TEST REPORT

Report Number: 3070626.013
Project Number: 3070626
March 18, 2005

FCC Evaluation of the
ECM III 802.11b/g Radio
FCC ID: S31ECM1400

To
FCC 15, Subpart C, Section 15.247

For
Kontron Mobile Computing Inc.

Test Performed by:
Intertek
7250 Hudson Blvd. Suite 100
Oakdale, MN 55128

Test Authorized by:
Kontron Mobile Computing Inc.
7631 Anagram Drive
Eden Prairie, MN 55344

Prepared by: _____ Date: March 18, 2005
Norman Shpilsher

Approved by: _____ Date: March 18, 2005
Uri Spector

CONTENTS

1.0 GENERAL DESCRIPTION

1.1 Related Submittals Grants

This is single application of the *ECM III 801.11b/g Radio* for Certification under FCC Part 15, Subpart C. There are no other simultaneous applications.

1.2 Product Description

The *ECM III 801.11b/g Radio* is a radio provides a wireless Ethernet communication.
The *ECM III 801.11b/g Radio* is a digitally modulated intentional radiator operating at 11 channels within 2400 - 2483.5MHz frequency band under **CFR 47:2003**, Section 15.247. The intended use of the *ECM III 801.11b/g Radio* is to generate a RF signal, deliver the signal to the antenna in order to communicate with the remote radios.
The *ECM III 801.11b/g Radio* uses a previously certified PRO/Wireless 2200BG embedded 802.11b/g Mini PCI type 3B module manufactured by Intel (FCC ID: PD9WM3B2200BG) installed to Mini-PCI slot of the ECM III computer and the module RF output connected to the XXXXXX antenna.
The digital portion will be verified under Declaration of Conformity.

RF Power Output:

0.06 Watt

Antenna Description:

The *ECM III 801.11b/g Radio* uses a non-detachable antenna.

Antenna Gain: 1.0dBi
Impedance: 50 Ohm
Connectors: No connectors (an antenna cable is soldered to antenna)

Sample Submitted: February 1, 2005
Test Work Started: February 2, 2005
Test Work Completed: February 28, 2005

1.3 Test Methodology

Emission measurements were performed according to the procedures in ANSI C63.4-2001. All field strength radiated emissions measurements were performed in the semi-anechoic chamber, and for each scan, the procedure for maximizing emissions in Appendices D and E were followed. All field strength radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "**Justification Section**" of this Application.

1.4 Test Facility

The test site facility used to collect the radiated and conducted measurement data is located at 7250 Hudson Blvd., Suite 100, Oakdale, Minnesota. This test facility has been fully described in a report dated on March 2003 submitted to FCC. Please reference the site registration number: 90706, dated April 18, 2003.

2.0 SYSTEM TEST CONFIGURATION

2.1 Justification

The *ECM III 801.11b/g Radio* uses a previously certified PRO/Wireless 2200BG embedded 802.11b/g Mini PCI type 3B module manufactured by Intel (FCC ID: PD9WM3B2200BG) with no any modifications, which is installed to Mini-PCI slot of the ECM III computer, with new antenna.
Based on that the following measurements and calculations were made during the *ECM III 801.11b/g Radio* Certification:

1. Verification of the level of the Output Power at channels 1, 6, and 11 at the Antenna Terminal
2. RF Exposure Calculation
3. Spurious Radiated Emissions for low transmitting frequency (channel 1), center transmitting frequency (channel 6), and high transmitting frequency (channel 11) in frequency range from 30MHz up to 10th harmonics.
4. Receiver (unintentional) Radiated emissions from 30MHz up to 5th harmonics.
5. Conducted Emissions from 150kHz to 30MHz.

2.2 EUT Setup and Test Conditions

For simplicity of testing, the transmitter was run to transmit continuously

Operating Frequency measurements were made at an ambient room temperature of 23°C within the range of +15 to +25°C.

2.3 EUT Exercising Software

The *ECM III 801.11b/g Radio* was operated in continuous single channel transmission mode for testing purposes using Intel PROSet/Wireless Software 9.0.1.0 under Windows XP running on the ECM III host computer.

2.4 Special Accessories

There are no special accessories necessary for compliance of these products.

2.5 Equipment Modification

No modifications were installed on the EUT during testing.

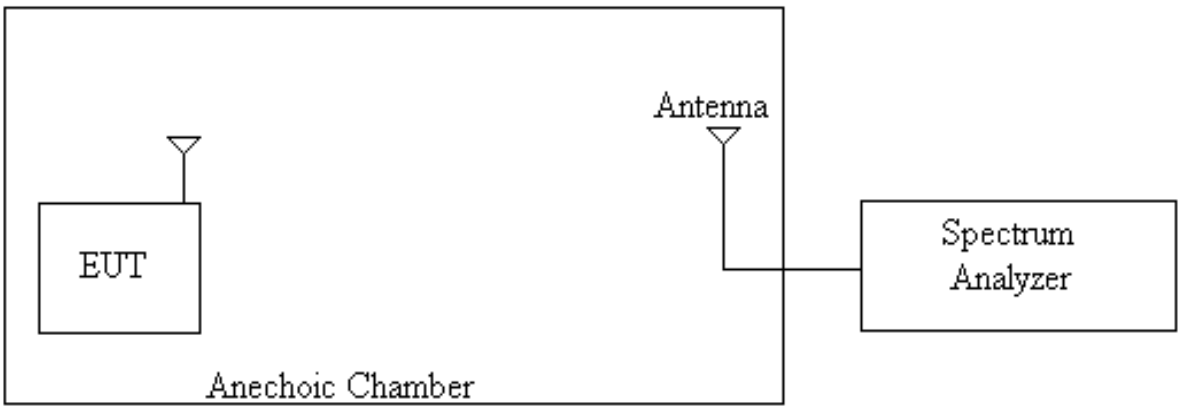
2.6 Support Equipment List and Description

Microsoft Basic Optical USB/PS2 Mouse, p/n X09-13963
HP D5158A Monitor, s/n 72901427
2VC60NT12BM AC Adapter 100-240VAC, 50-60Hz / 12VDC

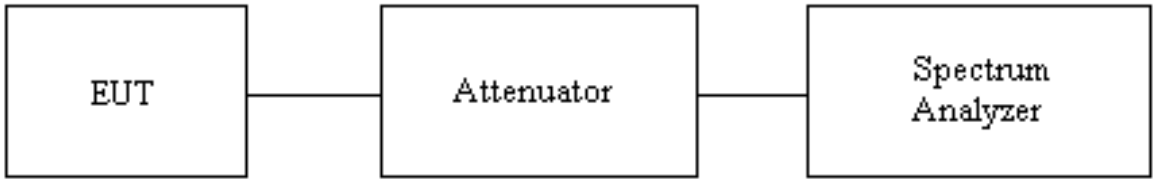
2.7 Test Configuration Block Diagrams

The EUT was setup as tabletop equipment.
The EUT was powered at 12VDC via the Power Adapter.

Field Strength Measurements



Measurements at Antenna Terminal



3.0 TEST RESULTS

Data is included for the worst case configuration (the configuration which resulted in the highest emission levels). A sample calculation, configuration photographs, data tables and graphical representations of the emissions are included.

The EUT is intended for operation under the requirements of Part 15 Subpart C. Specific test requirements include the following:

47 CFR 15.247(b)(3)	Peak Output Power verification
47 CFR 1.1307, 15.247(b)(5)	RF Exposure
47 CFR 15.247(c), 15.205(a), 15.209(a)	Radiated Spurious Emissions
47 CFR 15.109, Class A	Receiver Radiated Emissions
47 CFR 15.207	Transmitter Conducted Emissions

3.1 Peak Output Power, FCC 15.247(b)(3), Verification

Peak Output verification measurements were made at channels 1, 6, and 11 40 at the maximum power transmission condition. The transmitter antenna port was connected to the Spectrum analyzer.

According to FCC Part 15.247(b)(3) the Maximum Peak Power is 1W.

Total Peak Power was calculated from Measured Power adding 0.44dB cable attenuation factor.

Total Maximum Peak Output = Measured Power + Cable Factor = 16.98dBm + 0.44dB = 17.42dBm, or 0.055W

Table 3-1-1 and Graphs 3-1-1 to 3-1-3 below show the Peak Output Power at the antenna terminal.

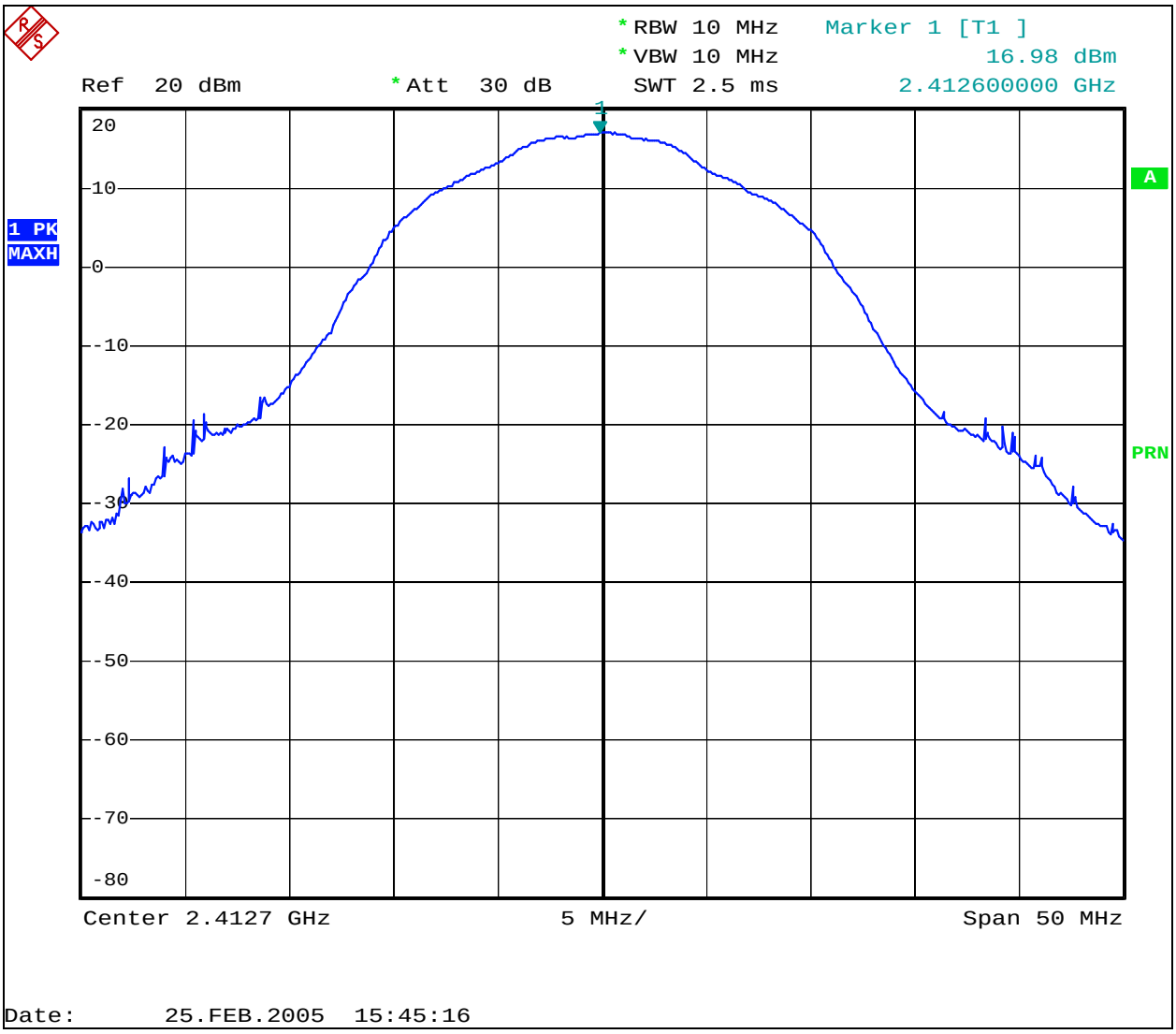
No the output power changes were observed with the nominal input voltage deviation of ±15%.

