

Tantalus Systems Corporation TC-1116 & TC-1216 Series

Report of Measurements

per

Industry Canada RSS-210 Issue 5 + Amends. 1 to 4 – 6.2.2(o)

and

FCC CFR47 Part 15/B; FCC CFR47 Part 15/C – 15.247

Revision 1.1

September 6, 2006

Approved by		
Checked by	Robert Stirling, P.Eng.	Date

**Protocol Datasystems Inc., Labs, Abbotsford BC, Canada
FCC Registration Number 96437
Industry Canada Registration Number IC3384**

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Section I: Information for Test Report of Measurements

Testing Details

TESTED BY: David Johanson

TEST CONDITIONS: Temperature and Humidity: 8.0°C, 53%

TEST VOLTAGE: 120Vac 60Hz, 208Vac, 50Hz
(Some testing performed using Battery/DC Power from the Auxiliary COM_POWER board)

Test Facilities

Protocol Datasystems Inc., Labs
28945 McTavish Rd.
Abbotsford BC, Canada, V4X 2E7

FCC Registration Number 96437
Industry Canada Registration Number IC3384

Test Equipment List

EMISSIONS:

Manufacturer	Model	Equipment Description	Serial No.	Last Cal	Next Cal
HP	85650A	CDN Quasi-Peak Adapter	2043A00240	22/03/05	22/03/06
HP	85662A	Spectrum Analyzer Display	2318A05184	22/03/05	22/03/06
HP	8566B	Spectrum Analyzer RF Section	2241A02102	22/03/05	22/03/06
HP	85685A	RF-Preselector	3107A01222	22/03/05	22/03/06
A.H. Systems	SAS-200/510	Antenna Log Periodic	761	04/03/05	04/03/06
EMCO	3105	Antenna DRG Horn (Med)	2024	25/02/05	25/02/06
LaPlace Instruments	AC1000	Low Distortion Power Source	138041	12/12/05	12/12/06
Thurlby Thandar	HA1600	Power and Harmonics Analyzer	140108	13/12/05	13/12/06
EMCO	3825 2	LISN(25A 50ohm 50/250uH 10k-100M)	9509-2470	20/07/05	20/07/06
EMCO	3110B	Antenna Biconical (Type 3)	9401-1850	01/03/05	01/03/06
Rhientech	Custom	Antenna Mast	N/A	N/A	N/A
Protocol EMC	Custom	Turntable	N/A	N/A	N/A

Measurement Uncertainty

Parameter	Uncertainty
Radio Frequency	$\pm 1 \times 10^{-5}$
Total RF power, conducted	$\pm 1,5$ dB
RF power density, conducted	± 3 dB
Spurious emissions, conducted	± 3 dB
All emissions, radiated	± 6 dB
Temperature	$\pm 1^{\circ}\text{C}$
Humidity	± 5 %
DC and low frequency voltages	± 3 %

Company Tested:

NAME: Tantalus Systems Corporation

ADDRESS: 100 – 2955 Virtual Way
Vancouver, BC V5M 4X6

CONTACT: Mr. Mark Fairburn

EMAIL: mfairburn@tantalus.com

NUMBER: 604-299-0458 ext. 229

Equipment Under Test**THE TEST SYSTEM:**

EUT: TC1116 & TC1216 Series Transceiver boards
 Is for use at 120Vac
 Manufacturer: Tantalus Systems Corp.
 Part Number: 100-0037
 Serial number: 000005BB3A, 000005AE4C, 000005AFCB

TC-1216 Is for use at 240Vac
 Manufacturer: Tantalus Systems Corp.
 Part Number: 100-0031
 Serial number: 000005F44D, 000005AFBB, 000005D3C8,
 000005ADDD, 000005D3C6

AUX EQUIP: COM_POWER board
 Manufacturer: Tantalus Systems Corp.
 Part Number: 200-0014-C
 Serial number: ENG01

AUX EQUIP. Laptop PC.
 Manufacturer: Toshiba.

AUX EQUIP: For TC-1116 & TC-1216

Ref. ID	Name / Description	Model Number	Part Number	S/N	Rev. #
1	ltron meter	FM 1S	TC-1116	40739256	E
2	ltron meter	FM 2S	TC-1216	20821935	E
3	ltron meter	FM 12S	TC-1116	39299867	E
4	ltron meter	FM 3S	TC-1116	42104225	E
5	ltron meter	FM 3S	TC-1216	42052330	E
6	ltron meter	FM 4S	TC-1216	42104222	E
7	ltron meter	FM 2S-320	TC-1216	41273244	E

Test Software: Hyperterminal

TEST SETUP:

The Transceiver Boards are designed to be inserted into various formats of electricity power meter housings. There are 2 variations of Transceiver boards, depending on the Voltage of the meter.

The EUT's are designed to communicate with a base unit using a Frequency Hopping Spread Spectrum (FHSS) system operating on the 902-928 MHz band. They can use one of two preprogrammed internal antennas to perform this function. In its normal mode of operation, the EUT's are powered by the AC power that is supplied through the power meter that this product is attached to. As a result of this connection, the EUT's are only designed to be operating about 5% of the time and is shut down for most of its time.

Since some measurements require that the EUT transmit in a continuous broadcast operation, the EUT was sometimes tested with a computer COM port interface board that would provide a Battery/6Vdc power source. Measurements have shown that the output transmission levels are higher when using this alternate power source. These higher levels were used in this report where applicable.

CABLING:

Cable	Pins	Connector	Load/Termination	Shielded	Ferrites
Power	3	Terminal	No	No	No

MODIFICATIONS:

No modifications were required for this unit to pass.

CONCLUSION:

The TC-1126 & TC-1216 series of transceivers complies with the requirements of IC RSS-210 Issue 5 +A1 to 4-6.2.2(o) & FCC CFR47 Part 15/B; FCC CFR47 Part 15/C – 15.247

Section II: Report of Measurements to IC RSS-210 Iss.5 & FCC CFR47 Part 15/B

Markings

According to FCC Section 15.19, and ICES 003, a statement similar to the following must be included on an identification label, which also uniquely identifies the Manufactured date, either explicitly or through a Serial number etc.:

"This equipment complies with FCC Rules, Part 15 and Industry Canada's ICES 003 for a Class B Digital Device. Operation is subject to two conditions:

- 1) This device may not cause harmful interference, and
- 2) This device must accept any interference that may cause any undesired operation"

Additionally, if the manufacturer markets product to Quebec, the following supplemental information should be added to the label:

"Cet Appareil numerique de la Classe A respecte toutes les exigences du Reglement sur le matériel brouilleur du Canada."

