port Conducted Emissions Limits

Frequency Range (MHz)	FCC Part 15 (dBm)	RSS-119 / (dBm)
30 - 1000	-57	-57
1000 - 1740	-57	-53
1740 - 2610		-53

5.3.2 Test Facility Information

Location: Solectron Technical Centre Lab 1

Date tested: September 21, 2004

Tested by: Denis Lalonde

5.3.3 Test Configurations

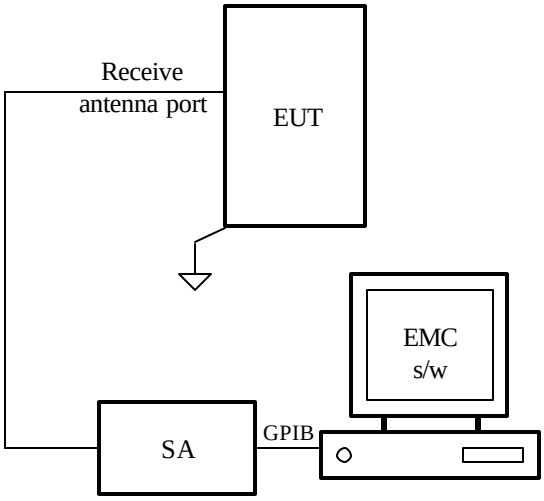
For conducted emissions test cases, the EUT hardware configuration / software load used is described in sections 3.7 and 3.8 (see Figure 3-2).

5.3.4 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-01-04 [7]. The test was performed as per the relevant Test procedures: FCC Part 15 [9], ANSI C63.4 [4], RSS-119[10].

The test method shown in Figure 5-2 was used for conducted emission measurements on the receive antenna port.

Figure 5-2: Rx Antenna Port Test Method



Abbreviations used in the above figures:

EUT Equipment under test
SA Spectrum Analyzer

- The positioning of the power and signal cables was representative of installation practice as shown in the figure above.
- Voltage 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.

5.3.5 Test Results:

This section presents the conducted emissions on the receive antenna port test results. They are presented in the tables below; graphical representations of the measurements taken appear in Appendix E: Rx Antenna Port Conducted Emissions Plots.

Note that a positive margin value in the "Receive Antenna Port Conducted Emissions Test Results" table(s) below indicates a PASS and a negative margin value indicates a FAILURE.

Table 5-13 lists the highest emissions measured:

Table 5-13: Receive Antenna Port Conducted Emissions Test Results

Freq. (MHz)	Meter Reading (dBm)	Det.	Margin	Plot no.	Test Result
2233	-68.2	PK	15.2	Figure 11-1	Pass

5.3.6 Measurement Uncertainties

The measurement uncertainty (with a 95% level of confidence) on conducted emissions measurements is of ± 2.3 dB.

Uncertainty evaluation has been calculated according to the method described in NAMAS NIS 81 [16].

5.3.7 Calculation of the Compliance Margin

The compliance margin is computed in a similar way as for E-field radiated emissions (see Section 5.1.7).

5.3.8 Test Conclusion

The EUT has passed the Receive Antenna Port Conducted Emissions tests with respect to FCC Part 15 [9] and RSS-119 [10] with more than 10 dB of margin.

5.3.9 Test Equipment List

Table 5-14: 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	11 Feb. 2005
Attenuator	Weinschel	6070-20	20 dB, 25 W	BE0847	22 Apr. 2005
Spectrum analyzer	HP	8564E	40 GHz	SSG012069	28 Apr. 2005
Signal generator	HP	83732A	20 GHz	3314A00190	4 Nov. 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.

6. References

6.1 Reference documents

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-01-07, July 2004.
3. C-MAC Engineering Inc. Lab Operations Manual KG000347-QD-LAB-01-05, June 7, 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. C-MAC Engineering Inc., EMC General Lab Test Procedure, KP000270-LP-EMC-01-04, July 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 Amended per FCC 89-103 (GEN Docket No. 87-389), Part 15, U.S. Federal Communications Commission, 2003.
10. ICES-003: Issue 4, 2004, “Spectrum Management: Interference-causing equipment standard (Digital Apparatus)”
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.
16. NAMAS Publication NIS 81: "The Treatment of Uncertainty in EMC Measurements", Edition 1, May 1994.
17. CISPR 22:1997/Amendment 2 2002 , Title: Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement.

7. Appendix A: Glossary

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

	Definition
AC	Alternating Current
AFC	Ambient Free Chamber
AM	Amplitude modulation
ANSI	American National Standards Institute
AVG	Average detector
CE	Conducted Emissions
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
Conduction/ Conducted Emission	The emission of electromagnetic energy guided by conductors forming a transmission line.
CSA	Canadian Standards Association
dB	Decibel
DC	Direct Current
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EN	European Normative
ETSI	European Telecommunications Standards Institute
EUT	Equipment Under Test
FCC	Federal Communications Commission, USA
GND	Ground
GPIB	General Purpose Interface Bus
IC	Industry Canada

	Definition
IEC	International Electro technical Association
LISN	Line Impedance Stabilization Network
MU	Measurement Uncertainty
NA	Not Applicable
NAMAS	National Measurement Accreditation Service
NBS/ NIST	National Bureau of Standards / National Institute of Standards and Technology
PK	Peak Detector
PS	Power Supply
QP	Quasi-peak Detector
QPA	Quasi-peak Adapter (for the Spectrum Analyzer)
RBW	Resolution Bandwidth
RE	Radiated Emissions
RF	Radio-Frequency
RMS	Root-mean-square
SA	Spectrum Analyzer, the ANSI C63.2 Compliant EMI meter
SCC	Standards Council of Canada
TL	Transient Limiter
UL	Underwriters Laboratories, Inc.
UUT	Unit Under Test
VBW	Video Bandwidth

8. Appendix B: Test Set-Up Photographs

This appendix presents the set-up used to cover the radiated and conducted emissions tests in this Test Report.