Maximum Peak Output Power Date: 02/21-28/2005
Company: Kontron Mobile Computing
Model: ECM III 802.11b/g Radio
Test Engineer: Norman Shpilsher
Special Info.: The EUT antenna terminal was connected to the Spectrum Analyzer
Standard: FCC Part 15.247(b)(3)

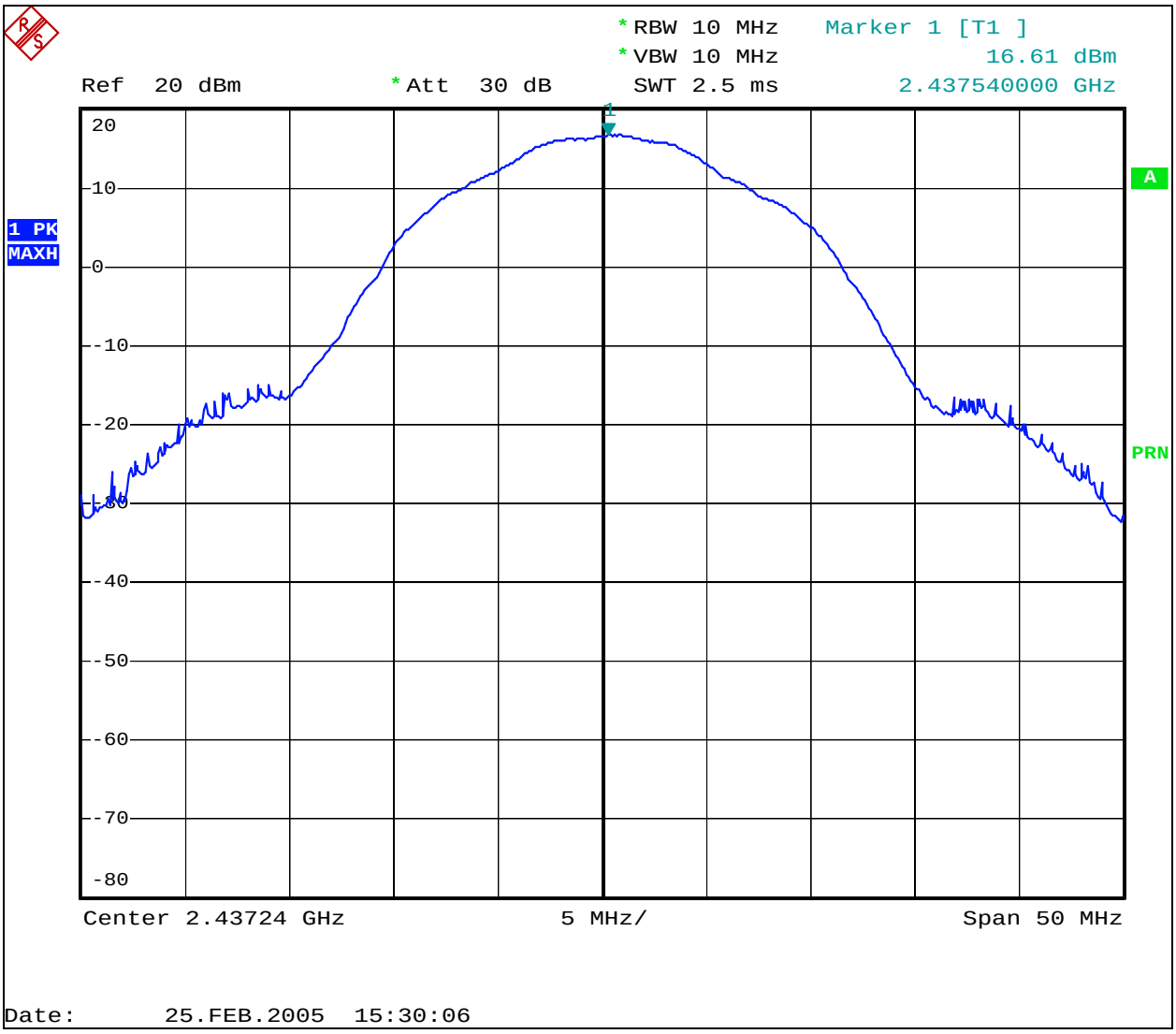
Table # 3-1-1

Channel	Measured Power dBm	Cable loss dB	Peak Output Power dBm	Peak Output Power W	Compliance
1	16.98	0.44	17.42	0.06	Complies
6	16.61	0.44	17.05	0.05	Complies
11	16.95	0.44	17.39	0.05	Complies

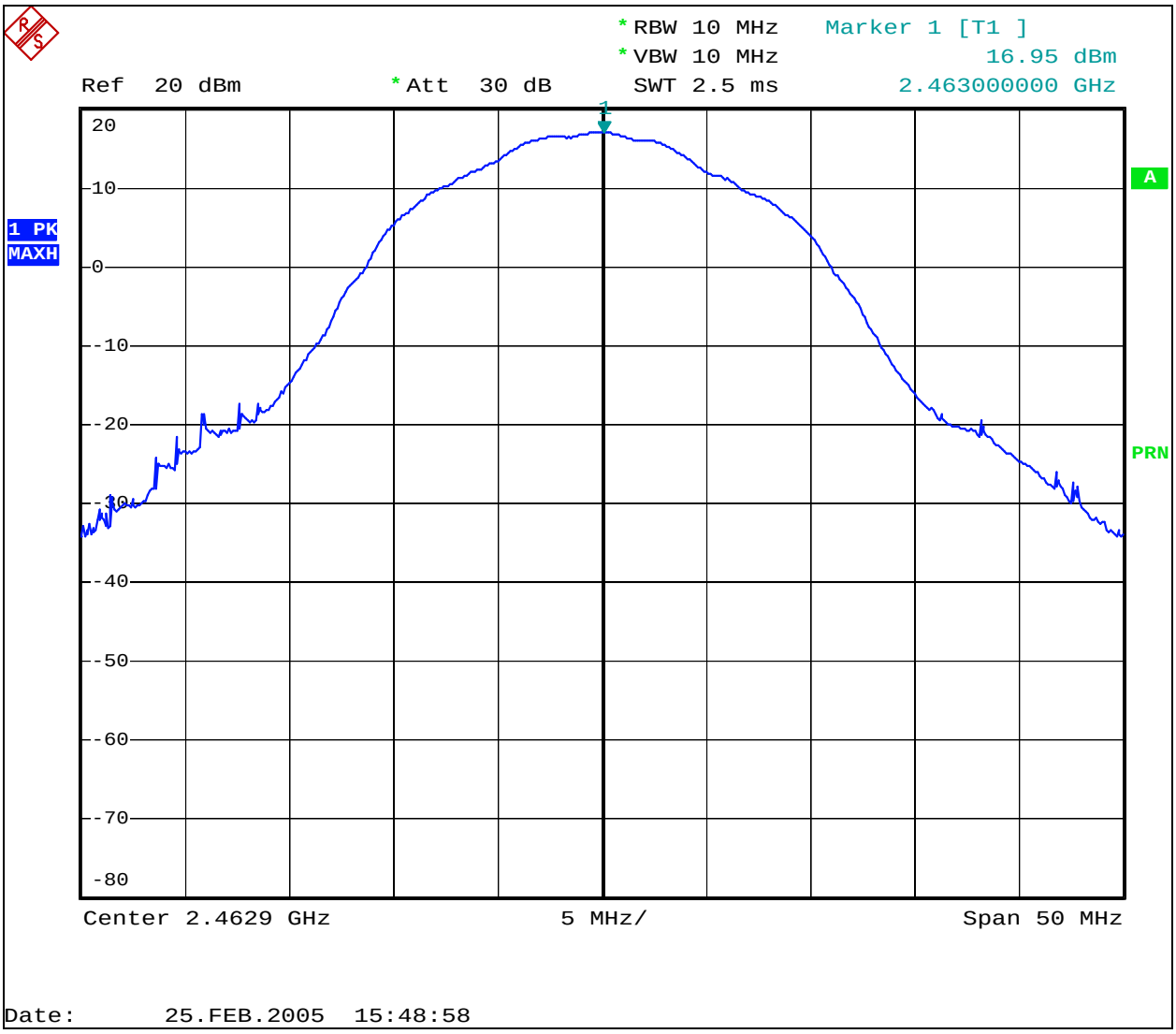
Graph # 3-1-1
Peak Output Power, Channel 1, Normal Test Conditions



Graph # 3-1-2
Peak Output Power, Channel 6, Normal Test Conditions



Graph # 3-1-3
Peak Output Power, Channel 11, Normal Test Conditions



3.1.1 RF Exposure Calculation, FCC 1.1307, 15.247(b)(5)

The RF Exposure calculations are based on manufacturer specification that minimum distance from the antenna to operator (user) is 20cm.
The RF Exposure can be calculated according to equation from OET Bulletin 65, Edition 97-01:

$S = PG/4*pi*R^2$,

Where: S is Limits for Maximum Permissive Exposure (MPE) (mW/ cm^2),
P is Maximum Peak Power to Antenna (mW),
G is Antenna Gain (numerical gain),
R is Distance to the antenna radiation center (cm), must be below 20cm (FCC2.1091)

$S = 1mW/ cm^2$ according to FCC1.1310,
P = 17.42dBm = 55mW,
G = 1.0dBi = 1.26 (numerical gain),
R is calculated and = 2.35cm, within 20 cm.