Labeling

According to FCC Section 15.105, and ICES 003, the following statement must be included in a prominent location in your User's Manual:

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

It is also required according to FCC Part B Section 15.21 that a caution is included such as:

Caution: Changes or modifications to this equipment, not expressly approved by the manufacturer could void the user's authority to operate the equipment.

This product is License Exempt for both FCC and IC, there is a requirement for this product to be submitted for certification and requires both an FCC ID and an IC ID number to be added to the labels in accordance with FCC CFR47 Part 2 subpart J (2.901 to 2.956) as well as IC Self-Marking standards.

Section III: Report of Measurements to IC RSS-210 Issue 5 +A. 1 to 4 Emissions Testing

Test Results - Summary

Testing was performed pursuant to Industry Canada RSS-210 Issue 5 Section 6.2.2(o) with Amendments 1 through 4.

Test	Standard	Description	Result
Radiated Emissions Idle Mode subclause 8.2	EN55022 Class B Limits	The radiated emissions are measured in the 30-1000Mhz range	Complies
Conducted Emissions Idle Mode subclause 8.3	EN55022 Class B Limits	The Conducted Emissions are measured on the phase and Neutral Power lines in the 0.15 - 30.0 MHz range.	Complies
Radiated Emissions Transmit Mode	RSS-210 6.2.2(o)(b); 6.3	The radiated emissions are measured in the 30-10000MHz range	Complies
Conducted Emissions Transmit Mode	RSS-210 6.6	The Conducted Emissions are measured on the phase and Neutral Power lines in the 0.45 - 30.0 MHz range Quasi-Peak 250uV(48dBuV)	Complies
Spectral Density Emissions	RSS-210 6.2.2(o)(b)	Spectral Density shall not be greater then 8dBm in any 3kHz band during a time interval exceeding 1,0 seconds; 50milliwatts per MHz	Complies
Output Power and EIRP Emissions	RSS-210 6.2.2(o)(b)	Output power shall not exceed 1.0 Watt	Complies

Part 1 - Radiated Emission Testing

DATE: January 9 – 12, 2006

TEST STANDARD: EN55022:1997

TEST VOLTAGE: 6VDC Battery source

MINIMUM STANDARD: Class B Limit:

Frequency (MHz)	Maximum Field Strength dB μ V/m at 10 m
30 - 230	30.0
230 - 1000	37.0
Note 1. The lower limit shall apply at the transition frequency Note 2. Additional provisions may be required for cases where interference occurs	

METHOD OF MEASUREMENT: The equipment was set up in a 10-meter open field test site; Tests were performed at 3 meters. Limit lines were modified to compensate as per procedures for short range, as below, using the manufacturer's specified normal cabling configuration, with all cables over 1 meter in length bundled at 1 meter and retained from the floor. A typical application was tested.

Emissions in both horizontal and vertical polarization's were measured while rotating the EUT on a turntable to maximize the emissions signal strength.

In cases where the presence of high ambient noise makes it impossible to measure an emission at the required distance, the measurement is performed at a closer distance and the limit is adjusted per EN61000-6-3: 2001

20 Log (D1/D2)
Where D1 = New Distance D2 = Required Distance The result is added to the required emission level to ensure compliance at the new distance.

All frequencies 30-2000GHz were tested at 3m and all frequencies 2GHz and up were tested at 1meter in accordance with ANSI c63.4

MEASUREMENT DATA: See Appendix C for Plots

EMISSIONS DATA: See Table 10 in Appendix C for corresponding frequencies.

PERFORMANCE: Complies.

Part 2 - Conducted Emission Testing

DATE: January 12, 2006

TEST STANDARD: EN55022:1997

TEST VOLTAGE: 6VDC Battery source

TEST SETUP: The EUT was connected to the conducted emissions LISN apparatus. The equipment was operated and tested at 120Vac 60Hz as well as 208Vac 50Hz

MINIMUM STANDARD: Class B Limit:

Frequency (MHz)	Conducted Limit (dB μ V)	
	Quasi-Peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
5 - 30	60	50
Note 1 The lower limit shall apply at the transition frequencies		
Note 2 The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz		

METHOD OF MEASUREMENT: Measurements were made using a spectrum analyzer with 9kHz RBW, Peak detector. Any emissions that are close to the limit are measured using a test receiver with 9kHz bandwidth, CISPR Quasi-Peak detector as well as an averaging meter.

DEVICE DESCRIPTIONS: As described in the Equipment under Test Section, above.

MEASUREMENT DATA: See Appendix C for Plots,

EMISSIONS DATA: See Tables 1 through 8 in Appendix C for corresponding frequencies.

PERFORMANCE: Complies.

Part 3 - Radiated Emissions – Transmit Mode

DATE:	January 9 – 12, 2006
TEST STANDARD:	RSS-210 Iss.5 6.2.2(o)(b) – Frequency Hopping Spread Spectrum Systems 902-928MHz.
MINIMUM STANDARD:	6.2.2(o)(e1) – Out of Band Emissions: In any 100 kHz bandwidth outside the operating frequency bands, between 30 MHz and 5 times the carrier frequency, the unwanted emission spectral density shall be either at least 20 dB below the inband spectral density, or shall not exceed the levels specified in Table 3, whichever is less stringent. Note: For frequency hopping systems, the inband density S_i shall be measured with the hopping sequence stopped at the lowest channel and the highest channel in turn, as well as with the hopping running normally. The 20dB shall be with reference to the lowest of the three S_i values.
TEST SETUP:	Refer to setup in Part 1 above.
METHOD OF MEASUREMENT:	Measurements were made using a spectrum analyzer with 9kHz RBW, Peak detector. Any emissions that are close to the limit are measured using a test receiver with 9kHz bandwidth, CISPR Quasi-Peak detector as well as an averaging meter.
DEVICE DESCRIPTIONS:	As described in the Equipment under Test Section, above.
EMISSIONS DATA:	See Plots and Tables 1,2 and 3 in Appendix A for corresponding frequencies.
PERFORMANCE:	Complies.