Figure 8-1: Radiated Emissions Test Set-Up

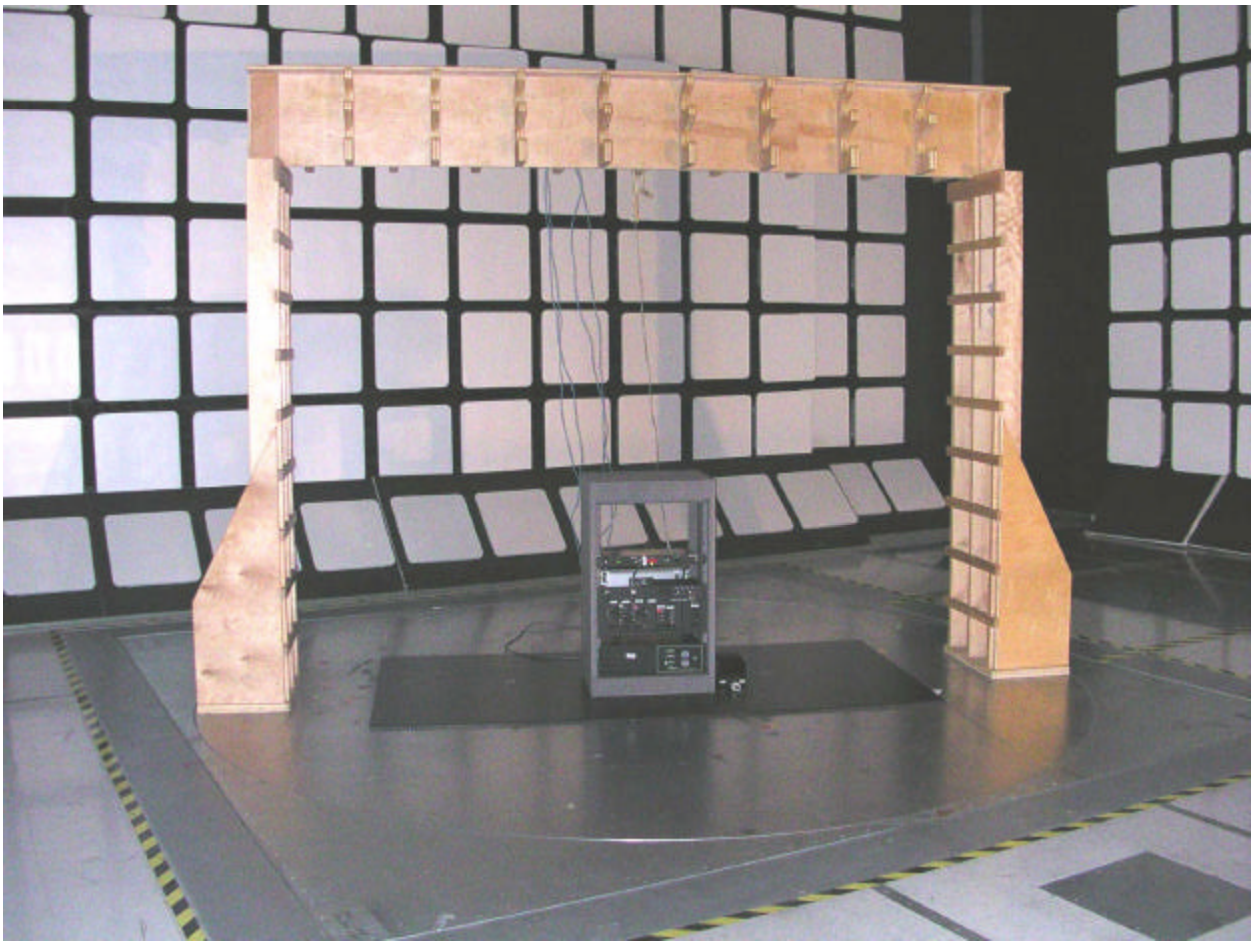


Figure 8-2: Conducted Emissions Test Set-Up

9. Appendix C: Radiated Emissions Plots

This appendix presents all radiated emissions plots for the test cases measured.

Figure 9-1: E-field Radiated Emissions, 30 – 1000 MHz (Switching Power Supply, AC Operation)