3.2 Radiated Spurious Emissions, FCC 15.247(c), 15.205(a), 15.209(a)

Field Strength of Spurious Emissions measurements were made from 30MHz up to 10th harmonic at low transmitting frequency (channel 1), center transmitting frequency (channel 11), and high transmitting frequency (channel 11).

The Table 3-2-1 and Graphs 3-2-1 to 3-2-7 show the Field Strength of Spurious Emissions.
No emissions above ambient was found at second and above harmonics.
Emissions at fundamental frequency were excluded from the Table.

The EUT complies with the Standard requirements for Spurious Emissions with minimum margin –6.9dB.

Notes: 1. Emission level shown on the Graph includes the Antenna Factor, Cable Loss, and Pre-amplifier gain (if applicable).

TILE Instrument Control System EMI Measurement Software

Radiated Emissions from 30MHz to 1GHz **Date:** 02-25-2005

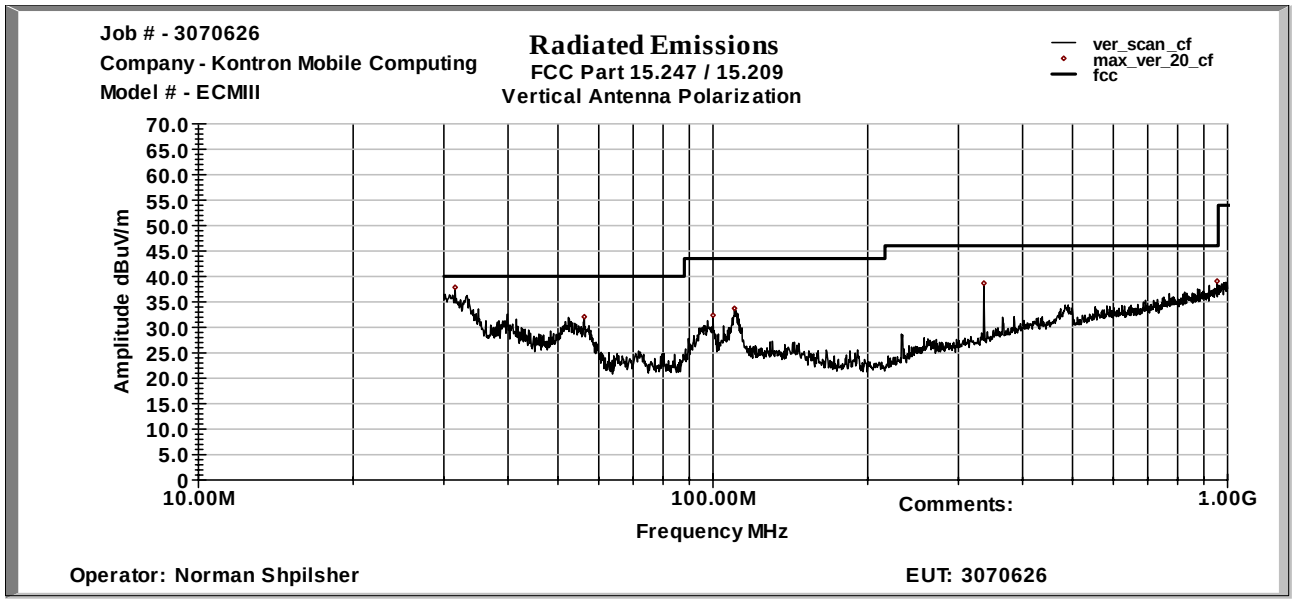
Company: Kontron Mobile Computing
Model: ECM III 802.11b/g Radio
Test Engineer: Norman Shpilsher
Special Info: Transmitting Mode
Standard: FCC Part 15.247 / 15.209
Test Site: 3m Anechoic Chamber, 3m measurement distance
Note: The table shows the worst case radiated emissions
All measurements were taken using a Peak detector
Antenna Factors (Ant.Factor) include cable loss factor

Table # 3-2-1

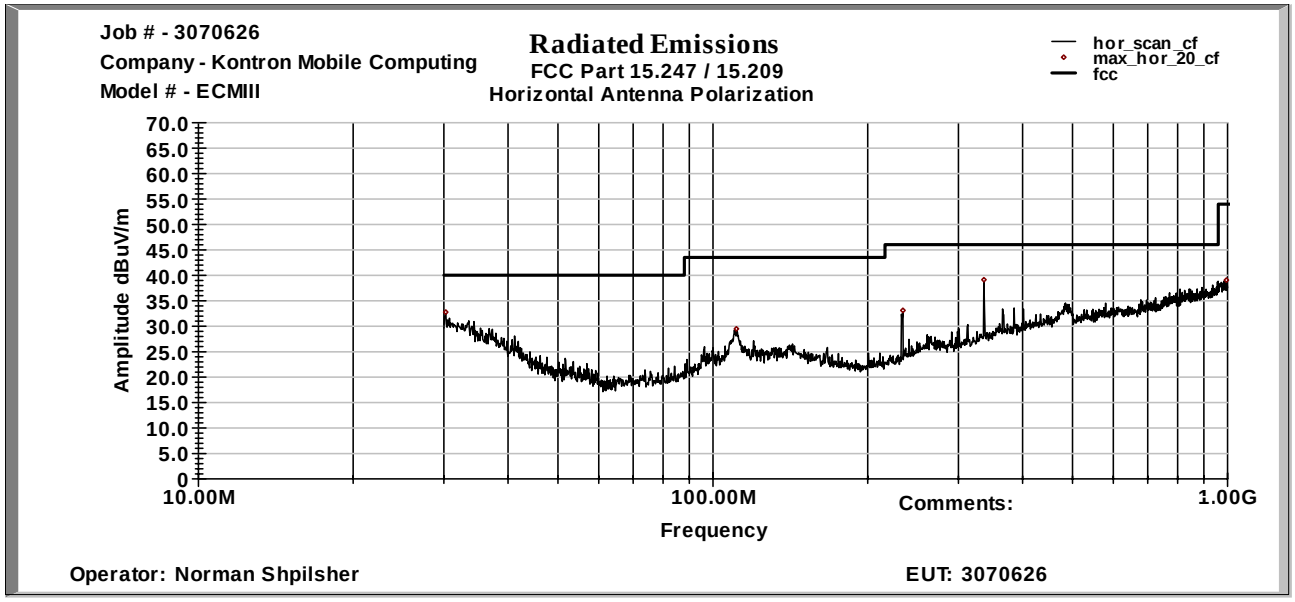
Frequency	Ant. Polarity	Reading dBμV	Ant.Factor dB1/m	Total at 3m dBμV/m	Limit dBμV/m	Margin dB
56.235 MHz	V	24.3	7.8	32.1	40.0	-7.9
100.07 MHz	V	20.8	11.6	32.4	43.5	-11.1
110.15 MHz	V	20.8	12.9	33.7	43.5	-9.8
336.36 MHz	V	22.3	16.4	38.7	46.0	-7.3
954.91 MHz	V	13.6	25.5	39.1	46.0	-6.9
111.08 MHz	H	16.5	13.0	29.5	43.5	-14.0
234.09 MHz	H	20.5	12.6	33.1	46.0	-12.9
336.36 MHz	H	22.7	16.4	39.1	46.0	-6.9
995.58 MHz	H	12.9	26.2	39.0	54.0	-15.0