Part 4 - Conducted Emission Testing – Transmit Mode

DATE: January 9 - 12, 2006

TEST STANDARD: RSS-210 Iss.5 6.6 – Transmitter AC Wireline Conducted Emissions

TEST SETUP: The EUT was connected to the conducted emissions LISN apparatus. The equipment was operated and tested at 120Vac 60Hz as well as 208Vac 50Hz

MINIMUM STANDARD:

- (a) On any frequency or frequencies within the band of 0.45-30 MHz, the measured RF voltage (CISPR meter) shall not exceed 250 microvolts (across 50 ohms).
- (b) Transmitters marketed for use only in a commercial, industrial or business environment and not intended for use in homes are permitted a limit of 1000 microvolts (0.45 - 1.705 MHz) and 3000 microvolts (1.705 - 30 MHz).

All applications not residential Frequency (MHz)	Residential Frequency (MHz)	Conducted Limit (dBμV)	
		Quasi-Peak(μV)	Quasi-Peak(dBμV)
	0.45 - 30	250	48
.45 – 1.705		1000	60
1.705 - 30		3000	69.5

METHOD OF MEASUREMENT: Measurements were made using a spectrum analyzer with 9kHz RBW, Peak detector. Any emissions that are close to the limit are measured using a test receiver with 9kHz bandwidth, CISPR Quasi-Peak detector as well as an averaging meter.

DEVICE DESCRIPTIONS: As described in the Equipment under Test Section, above.

EMISSIONS DATA: See Tables 1,2,3,4,5 and 6 in Appendix C for corresponding frequencies.

PERFORMANCE: Complies.

Part 5 - Spectral Density Emissions Testing

DATE:	January 9 – 12, 2006
TEST STANDARD:	RSS-210 Iss.5 6.2.2(o)(b) – Frequency Hopping Spread Spectrum Systems 902-928MHz.
MINIMUM STANDARD:	The transmitter power spectral density (into the antenna) shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission or over 1.0 second if the transmission exceeds 1.0 second duration.
METHOD OF MEASUREMENT:	<p>Measurements were made using a spectrum analyzer with 9kHz RBW, Peak detector. Any emissions that are close to the limit are measured using a test receiver with 9kHz bandwidth, CISPR Quasi-Peak detector as well as an averaging meter. Since the antenna is an etched trace on the EUT, the measurement could not be a conducted measurement done directly on the board. The procedures used to indicate compliance were done in accordance with RSS-212 (3.2). Measurements were made at 1 meter, setting the frequency on a continuous broadcast. The Antenna was connected directly to the Spectrum Analyzer without using a Microwave Amplifier.</p> <p>The Gain of the antenna was -7.5dBi and $G_n=0.178G_n$ was used to calculate the power.</p> <p>The following formula was used to convert the maximum field strength (FS) in volts/meter to the EUT output power (TP) in watts:</p> $TP = ((FS \times D)^2) / (30 \times G)$ <p>where D is the distance in meters between the two antennas and G is the EUT antenna numerical gain referenced to isotropic gain.</p>
DEVICE DESCRIPTIONS:	As described in the Equipment under Test Section, above.
EMISSIONS DATA:	See Plots 6,7,8 and 9 in Appendix A for corresponding frequencies.
PERFORMANCE:	Complies.

Part 6 - Output Power and EIRP Emissions

DATE: January 9 – 12, 2006

TEST STANDARD: RSS-210 Iss.5 6.2.2(o)(b) – Frequency Hopping Spread Spectrum Systems 902-928MHz.

MINIMUM STANDARD: 6.2.2(o)(b) – For the band 902 - 928 MHz, the transmitter output power shall not exceed 1.0 watt.

TEST SETUP: Refer to setup in Part 1 above.

METHOD OF MEASUREMENT: Measurements were made using a spectrum analyzer with 9kHz RBW, Peak detector. Any emissions that are close to the limit are measured using a test receiver with 9kHz bandwidth, CISPR Quasi-Peak detector as well as an averaging meter. Since the antenna is a permanently mounted antenna that is an etched trace on the EUT, the measurement could not be a conducted measurement done directly on the board. The procedures used to indicate compliance were done in accordance with RSS-212 (3.2). Measurements were made at 1 meter, setting the frequency on a continuous broadcast. The Antenna was connected to the Spectrum Analyzer using a Microwave Amplifier.

The Gain of the antenna was recorded as -7.5dBi and $G_n=0.178G_n$ was used to calculate the power.

The following formula was used to convert the maximum field strength (FS) in volts/meter to the EUT output power (TP) in watts:

$$TP = ((FS \times D)^2) / (30 \times G)$$

where D is the distance in meters between the two antennas and G is the EUT antenna numerical gain referenced to isotropic gain.

DEVICE DESCRIPTIONS: As described in the Equipment under Test Section, above.

EMISSIONS DATA: See Plots 9, 10 and 11 in Appendix A for corresponding frequencies.

PERFORMANCE: Complies.

MEASUREMENT DATA:

Mode of Operation	Frequency	Measured Signal Peak at 1m	Equipment Correction	Corrected Signal Peak at 3m	Signal Power Level E.I.R.P. per RSS-210(11)	Limit Line E.I.R.P.
	MHz	dBμV	dB	dBμV	(W)dBW	(W)(dBW)
DC Powered Continuous Broadcast single channel	902-174	91.6	21.3	112.9	0.328/-4.83	4.0/6.0

Section IV: Report of Measurements to FCC CFR47 Part 15/C

General

Tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 15 – Subpart B – Unintentional Radiators Class B; Part 15 – Subpart C - Intentional Radiators.

Additionally, the specific section used for Intentional Radiator compliance is 15.247 – Operation within the band 902-928 MHz – limited to Frequency Hopping Spread Spectrum intentional radiator. The procedures used includes the use of the FCC Public Notice DA 00-705 (Filing and Measurement guidelines for Frequency Hopping Spread Spectrum Systems)

Labeling Requirements

Please refer to labeling requirements as outlined above in Section 1.

Test Results - Summary

Testing was performed pursuant to Industry Canada RSS-210 Issue 5 Section 6.2.2(o) with Amendments 1 through 4.