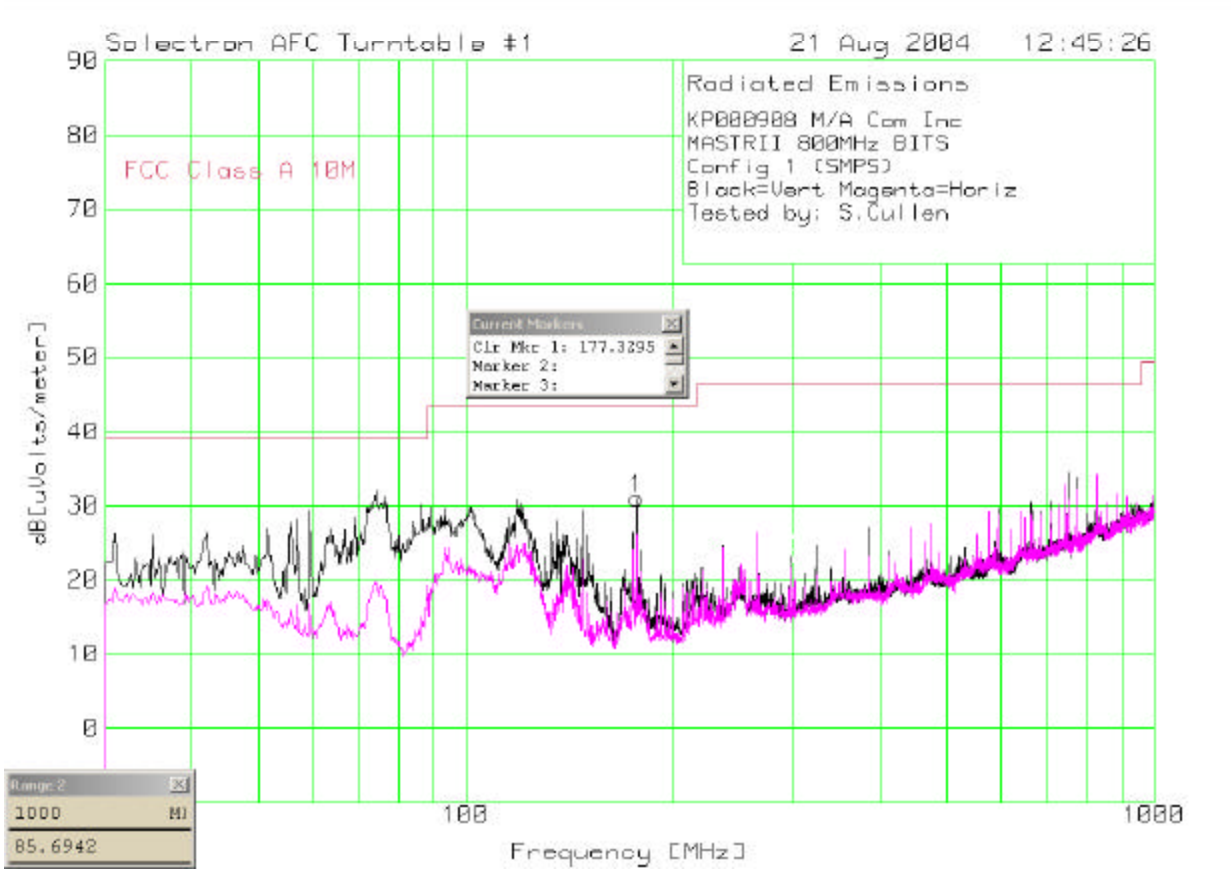


Figure 9-2: E-field Radiated Emissions, 1 GHz – 4.35 GHz (Switching Power Supply, AC Operation)

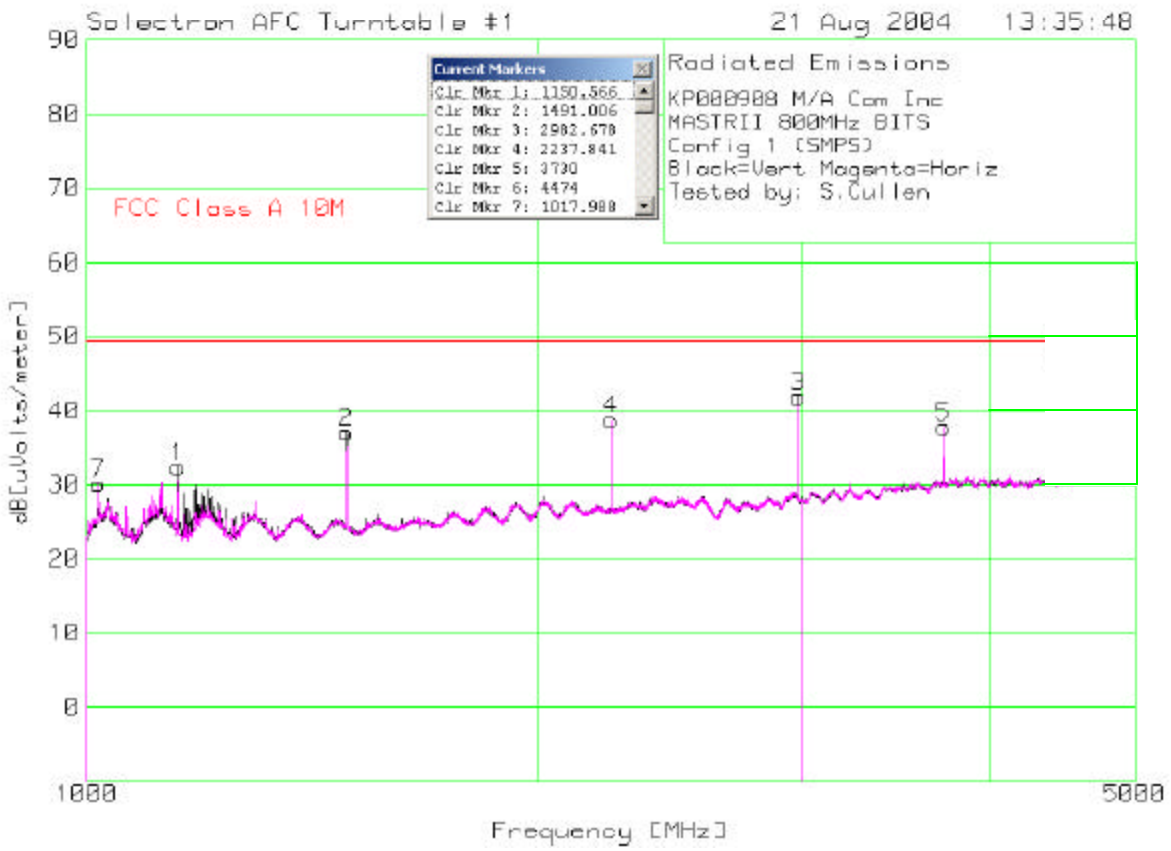


Figure 9-3: E-field Radiated Emissions, 30 – 1000 MHz (Switching Power Supply, DC Operation)