Graph #3-2-1
Transmitter Spurious Radiated Emissions from 30MHz to 1GHz

Vertical Antenna Polarization

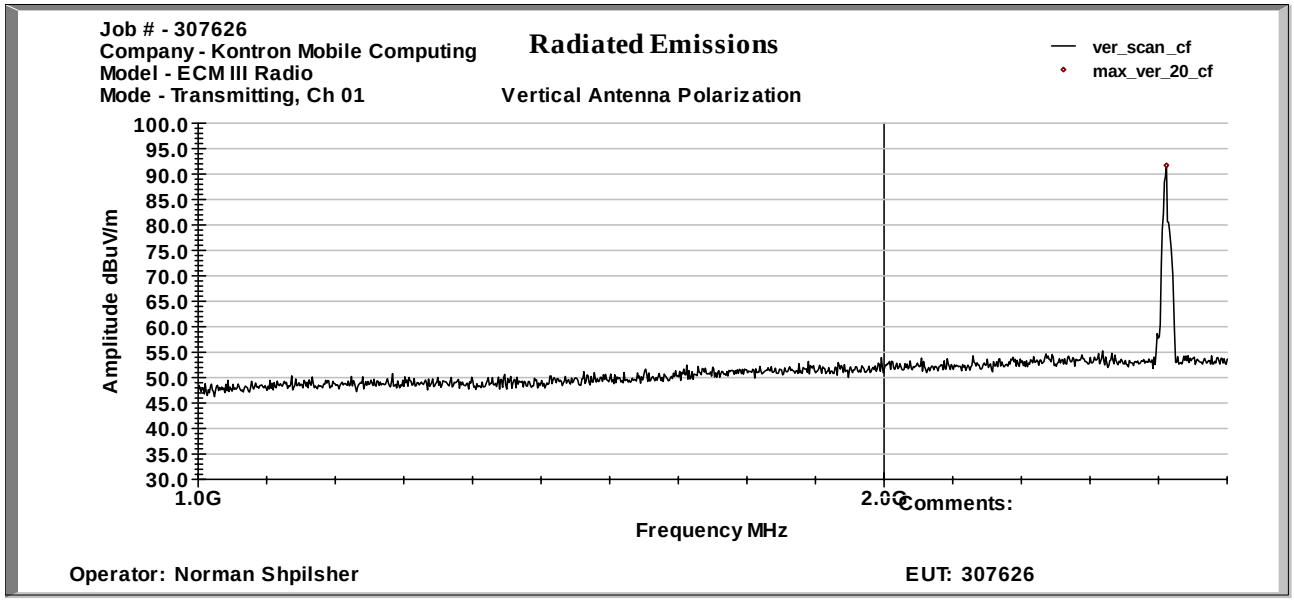


Horizontal Antenna Polarization

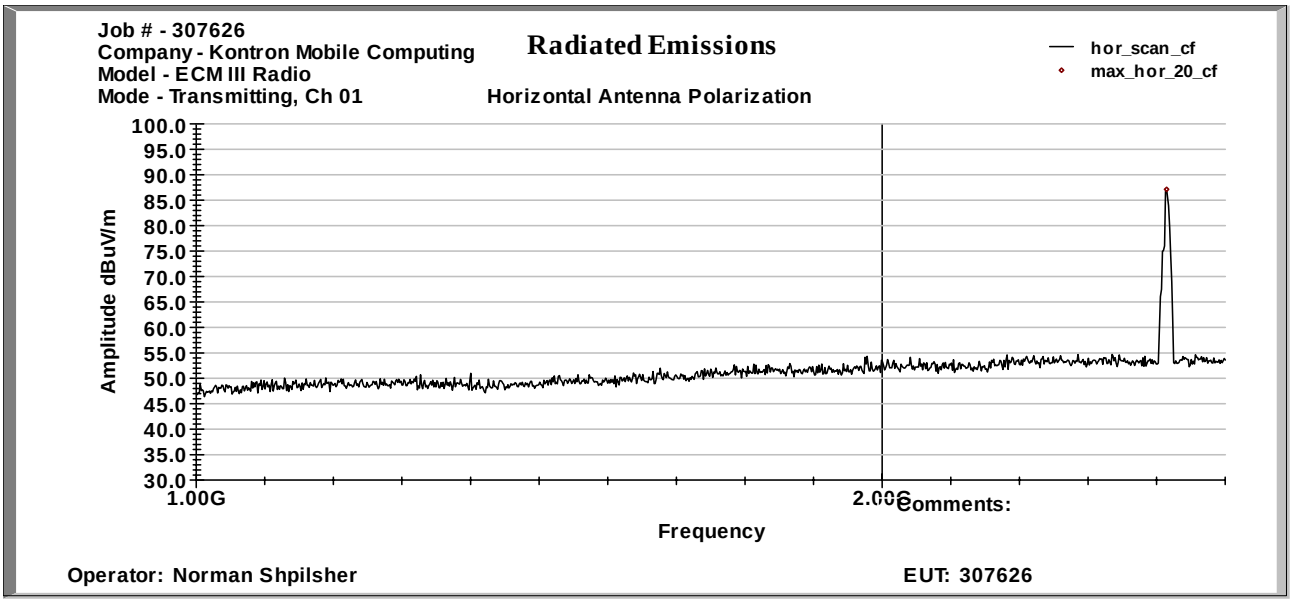


Graph #3-2-2
Transmitter Spurious Radiated Emissions from 1 to 2.5GHz, Channel 1

Vertical Antenna Polarization

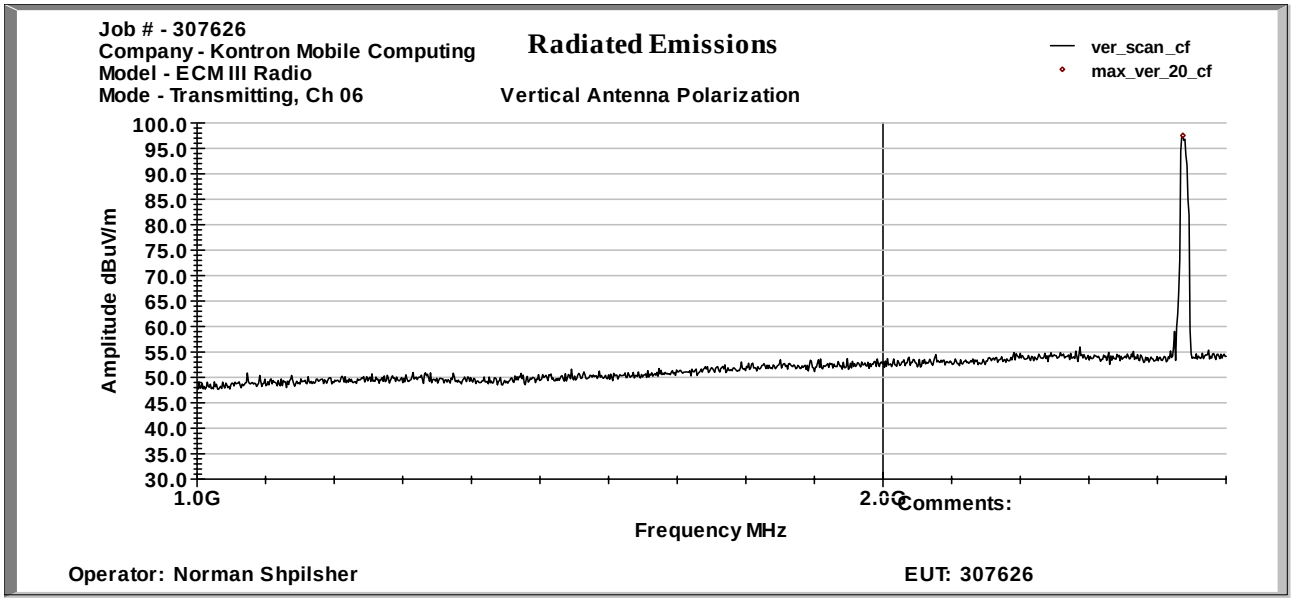


Horizontal Antenna Polarization

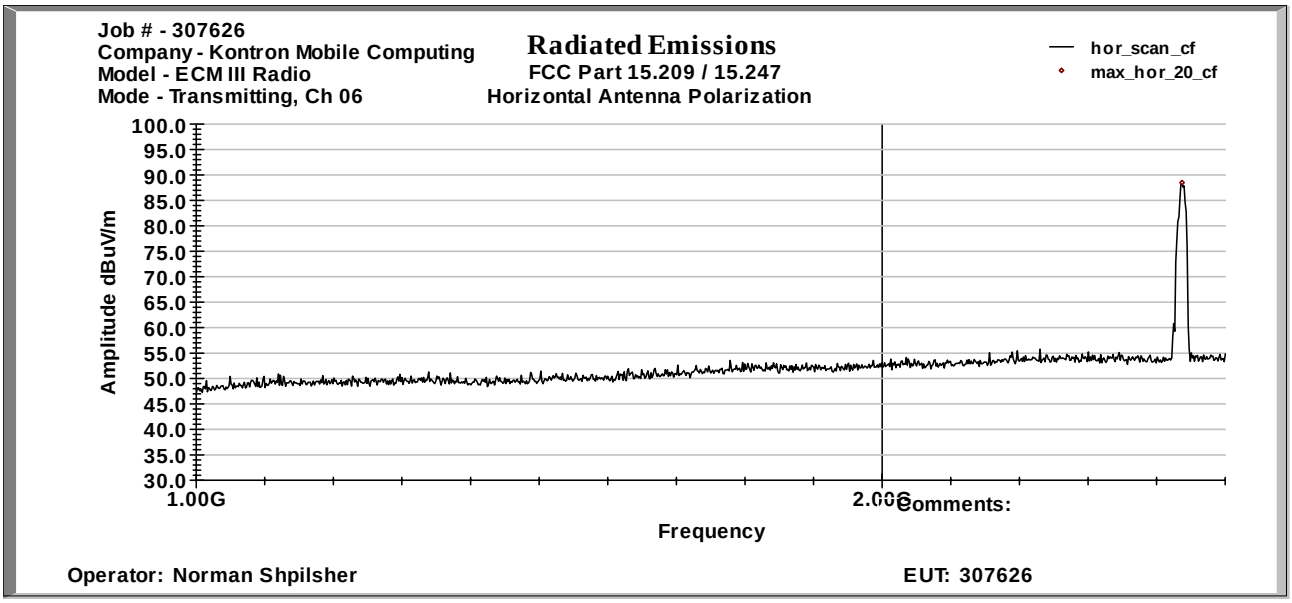


Graph #3-2-3