Test	Standard	Description	Result
Radiated Emissions Idle Mode	FCC PART 15 Subpart B Class B Limits	The radiated emissions are measured in the 30-2000Mhz range	Complies
Conducted Emissions Idle Mode	FCC PART 15 Subpart B Class B Limits	The Conducted Emissions are measured on the phase and Neutral Power lines in the 0.15 - 30.0 MHz range.	Complies
Antenna Requirement	FCC Part 15 Subpart C 15.203	Proper Antenna is specified and used.	Complies
Radiated Emissions Transmit Mode – Frequency Hopping Spread Spectrum Operation	FCC Part 15 Subpart C 15.247	Radiated emission characteristics for Spread Spectrum devices operating in the range 902-928 MHz that use the Frequency Hopping technique. Emissions are measured in the 30-10000MHz range	Complies

Part 1 - Radiated Emission Testing

DATE: February 23, 2006

TEST STANDARD: FCC CFR47, Part 15, Subpart B

TEST VOLTAGE: 6VDC Battery source

TEST SETUP: This EUT was set up in a 3-meter open field test site. Emissions in both horizontal and vertical polarizations were measured while rotating the EUT on a turntable to maximize the emissions.

MINIMUM STANDARD: Class B Limits:

Frequency	Maximum Field Strength	Maximum Field Strength
(MHz)	$\mu\text{V/m}$ at 3 m	$\text{dB}\mu\text{V/m}$ at 3 m
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
960 - 1000	500	54

DEVICE DESCRIPTIONS: Refer to the Equipment Under Test Section, above, for EUT descriptions. Due to the nature of the product, only one version was tested for Radiated emissions.

CABLE DESCRIPTIONS: No cables required

EMISSIONS DATA: See Table 9 in Appendix C for corresponding frequencies.

PERFORMANCE: Complies.

Part 2 - Conducted Emission Testing

DATE: January 12, 2006

TEST STANDARD: FCC CFR47, Part 15, Subpart B

TEST VOLTAGE: 120Vac, 60Hz and 208Vac, 50Hz,

TEST SETUP: The EUT was connected to the conducted emissions LISN apparatus. The TC-1116 equipment was operated and tested at 120Vac 60Hz. The TC-1216 equipment was operated and tested at 208Vac, 50Hz

MINIMUM STANDARD: Class B Limit:

Frequency (MHz)	Conducted Limit (dB μ V)	
	Quasi-Peak	Average
0.15 - 0.50	66 to 56*	56 to 46*
0.50 - 5	56	46
5 - 30	60	50
* Decreases with the logarithm of the frequency		

METHOD OF MEASUREMENT: Measurements were made using a spectrum analyzer with 10kHz RBW, Peak detector. Any emissions that are close to the limit are measured using a test receiver with 9kHz bandwidth, CISPR Quasi-Peak detector as well as an averaging meter.

DEVICE DESCRIPTIONS: As described in the Equipment under Test Section, above.

MEASUREMENT DATA: See Appendix C for Plots,

EMISSIONS DATA: See Tables 1,2,3,4,5,6,7 and 8 in Appendix C for corresponding frequencies.

PERFORMANCE: Complies.

Part 3 - Antenna Requirement - 15.203

APPLICABLE REGULATIONS: 2.1

15.203 - An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators, which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

RESULT:

2.2

This unit meets this requirement. There are two antennas that are in this unit. During installation, the installer uses software and chooses which of the two antennas is best for the situation. The antennas that are mounted in this unit, are 915 MHz antennas that are permanently mounted to the plastic molding that holds the circuit board in place and are not replaceable.

Part 4 - Frequency Hopping Spread Spectrum Operation - 15.247

TEST STANDARD: FCC CFR47, Part 15, Subpart C 15.247 Filing and measurement guidelines DA 00-705 Frequency Hopping Spread Spectrum Systems

APPLICABLE REGULATIONS:

15.247(a) - Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions. (Please note that only the applicable regulations are listed):

(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. ... The system shall hop to channel frequencies that are selected at the system-hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

(i) For frequency hopping systems operating in the 902–928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20dB. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

DEVICE DESCRIPTIONS: Refer to the Equipment Under Test Section, above, for EUT Descriptions.

TEST SETUP:

Freq. Range Measured	30MHz – 10000MHz
Test Distance	1 to 3m
Test Instrumentation resolution	120KHz (30MHz to 1000MHz)

Receive Ant. Scan Height	1m – 4m
Receive Ant. Polarization	Vertical and Horizontal.

The equipment was set up in a 3-meter open field test site. Emissions in both horizontal and vertical polarizations were measured while rotating the EUT on a turntable to maximize the emissions signal strength and the results recorded on the attached plots. The emissions were tested using radiated test procedures instead of conducted measurement procedures.

This unit was designed to communicate on any one of several channels within the 902 – 928MHz band. The unit is designed to automatically transmit/receive data on the specified channel that was programmed into the Unit.

Measurements were performed at the lowest, middle and highest operating frequencies

MODIFICATIONS: No modifications have been made to the EUT in order to achieve compliance.

CABLING DETAILS: DB9 Com Port Cable,

RESULTS: To verify compliance, the radiated emission tests were carried out in accordance with part 15.109, 15.205, 15.209 and 15.247. The spectrum was scanned from 0.4MHz to 25000 MHz looking for all Spurious and Harmonic emissions in Quiescent, and Transmit modes. The Quiescent Mode and Transmit mode measurements and plots for Un-intentional emissions 30-1000 MHz are contained in Appendix B.

For the requirements of §15.247(a), refer to plots in Appendix A:

Channel Carrier Frequency Separation:	as per Plot 1 – 126kHz
20dB bandwidth:	as per Plot 5 – 142.2kHz
Number of Hopping Channels:	as per plots 2A to 2F – 50
Time of Occupancy – Dwell Time:	as per plot 3 – 4.60msec
Time of Occupancy – Silent Period:	as per plot 4 – 1.178sec
Time of Occupancy – Average per 20sec:	$(20/((.0046+1.178)) \times (0.0046))$ = 0.0778 sec

For the requirements of §15.247(d):

For emissions that fall within the restricted bands, the limit is set to 54 at 3 meters. For emissions that fall outside of the restricted bands, the limit is set to 92dBµV/m Where measured frequencies of concern are over 1.0GHz, we used the Average measurement procedure as outlined in FCC 97-114 Appendix C. The results of the harmonics and spurious frequencies 1000-10000 MHz are contained in Appendix A. – Emission Plots and Data.