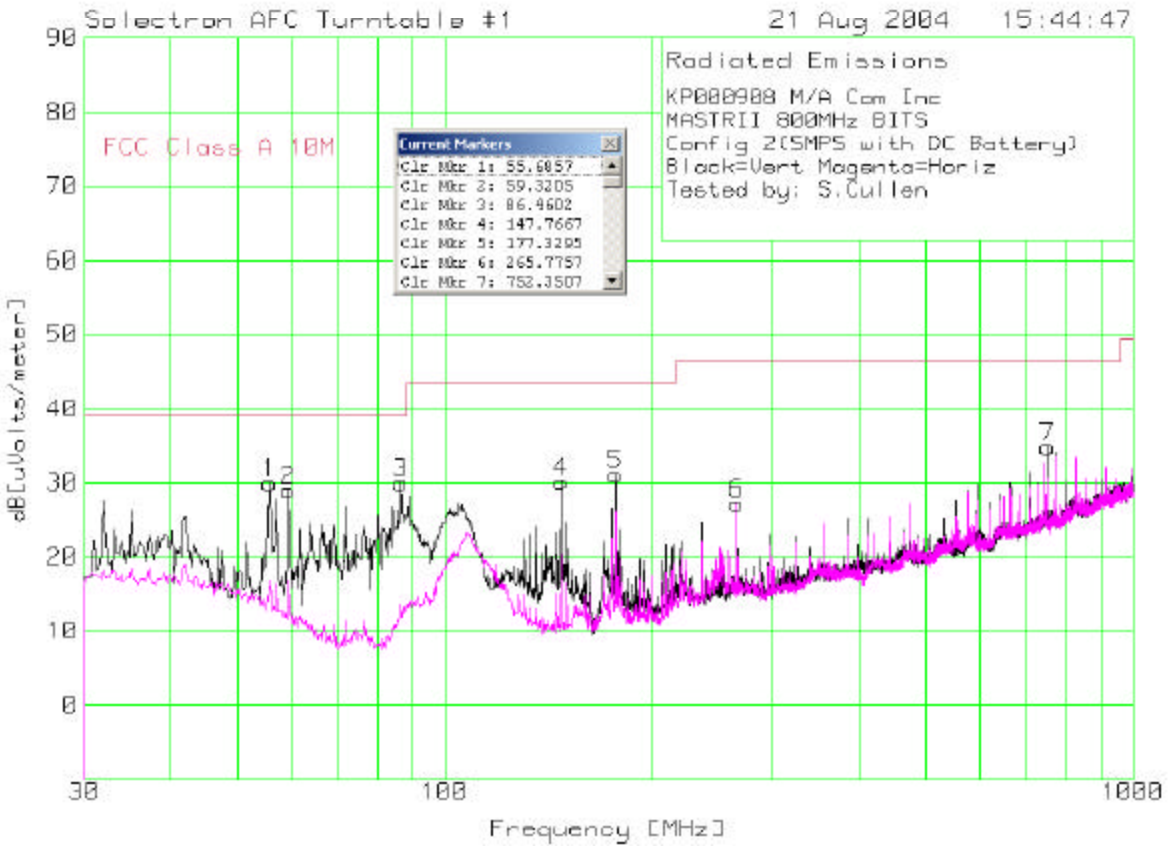


Figure 9-4: E-field Radiated Emissions, 1 GHz – 4.35 GHz (Switching Power Supply, DC Operation)

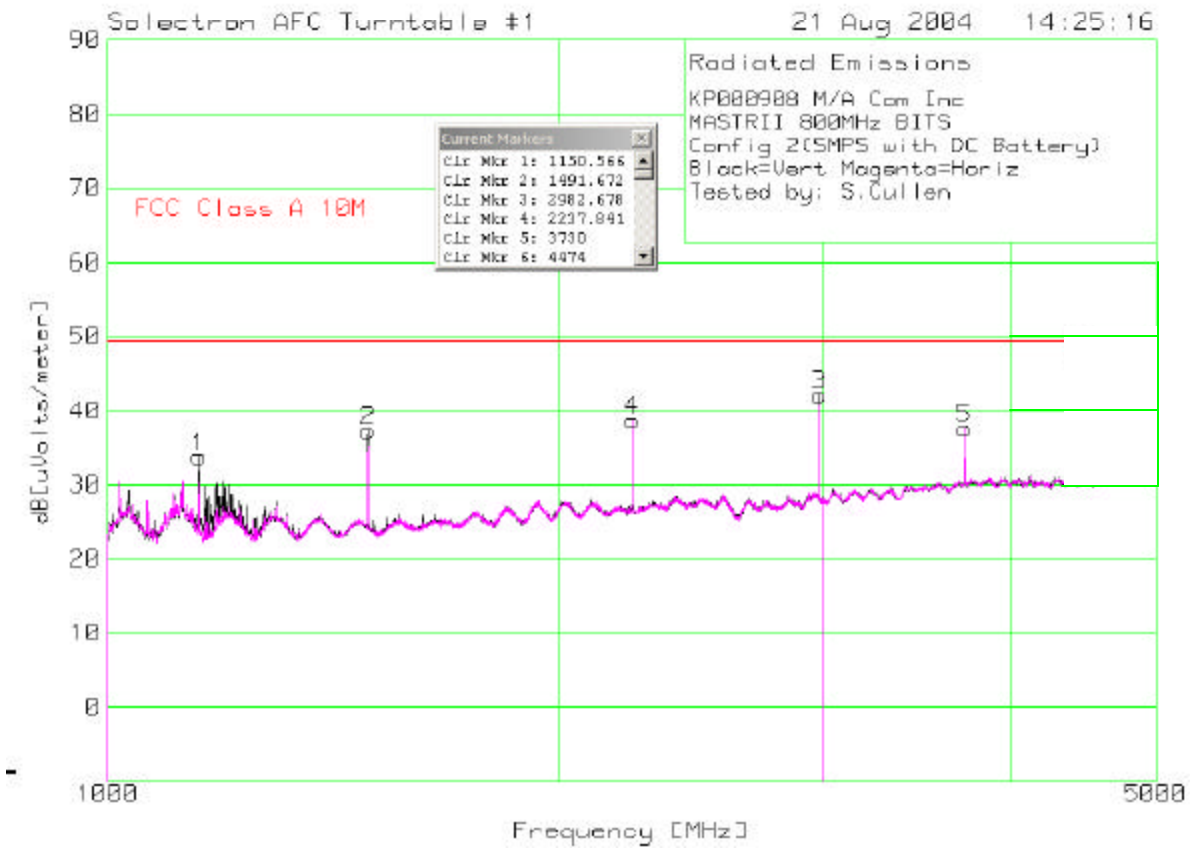


Figure 9-5: E-field Radiated Emissions, 30 – 1000 MHz (Linear Power Supply)