Transmitter Spurious Radiated Emissions from 1 to 2.5GHz, Channel 6

Vertical Antenna Polarization

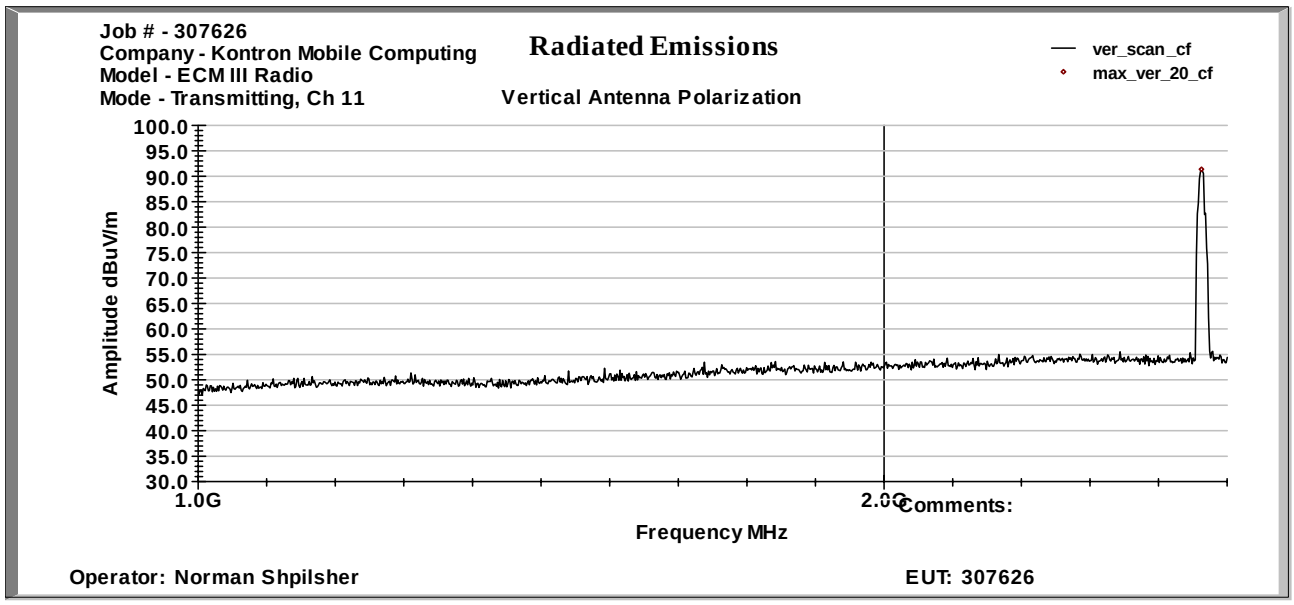


Horizontal Antenna Polarization

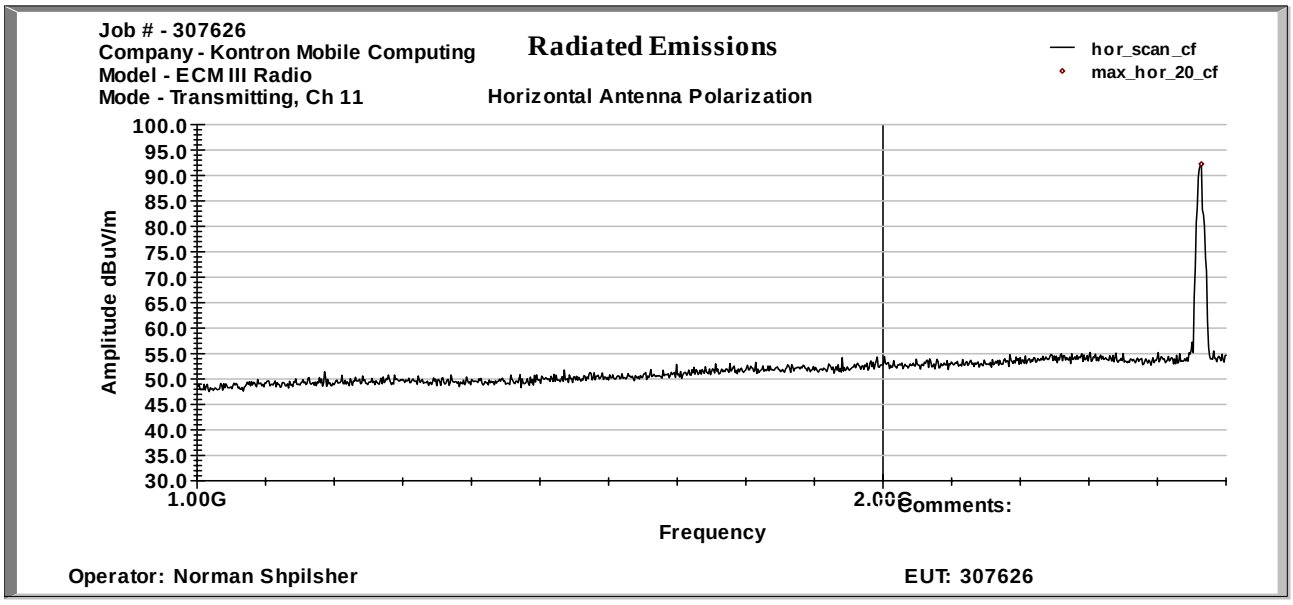


Graph #3-2-4
Transmitter Spurious Radiated Emissions from 1 to 2.5GHz, Channel 11

Vertical Antenna Polarization

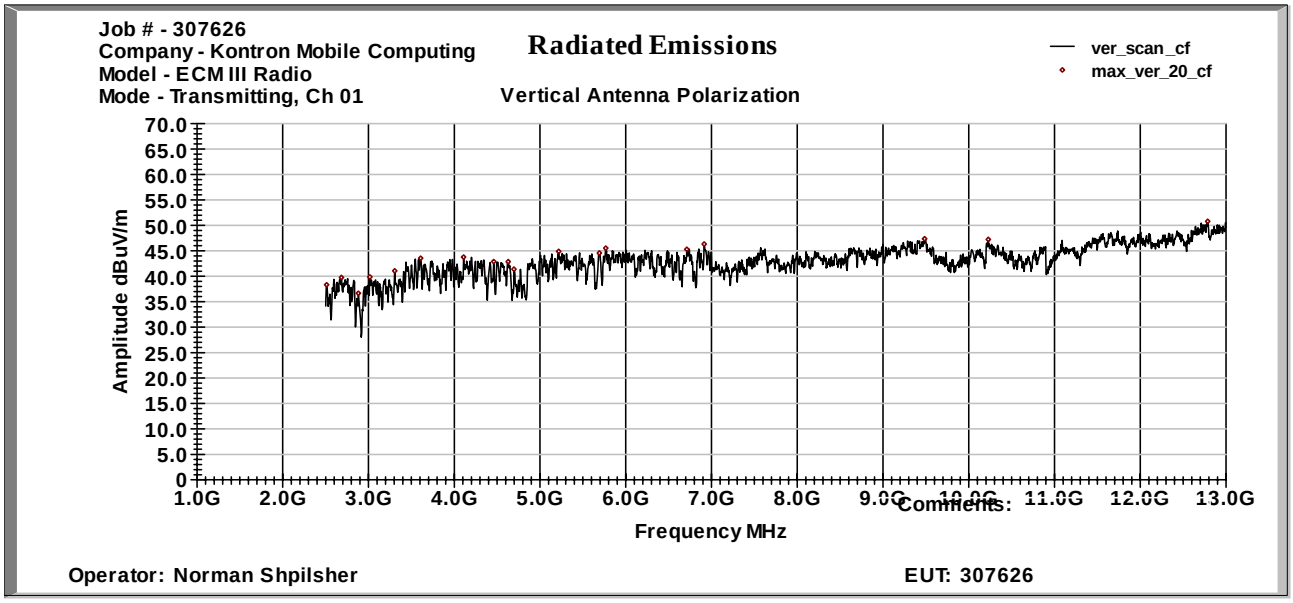


Horizontal Antenna Polarization

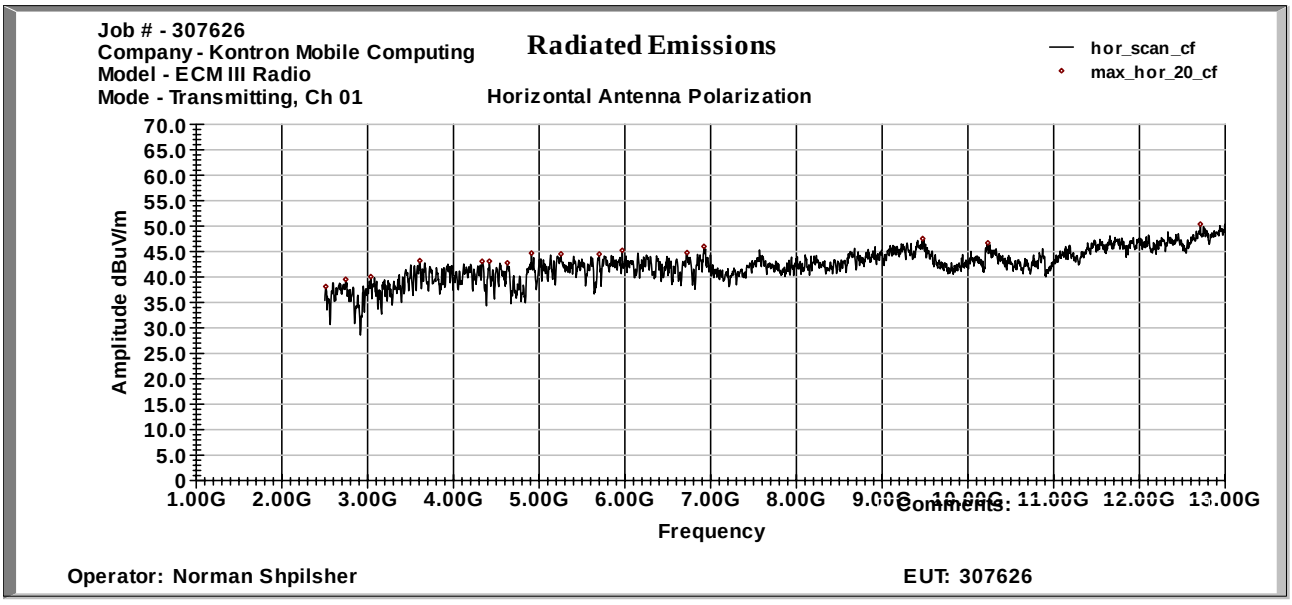


Graph #3-2-5
Transmitter Spurious Radiated Emissions from 2.5 to 13GHz, Channel 1