Part 5 - Output Power and EIRP Emissions

DATE: January 12, 2006

TEST STANDARD: FCC 15.247(b)(2) – Hopping Frequency Systems 902-928MHz

MINIMUM STANDARD: 15.247(b)(2) – for the band 902-928MHz, the transmitter output power shall not exceed 1.0 watt for systems employing at least 50 Hopping Channels

TEST SETUP: Refer to setup in Part 1 above.

METHOD OF MEASUREMENT: Measurements were made using a spectrum analyzer with 9kHz RBW, Peak detector. Any emissions that are close to the limit are measured using a test receiver with 9kHz bandwidth, CISPR Quasi-Peak detector as well as an averaging meter. Since the antenna is a permanently mounted antenna that is an etched trace on the EUT. The measurement could not be a conducted measurement done directly on the board; the procedures used to indicate compliance were done in accordance with FCC Guidelines DA 00-705. Measurements were made at 3 meters using the appropriate antenna, cables filters and amplifiers.

The Gain of the antenna is $G_n = 0.178$ in relation to an isotropic antenna.

The following formula was used to convert the maximum field strength (FS) in volts/meter to calculate the EUT output power (TP) in watts:

$$TP = ((FS \times D)^2) / (30 \times G)$$

Where D is the distance in meters between the two antennas and G is the EUT antenna numerical gain referenced to isotropic gain.

MEASUREMENT DATA:

Mode of Operation	Frequency	Measured Signal – Peak at 1meter	Equipment correction	Corrected Signal - Peak at 3m	Signal Power Level – per DA 00-705	Limit Line –
	(MHz)	(dBμV)	(dB)	(dBμV)	(W)/dBW	(W)/(dBW)
DC Powered Continuous Broadcast single channel	902.174	91.6	21.3	112.9	0.328	1.0

EMISSIONS DATA: See Plot in Appendix A for corresponding frequencies.

PERFORMANCE: Complies.

Part 6 - Restricted Bands Review – 15.205(b)**APPLICABLE REGULATIONS:**

15.205(b) - Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

RESULT:

All of the measurements shown below were made when the system under test was set into a mode that only transmits a CW tone in order to facilitate measurements of the spurious emissions. The 20dB bandwidth of the CW signal is 15Hz.

The spurious frequencies that have been identified to fall into restricted bands are the various harmonics of 906 and 918 MHz. The restricted bands affected are 2655-2900MHz, 3600-4400MHz, 4500-5150MHz, 5350-5460MHz, 7250-7750MHz, 8025-8500MHz and 9000-9200MHz.

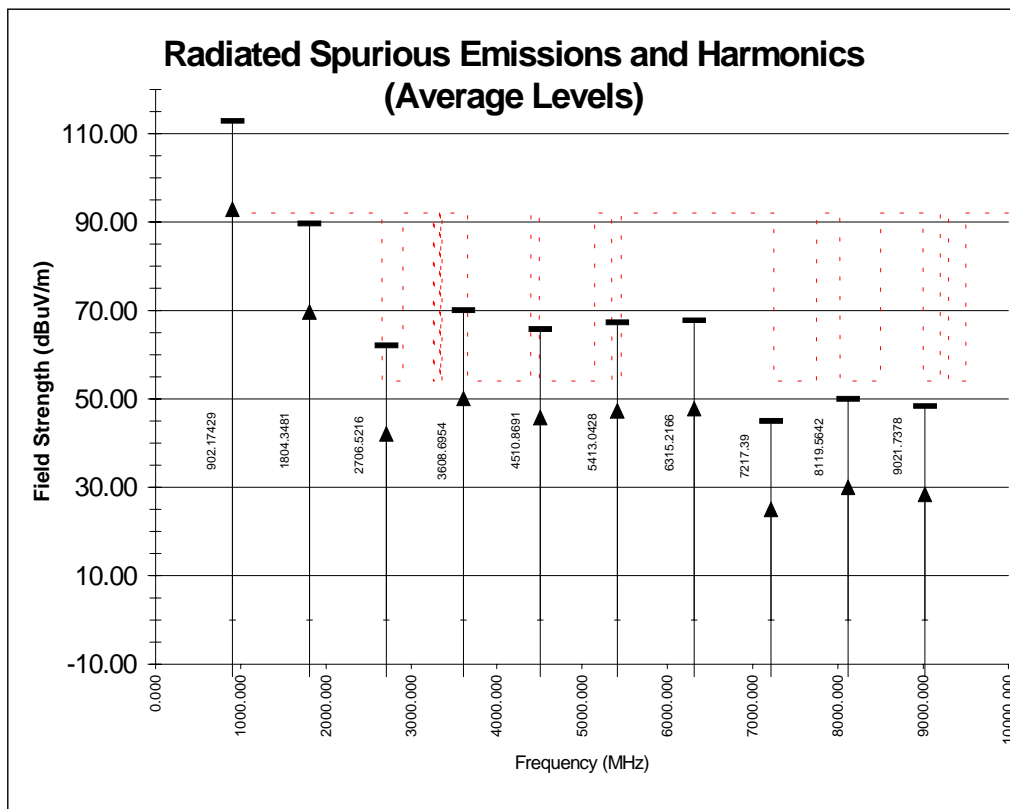
EMISSIONS DATA:

See Plots in Appendix A for corresponding frequencies.

PERFORMANCE:

Complies

Appendix A: Emission Plots and Data



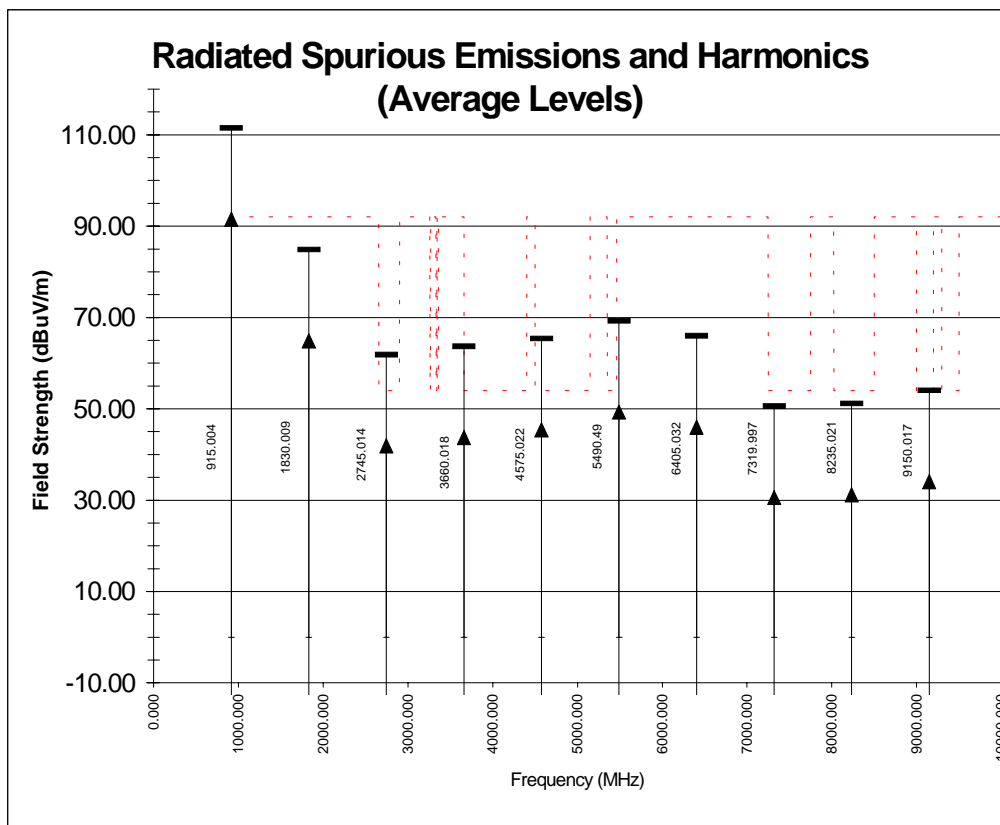
Plot 1: 15.247(b,c): Meter Type: 1S Serial Number: 5AFCB
902.2MHz, Antenna 0, Low Channel Harmonic and Spurious Emissions

Freq.	Har	Restricted bands (15.205(a))	Meas. Signal	Equipment Attenuatio n	Corrected Peak Signal at meas. distance	Meas. Distance	Corrected Peak Signal at 3m distance	Calculated Averaged Signal (with Duty Cycle Correction) **	Limit Lines – FCC 15.247	Delta Limit – FCC 15.247 (Average)
(MHz)			(dBμV) (note 1)	(dB)	(dBμV)	(m)	(dBμV)	(dBμV)	(dBμV)	(dB)
902.174	fund	N/A	91.6	30.8	122.4	1.0	112.9	92.9	N/A	N/A
1804.348	2nd	N/A	61.0	38.2	99.2	1.0	89.7	69.7	92.9	-23.2
2706.522	3rd	2655-2900	26.8	44.8	71.6	1.0	62.1	42.1	54.0	-11.9
3608.695	4th	3600-4400	29.4	50.2	79.6	1.0	70.1	50.1	54.0	-3.9
4510.869	5th	4500-5150	20.8	54.5	75.3	1.0	65.8	45.8	54.0	-8.2
5413.043	6th	5350-5460	15.2	61.6	76.8	1.0	67.3	47.3	54.0	-6.7
6315.217	7th	N/A	9.7	67.6	77.3	1.0	67.8	47.8	92.9	-62.2
7217.390*	8th	N/A	16.9	37.6	54.5	1.0	45.0	25.0	92.9	-67.9
8119.564*	9th	8025-8500	18.4	39.5	59.5	1.0	50.0	30.0	54.0	-24.0
9021.738*	10th	9000-9200	20.3	39.2	57.9	1.0	48.4	28.4	54.0	-25.6

Notes:.. The results shown comply with the guidelines set out in DA 00-705 using a RBW of 1MHz and a 10Hz video bandwidth. All measurements were based on using a CW signal, without any modulation, having a 20dB bandwidth of 15Hz. Most frequencies were measured using a RBW of 1MHz and a VBW of 10Hz. In order to measure the Frequencies that are in the noise floor when using a RBW of 1MHz, these were re-measured using a RBW of 30Hz.

* These measurements were made using a RBW of 30Hz.

** The Peak Carrier detected was at 902.174MHz when using Antenna 0.



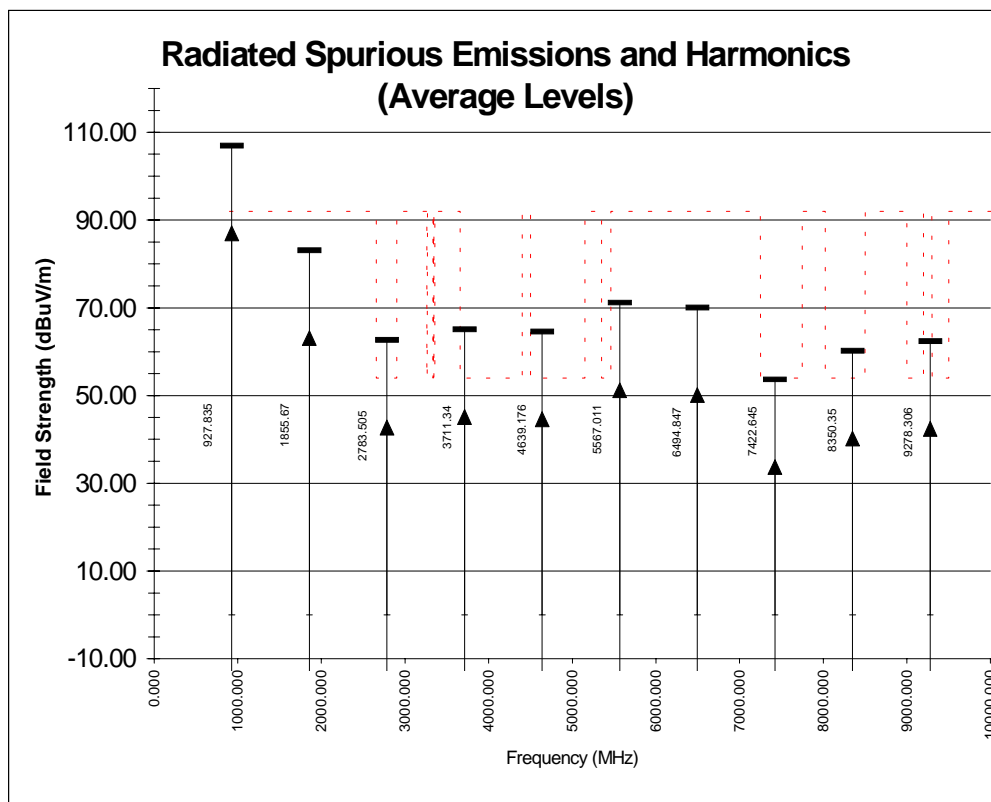
Plot 2: 15.247(b, c): Meter Type: 1S Serial Number: 5AFCB
915.0MHz, Antenna 0, Low Channel Harmonic and Spurious Emissions