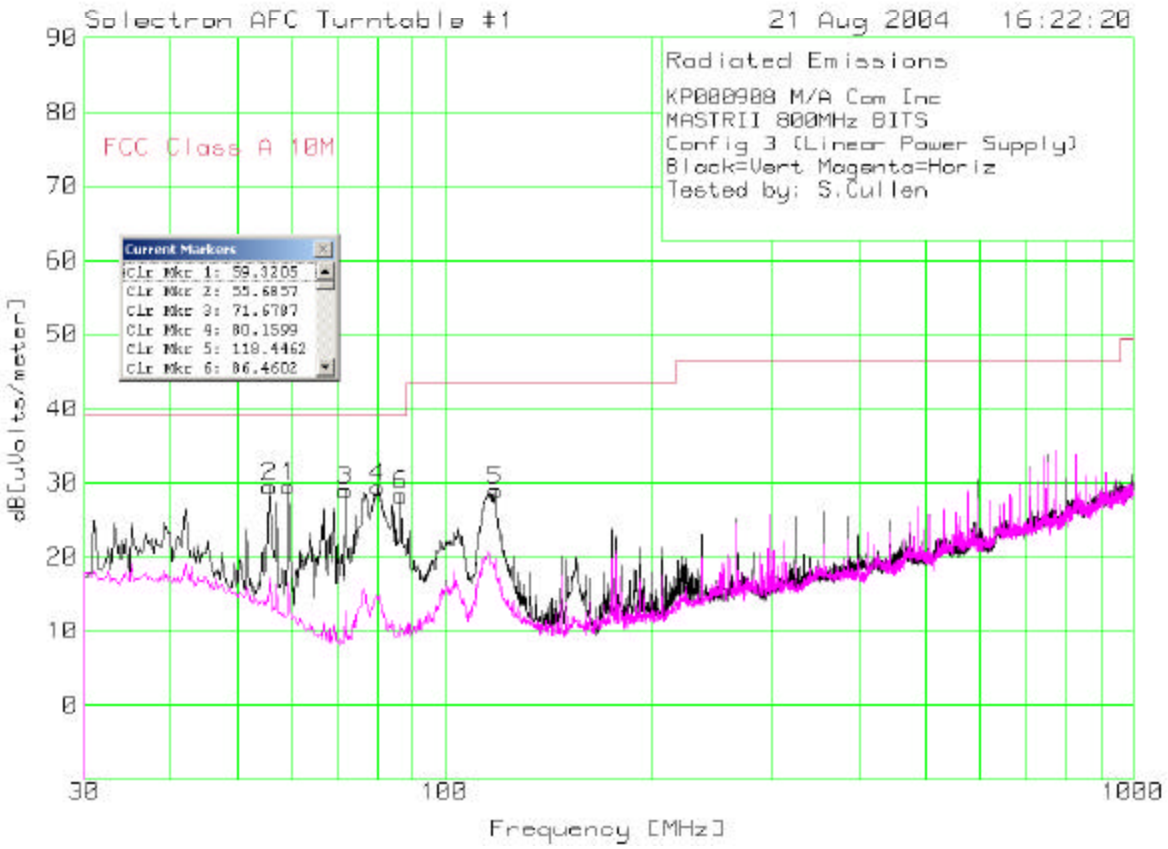
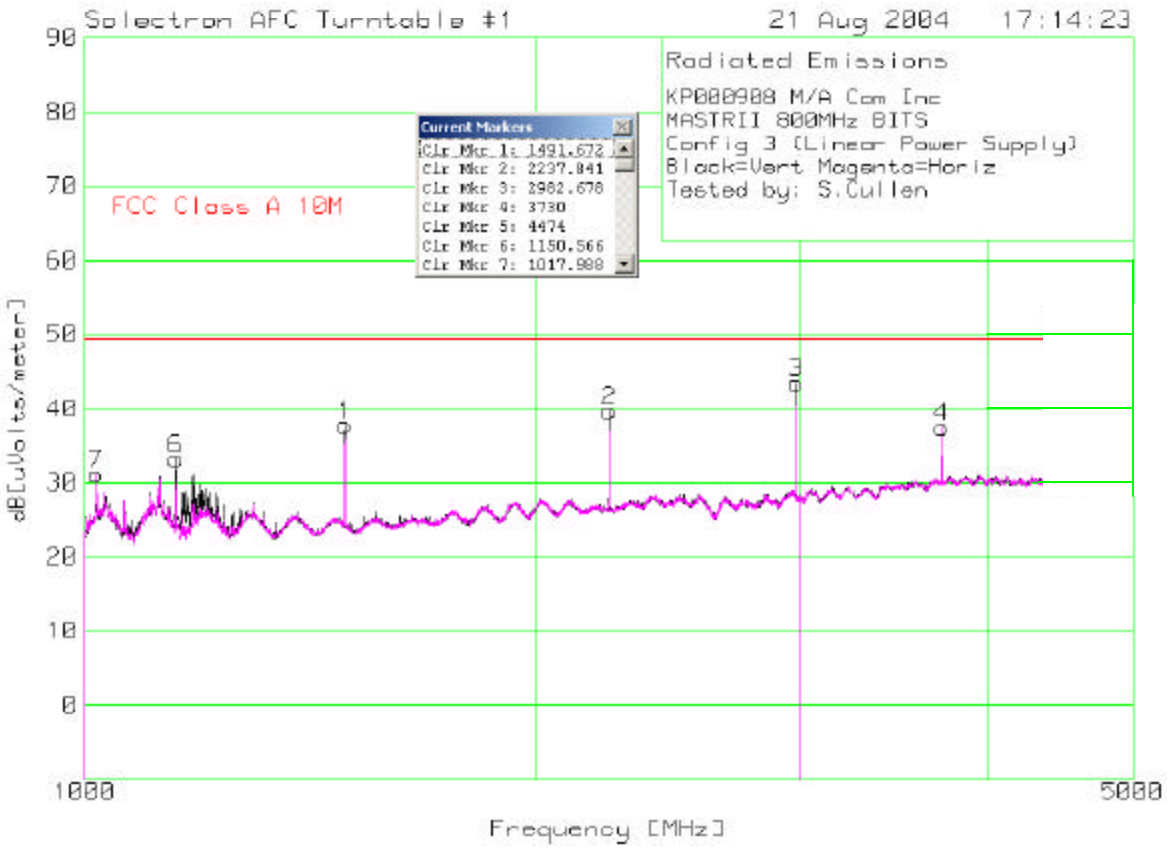