Vertical Antenna Polarization

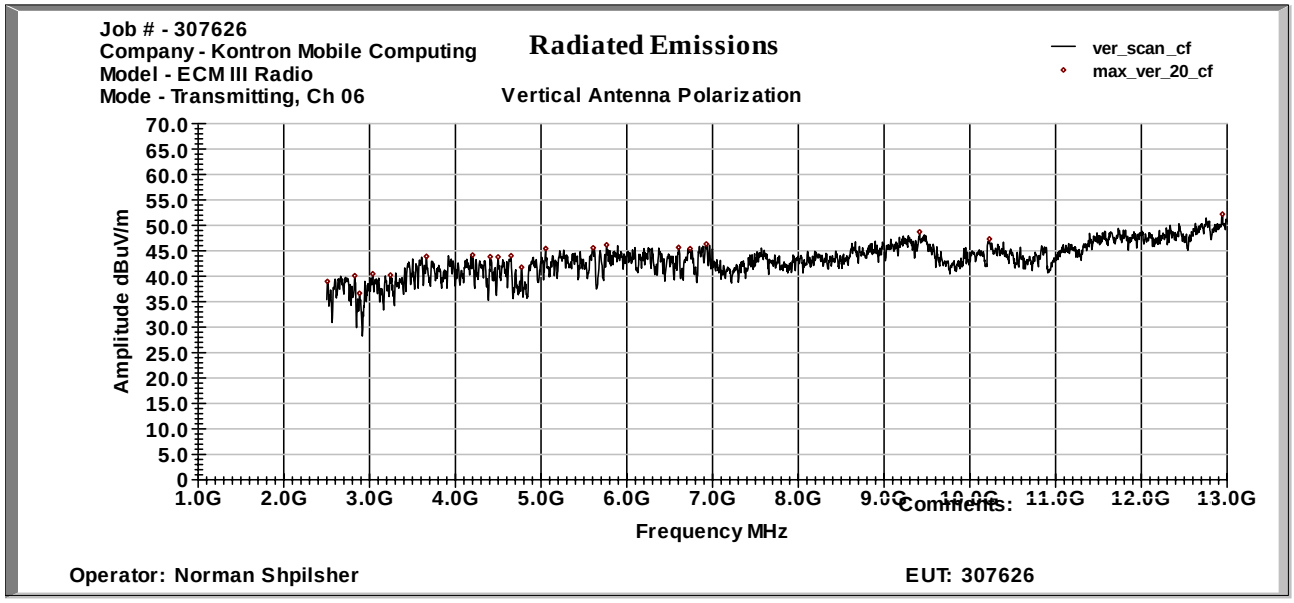


Horizontal Antenna Polarization

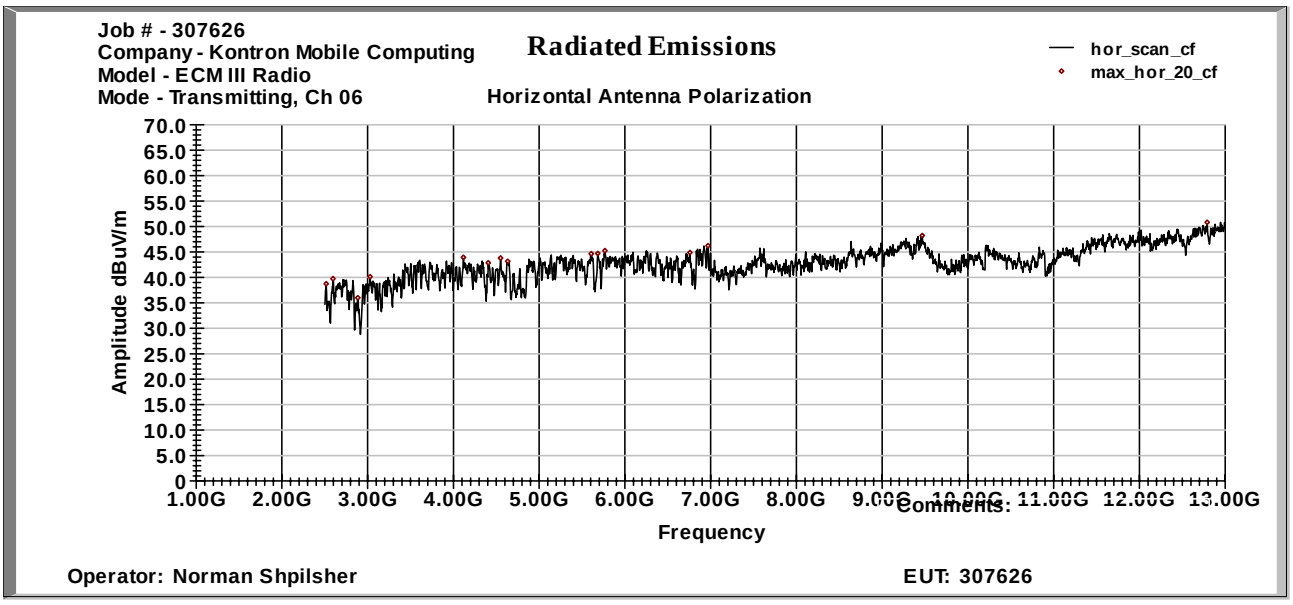


Graph #3-2-6
Transmitter Spurious Radiated Emissions from 2.5 to 13GHz, Channel 6

Vertical Antenna Polarization

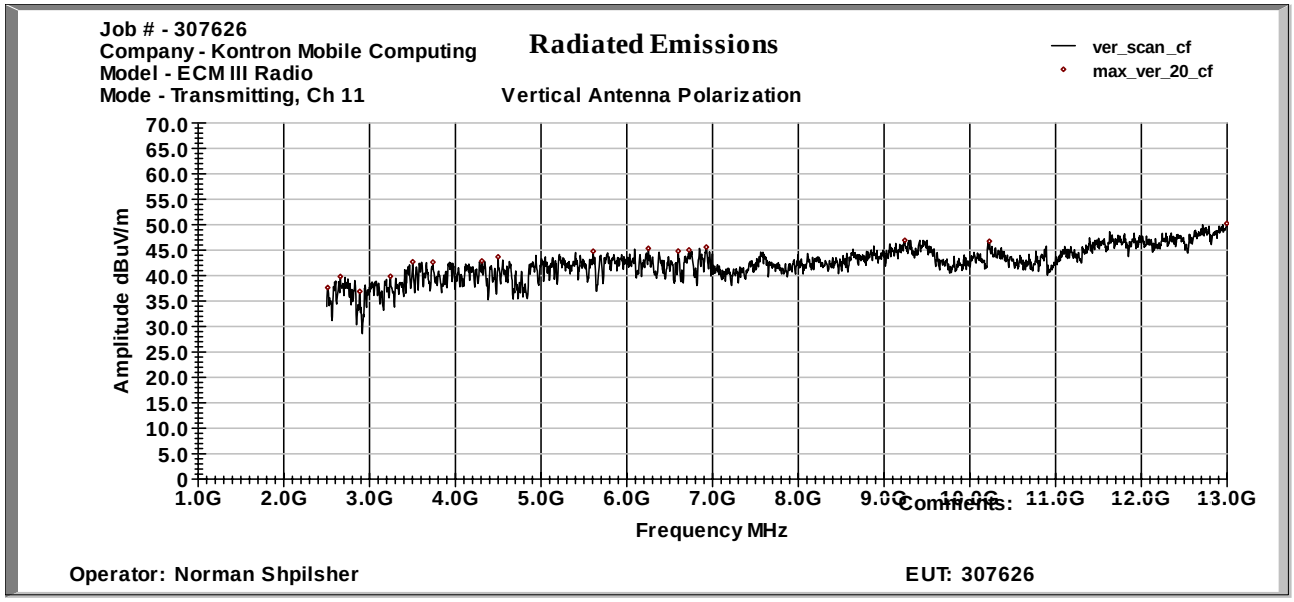


Horizontal Antenna Polarization

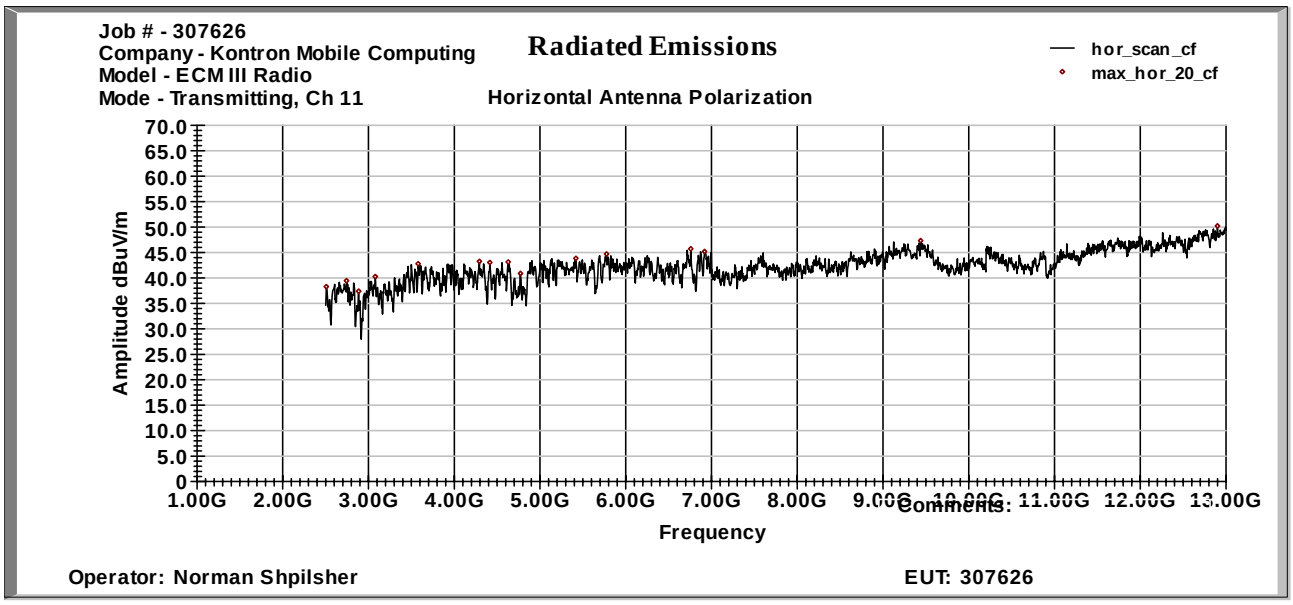


Graph #3-2-7
Transmitter Spurious Radiated Emissions from 2.5 to 13GHz, Channel 11

Vertical Antenna Polarization



Horizontal Antenna Polarization



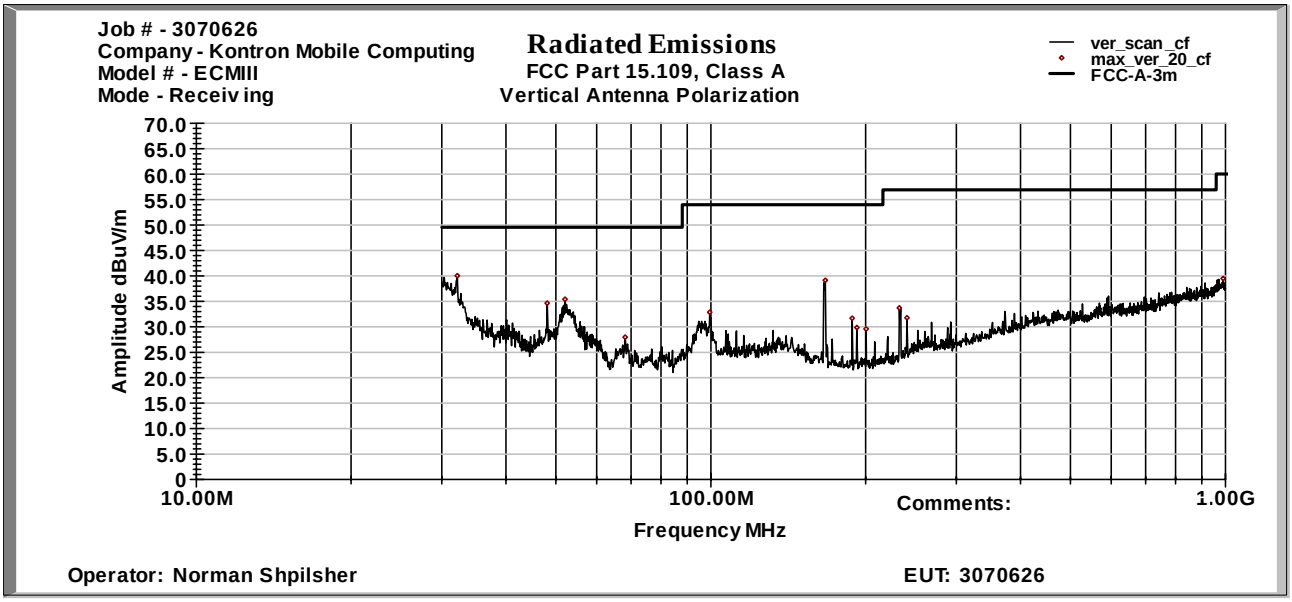
3.3 Receiver Radiated Emissions, FCC 15.109

The *Radio* was tested in receiving mode according to FCC Part 15.109 in frequency range from 30MHz to 12.5GHz. Radiated Emissions testing was performed in Anechoic Chamber with 3m-measurement distance.