Freq.	Har	Restricted bands (15.205(a))	Measured Signal	Equipment Attenuation	Corrected Peak Signal at meas. distance	Meas. Distance	Corrected Peak Signal at 3m distance	Calculated Averaged Signal (with Duty Cycle Correction) **	Limit Lines FCC 15.247	Delta Limit FCC 15.247 (Average)
(MHz)			(dBμV) (note 1)	(dB)	(dBμV)	(m)	(dBμV)	(dBμV)	(dBμV)	(dB)
915.004	fund	N/A	89.6	31.4	121.0	1.0	111.5	91.5	N/A	N/A
1830.009	2nd	N/A	55.8	38.6	94.4	1.0	84.9	64.9	92.9	-28.0
2745.014	3rd	2655-2900	25.5	45.9	71.4	1.0	61.9	41.9	54.0	-12.1
3660.018	4th	3600-4400	22.4	50.8	73.2	1.0	63.7	43.7	54.0	-10.3
4575.022	5th	4500-5150	19.9	55.0	74.9	1.0	65.4	45.4	54.0	-8.6
5490.490	6th	N/A	16.7	62.1	78.8	1.0	69.3	49.3	92.9	-43.6
6405.032	7th	N/A	7.2	68.3	75.5	1.0	66.0	46.0	92.9	-46.9
7319.997*	8th	7250-7750	21.7	38.4	60.1	1.0	50.6	30.6	54.0	-23.4
8235.021*	9th	8025-8500	23.9	39.7	60.7	1.0	51.2	31.2	54.0	-22.8
9150.017*	10th	9000-9200	19.8	40.9	63.6	1.0	54.1	34.1	54.0	-19.9

Notes: The results shown comply with the guidelines set out in DA 00-705 using a RBW of 1MHz and a 10Hz video bandwidth. All measurements were based on using a CW signal, without any modulation, having a 20dB bandwidth of 15Hz. Most frequencies were measured using a RBW of 1MHz and a VBW of 10Hz. In order to measure the Frequencies that are in the noise floor when using a RBW of 1MHz, these were re-measured using a RBW of 30Hz.

* These measurements were made using a RBW of 30Hz.

** The Peak Carrier detected was at 902.174MHz when using Antenna 0.



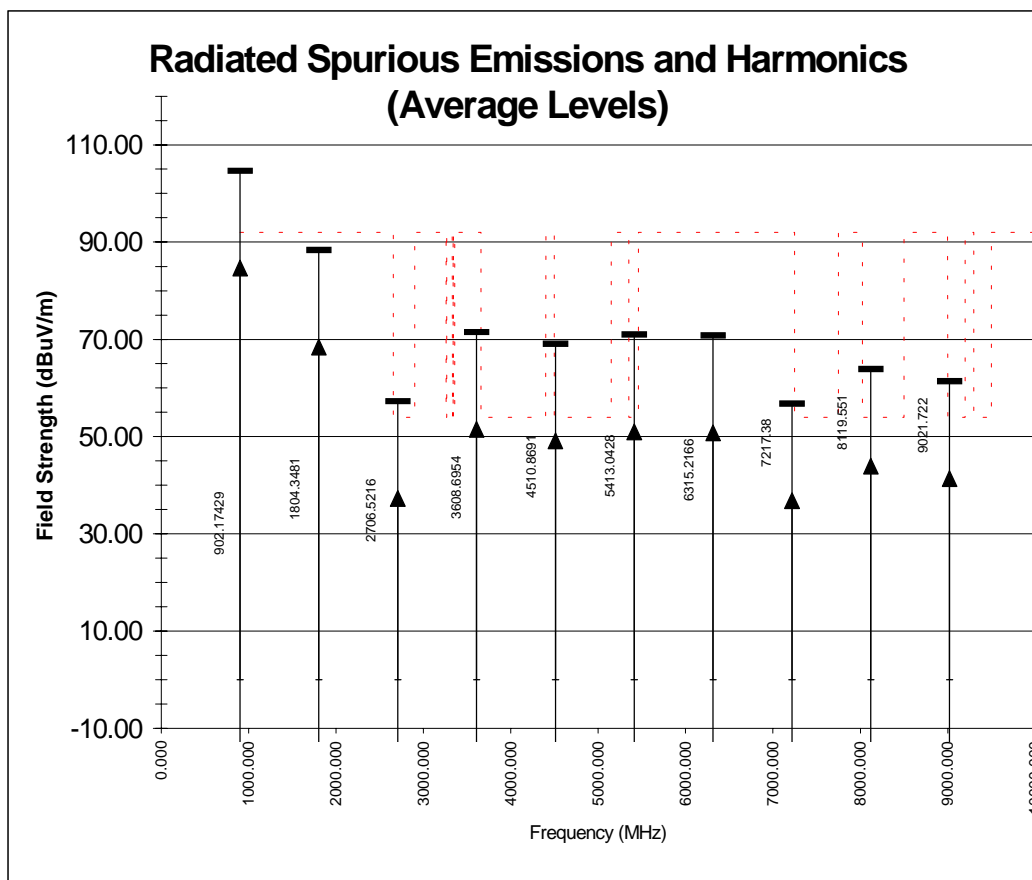
Plot 3: 15.247(b, c): Meter Type: 1S Serial Number: 5AFCB
928.0MHz, Antenna 0, Low Channel Harmonic and Spurious Emissions