Figure 9-6: E-field Radiated Emissions, 1 GHz – 4.35 GHz (Linear Power Supply)



10. Appendix D: AC Mains Conducted Emissions Plots

This appendix presents all AC mains conducted emissions plots for the test cases measured.

Figure 10-1: AC Mains Conducted Emissions, 0.15 – 30 MHz (Switching Power Supply, Live Wire)

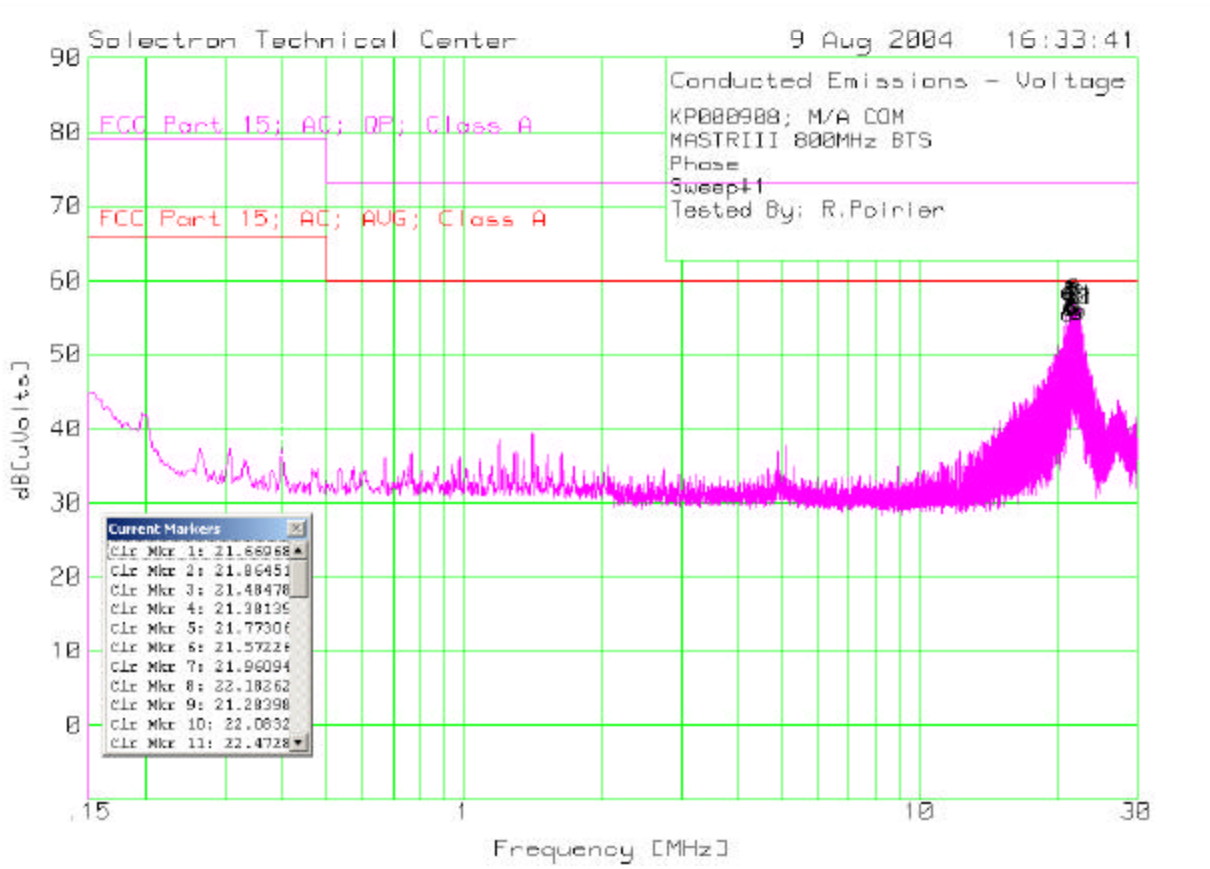


Figure 10-2: AC Mains Conducted Emissions, 0.15 – 30 MHz (Switching Power Supply, Neutral Wire)