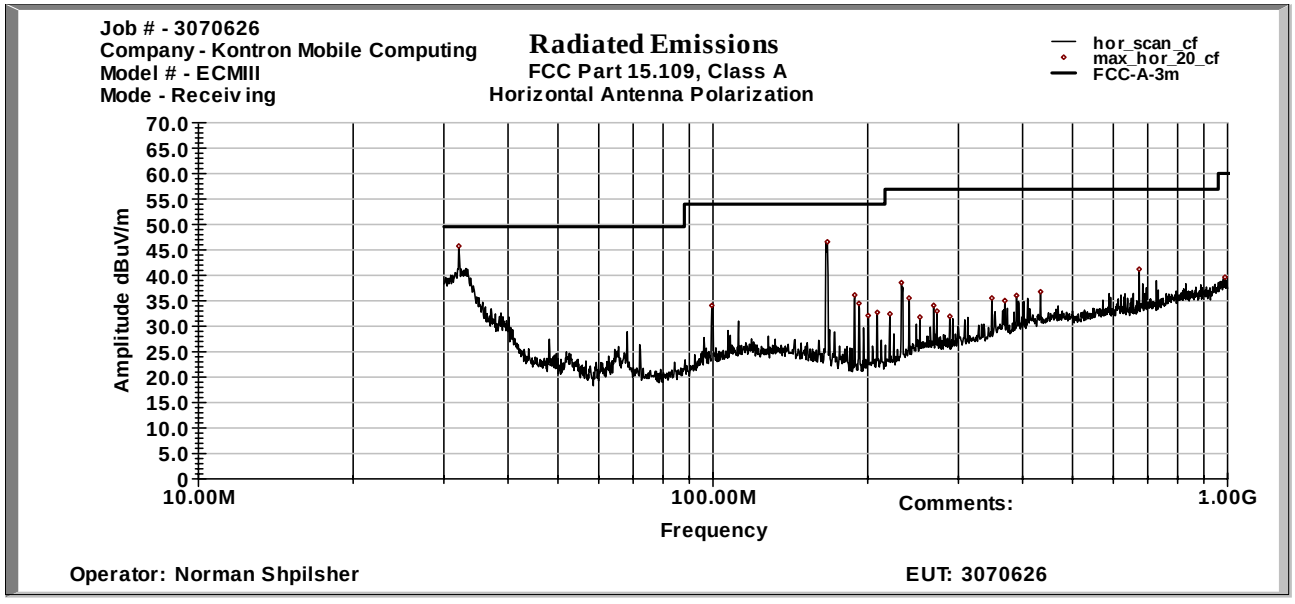
Graphs 3-3-1 and 3-3-2 show radiated emissions in receiving mode.
No emissions above ambient was found above 1GHz.

Graph #3-3-1
Receiver Radiated Emissions from 30MHz to 1GHz

Vertical Antenna Polarization

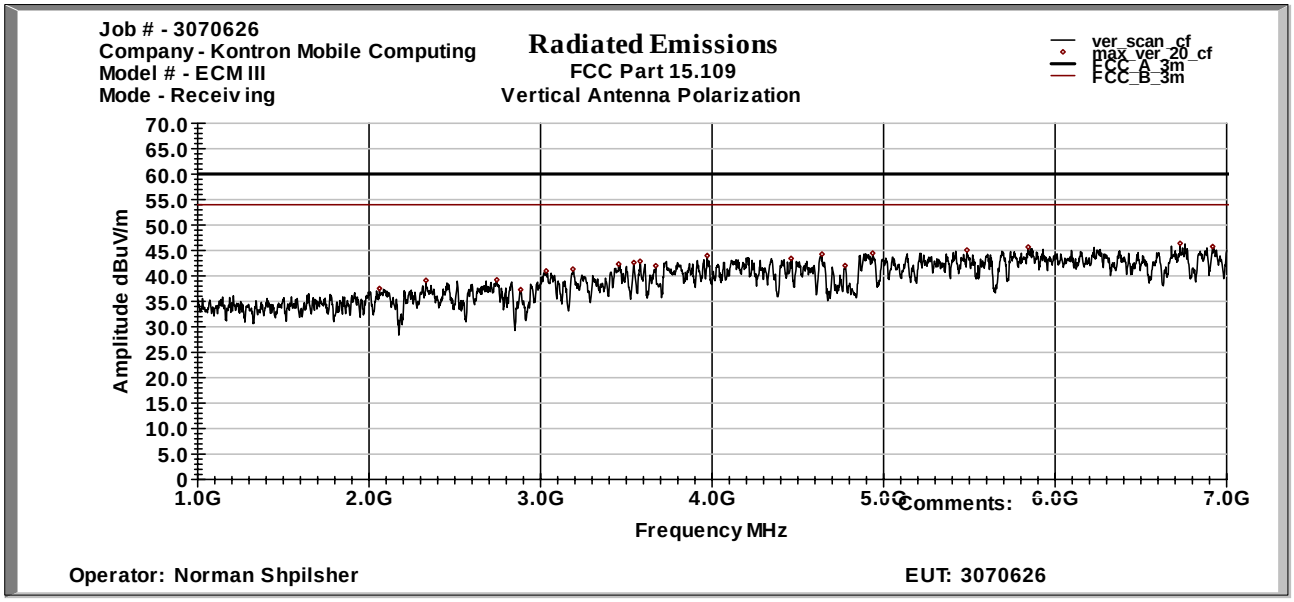


Horizontal Antenna Polarization

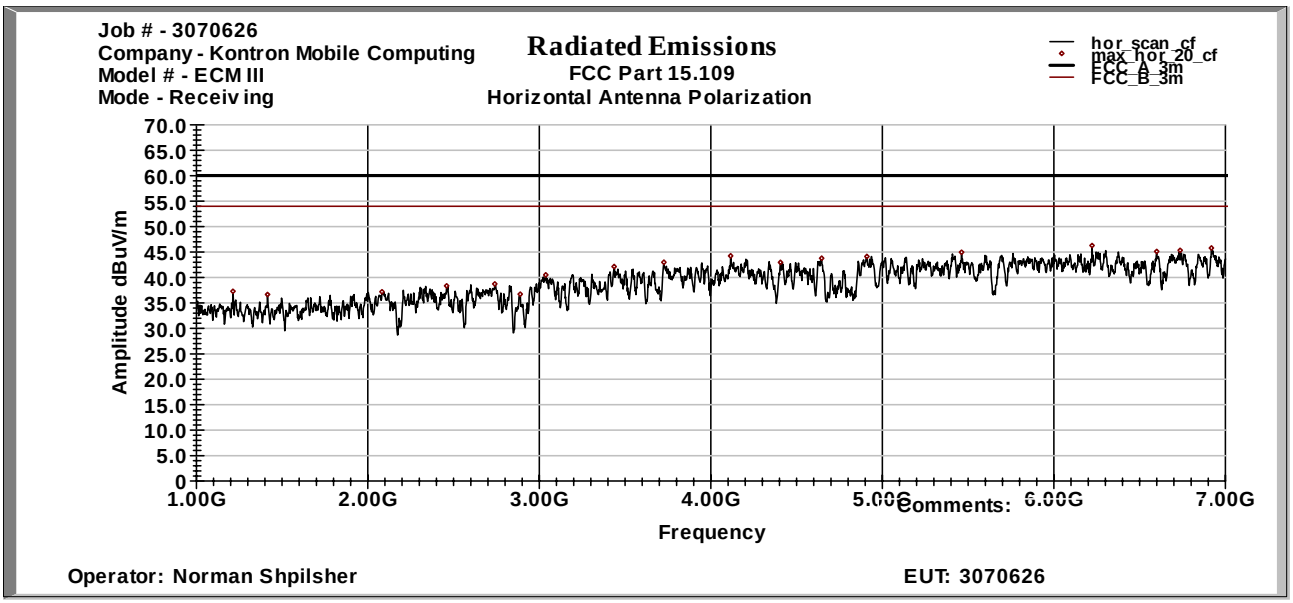


Graph #3-3-2
Receiver Radiated Emissions from 1GHz to 7GHz

Vertical Antenna Polarization



Horizontal Antenna Polarization



3.4 Power Line Conducted Emissions, FCC 15.207

Power Line Conducted Emissions testing was performed in frequency range from 150kHz to 30MHz.

The Table 3-4-1 and Graph 3-4-1 show the Power Line Conducted Emissions.