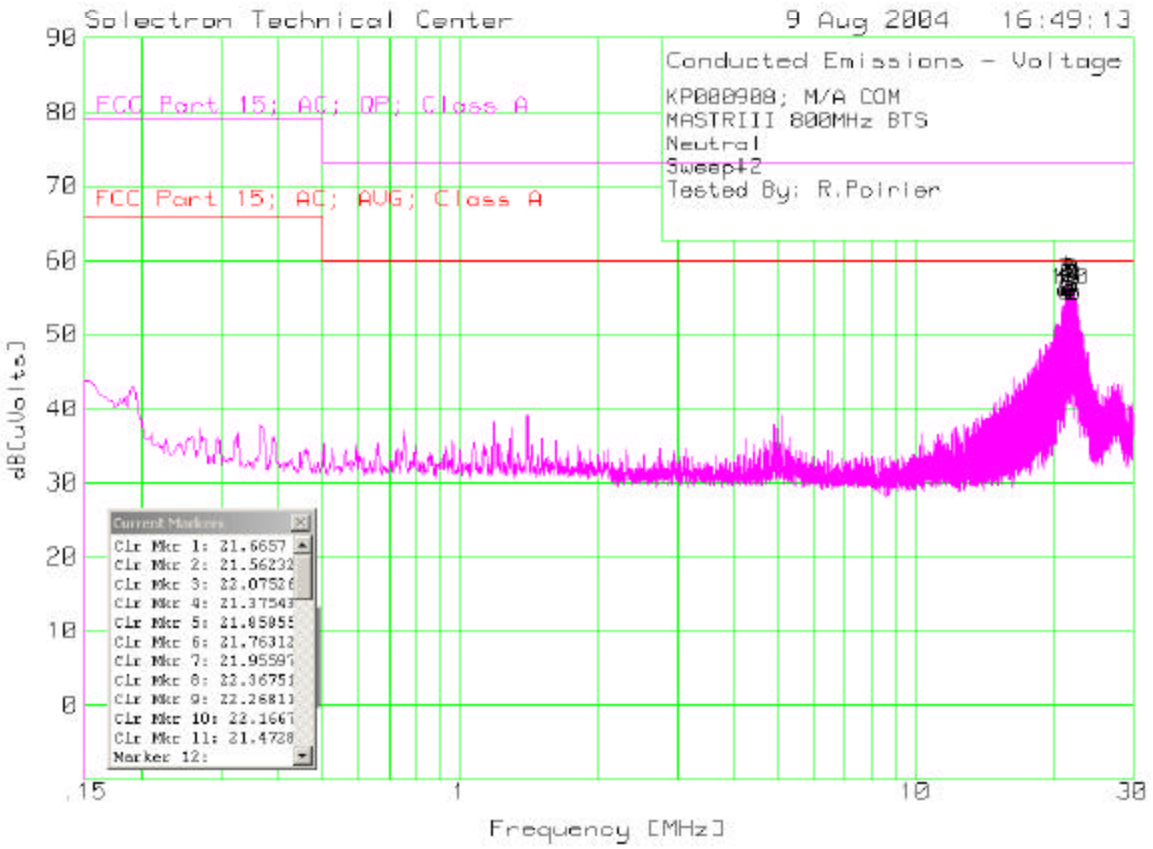


Figure 10-3: AC Mains Conducted Emissions, 0.15 – 30 MHz (Linear Power Supply, Live Wire)