TILE Instrument Control System EMI Measurement Software

Conducted Emissions from 150kHz to 30MHz		**Date:**	02-28-2005
Company:	Kontron Mobile Computing		
Model:	ECM III 802.11b/g Radio		
Test Engineer:	Norman Shpilsher		
Special Info:	Transmitting Mode		
Standard:	FCC Part 15.207		
Note:	The table shows the worst case conducted emissions		
	All measurements were taken using a CISPR Quasi-peak detector		

Table # 3-4-1

Line 1

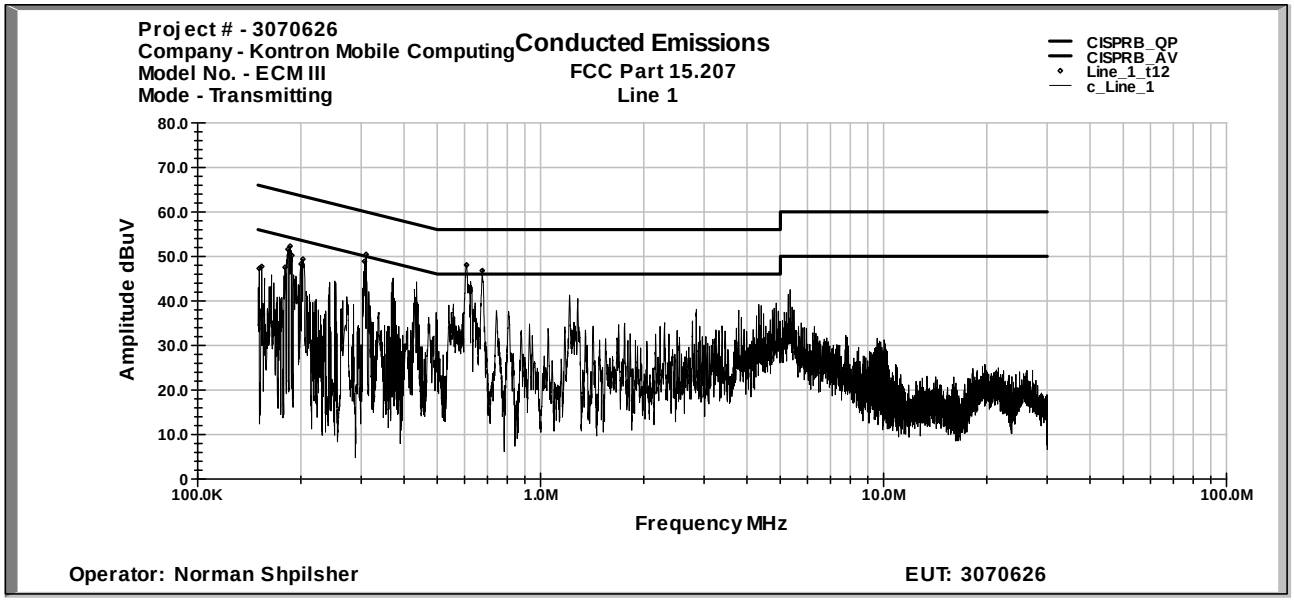
Frequency MHz	QP dBμV	AVG dBμV	QP Lim dBμV	AVG Lim dBμV	QP Margin dB	AVG Margin dB
187.26 KHz	50.6	36.0	64.2	54.2	-13.5	-18.1
201.97 KHz	48.5	37.7	63.5	53.5	-15.1	-15.8
309.15 KHz	47.8	33.2	60.0	50.0	-12.2	-16.8
309.77 KHz	47.6	33.0	60.0	50.0	-12.4	-17.0
607.91 KHz	49.2	44.2	56.0	46.0	-6.8	-1.8
674.24 KHz	44.8	43.0	56.0	46.0	-11.2	-3.0

Line 2

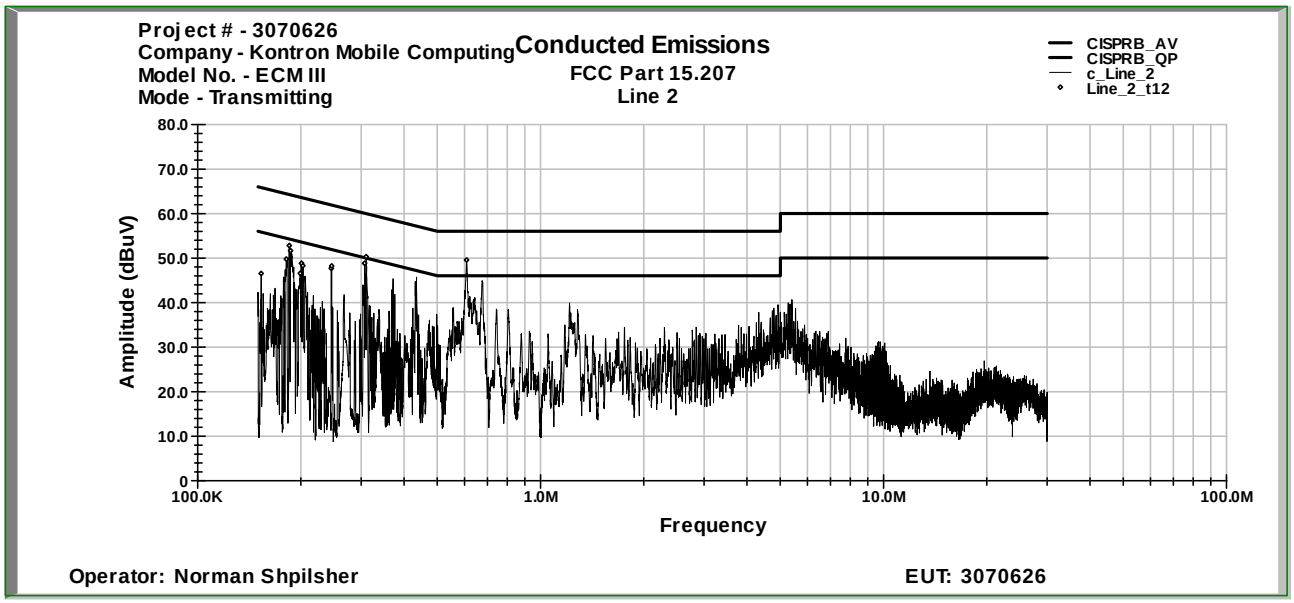
Frequency MHz	QP $dB_{\mu}V$	AVG $dB_{\mu}V$	QP Lim $dB_{\mu}V$	AVG Lim $dB_{\mu}V$	QP Margin dB	AVG Margin dB
184.77 KHz	51.9	37.1	64.3	54.3	-12.4	-17.2
247.63 KHz	44.9	19.8	61.8	51.8	-17.0	-32.0
308.8 KHz	47.7	32.9	60.0	50.0	-12.3	-17.1
371.79 KHz	42.1	16.4	58.5	48.5	-16.3	-32.0
433.33 KHz	43.8	31.7	57.2	47.2	-13.4	-15.5
607.73 KHz	49.4	44.4	56.0	46.0	-6.6	-1.6

Graph #3-4-1
Power Line Conducted Emissions from 150kHz to 30MHz

Vertical Antenna Polarization



Horizontal Antenna Polarization



3.5 Test Procedure

Field Strength Measurements

The EUT was placed on a non-conductive table 0.8m above the ground plane inside the Anechoic Chamber. The table was centered on a motorized turntable, which allows 360-degree rotation. The measurement antenna was positioned at 3m distance. The Bicono-Log antenna was used in frequency range from 30MHz to 1GHz, and the Horn antenna was used in frequency range above 1GHz. The radiated emissions were maximized by rotating the EUT, by changing antenna polarization, and by changing antenna height from 1 to 4m. Method of the Field Strength Calculation is shown in the Section 3.6.

Measurements at Antenna Terminal

The Measurements at Antenna Terminal were made at the maximum power transmission condition. The transmitter antenna port was connected to the Spectrum Analyzer Input.

Conducted Emissions

For conducted emissions testing, the equipment is moved to an insulating platform over the ground plane, and the EUT is powered from a LISN. Both sides of the AC line are measured and the results are compared to the applicable limits. Measurements are taken using CISPR quasi-peak and average detectors when the peak readings approach or exceed the average limit. Only quasi-peak readings are taken when the emissions from the EUT meet the average limit as measured with the quasi-peak detector.

3.6 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured emissions reading on the EMI Receiver.
The basic equation with a sample calculation is as follows:

FS = RA + AF + CF - AG

Where: FS = Field Strength in dB(μV/m)
RA = Receiver Amplitude in dB(μV)
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB(m^{-1})
AG = Amplifier Gain in dB

Assume a receiver reading of 48.1 dB(μV) is obtained. The antenna factor of 7.4 dB(m^{-1}) and cable factor of 1.6 dB is added and amplifier gain of 16.0 dB is subtracted giving field strength of 41.1 dB(μV/m).

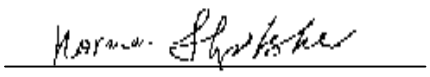
RA = 48.1 dB(μV)
AF = 7.4 dB(m^{-1})
CF = 1.6 dB
AG = 16.0 dB
FS = RA + AF + CF - AG
FS = 48.1 + 7.4 + 1.6 – 16.0
FS = 41.1 dB(μV/m)

In the tables the Cable correction factors are included to the Antenna Factors.

Tested by:

Norman Shpilsher
Sr. EMC Engineer
Intertek ETL SEMKO

Signature



Date: February 28, 2005

4.0 TEST EQUIPMENT

Receivers/Spectrum Analyzers and Test Software

DESCRIPTION	SERIAL NO.	LAST CAL	CAL DUE	USED
HP85462A Receiver RF Section	3325A00106	09/04	09/05	X
HP85460A RF Filter Section	3330A00109	09/04	09/05	X
HP85462A Receiver RF Section	3549A00306	01/05	01/06	
HP85460A RF Filter Section	3448A00276	01/05	01/06	
Rohde & Schwarz FSP 40 Spectrum Analyzer	100024	03/04	03/05	X
Advantest R3271A Spectrum Analyzer	55050084	06/04	06/05	
TILE! Instrument Control System	Ver. 3.4.E.2	N/A	N/A	X

Antennas/Pre-Amplifiers/Filters

DESCRIPTION	SERIAL NO.	LAST CAL	CAL DUE	USED
Schaffner-Chase Bicono-Log Antenna	2468	01/05	01/06	X
Schaffner-Chase Bicono-Log Antenna	2630	07/04	07/05	
EMCO Horn Antenna 3115	9507-4513	12/04	12/05	X
HP 83017A Pre-Amplifier	3123A00475	05/04	05/05	X
Reactel 7HS-4G-S12 Filter	0223	01/05	01/06	X

Artificial Mains Networks

DESCRIPTION	SERIAL NO.	LAST CAL	CAL DUE	USED
FCC LISN-2	316	04/04	04/05	X
FCC-LISN-50-25-2	2014	05/04	05/05	X