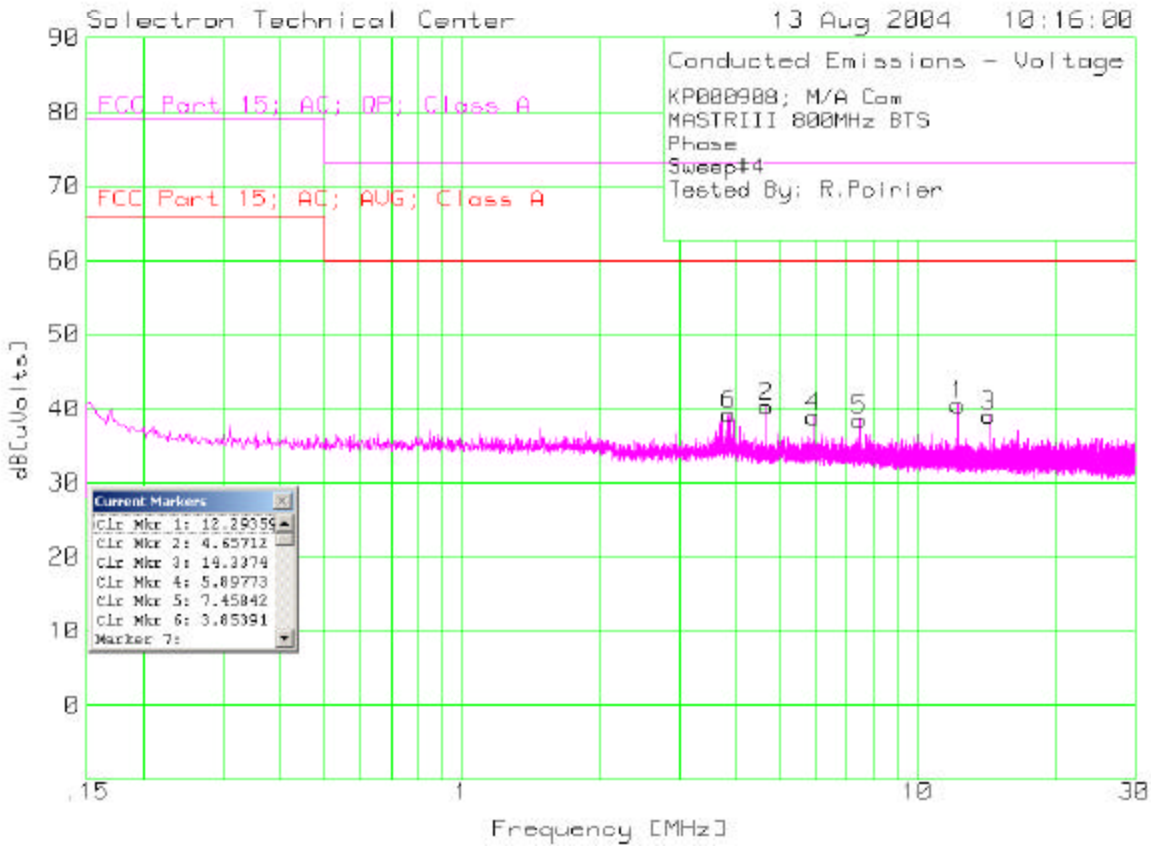
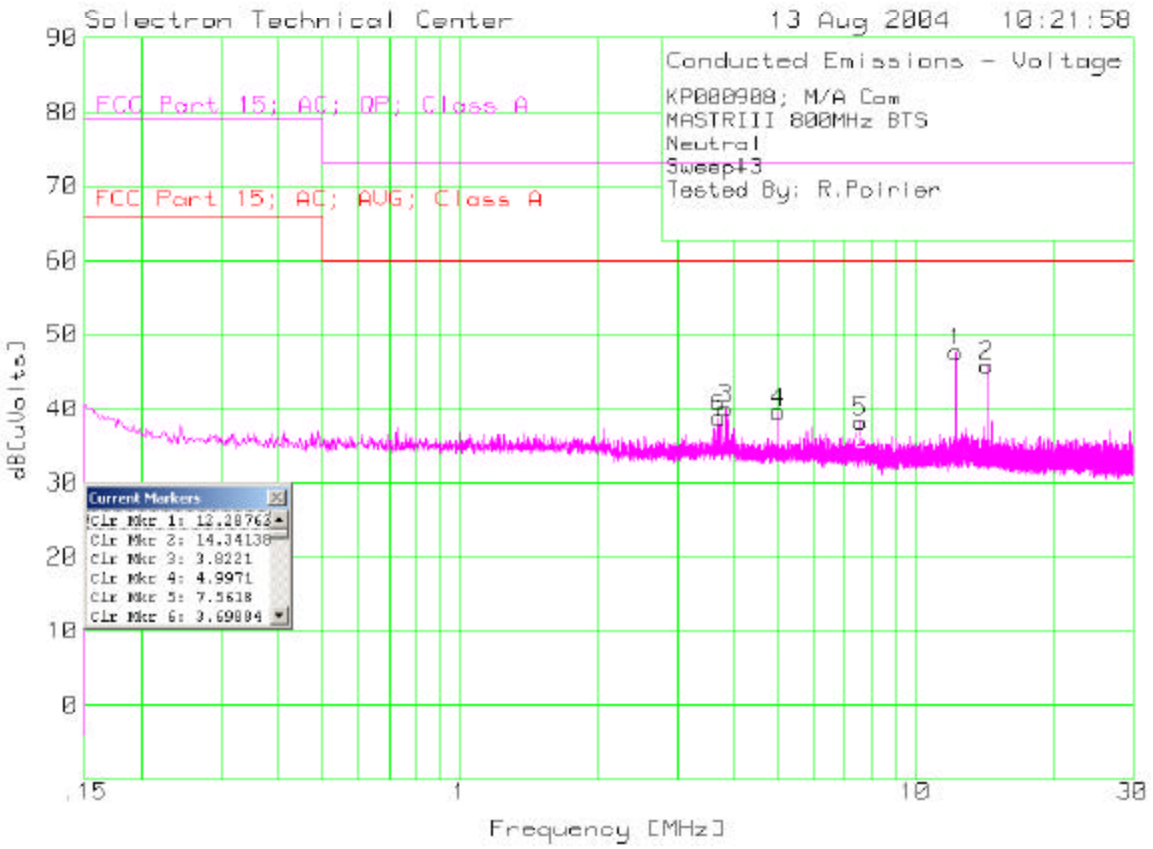
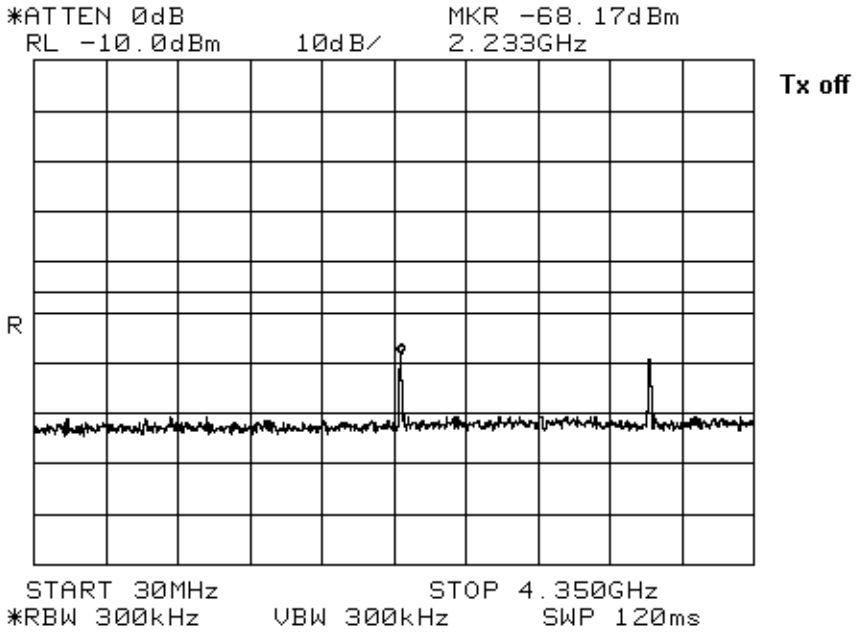


Figure 10-4: AC Mains Conducted Emissions, 0.15 – 30 MHz (Linear Power Supply, Neutral Wire)



11. Appendix E: Rx Antenna Port Conducted Emissions Plots

Figure 11-1: Rx Antenna Port Conducted Emissions, 30 MHz – 4.35 GHz



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