Freq.	Har	Restricted bands (15.205(a))	Meas. Signal	Equipment Attenuation	Corrected Peak Signal at meas. distance	Meas. Distance	Corrected Peak Signal at 3m distance	Calculated Averaged Signal (with Duty Cycle Correction) **	Limit Lines FCC 15.247	Delta Limit FCC 15.247 (Average)
(MHz)			(dBμV) (note 1)	(dB)	(dBμV)	(m)	(dBμV)	(dBμV)	(dBμV)	(dB)
927.835	fund	N/A	85.5	31.0	116.5	1.0	107.0	87.0	N/A	N/A
1855.670	2nd	N/A	54.0	38.6	92.6	1.0	83.1	63.1	92.9	-29.8
2783.505	3rd	2655-2900	26.2	46.0	72.2	1.0	62.7	42.7	54.0	-11.3
3711.340	4th	3600-4400	23.6	51.0	74.6	1.0	65.1	45.1	54.0	-8.9
4639.176	5th	4500-5150	19.1	55.0	74.1	1.0	64.6	44.6	54.0	-9.4
5567.011	6th	N/A	17.4	63.3	80.7	1.0	71.2	51.2	92.9	-41.7
6494.847	7th	N/A	11.0	68.6	79.6	1.0	70.1	50.1	92.9	-42.8
7422.645	8th	7250-7750	24.8	38.4	63.2	1.0	53.7	33.7	54.0	-20.3
8350.350	9th	8025-8500	32.0	39.9	69.7	1.0	60.2	40.2	54.0	-13.8
9278.306	10th	9000-9200	29.4	40.3	71.9	1.0	62.4	42.4	54.0	-11.6

Notes: Most of the results shown was measured using the guidelines set out in DA 00-705. When measurement result was close to the noise floor, an unmodulated signal with a 20dB bandwidth of 15Hz was used that allowed the RBW to be reduced to 30Hz with out comprising measurement accuracy. In order to measure the Frequencies that are in the noise floor when using a RBW of 1MHz, these were re-measured using a RBW of 30Hz.

* These measurements were made using a RBW of 30Hz.

** The Peak Carrier detected was at 902.174MHz when using Antenna 0.



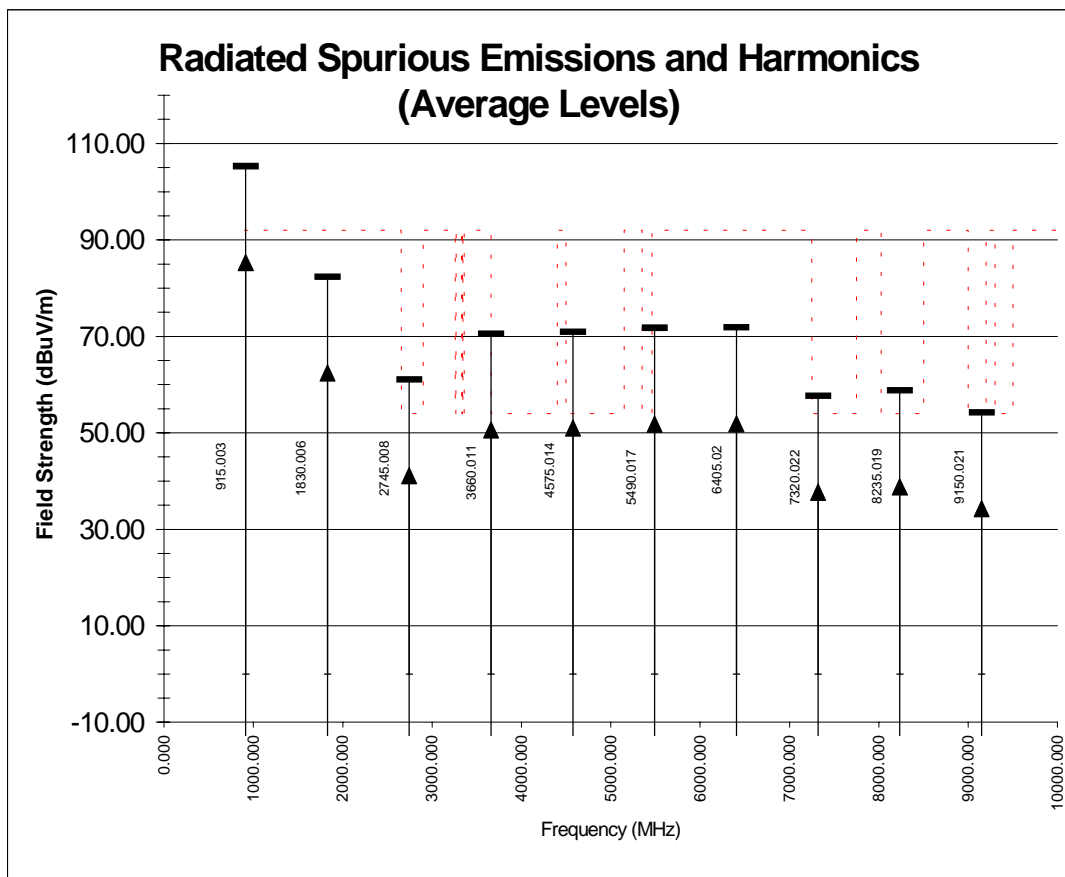
Plot 4: 15.247(b, c): Meter Type: 1S Serial Number: 5AFCB
902.0MHz, Antenna 1, Low Channel Harmonic and Spurious Emissions

Freq.	Har	Restricted bands (15.205(a))	Meas. Signal	Equipment Attenuation	Corrected Peak Signal at meas. distance	Meas. Distance	Corrected Peak Signal at 3m distance	Calculated Averaged Signal (with Duty Cycle Correction) **	Limit Lines FCC 15.247	Delta Limit FCC 15.247 (Average)
(MHz)			(dBμV) (note 1)	(dB)	(dBμV)	(m)	(dBμV)	(dBμV)	(dBμV)	(dB)
902.174	fund	N/A	83.4	30.8	114.2	1.0	104.7	84.7	N/A	N/A
1804.348	2nd	N/A	59.7	38.2	97.9	1.0	88.4	68.4	92.9	-24.5
2706.522	3rd	2655-2900	22.0	44.8	66.8	1.0	57.3	37.3	54.0	-16.7
3608.695	4th	3600-4400	30.8	50.2	81.0	1.0	71.5	51.5	54.0	-2.5
4510.869	5th	4500-5150	24.1	54.5	78.6	1.0	69.1	49.1	54.0	-4.9
5413.043	6th	5350-5460	18.9	61.6	80.5	1.0	71.0	51.0	54.0	-3.0
6315.217	7th	N/A	12.7	67.6	80.3	1.0	70.8	50.8	92.9	-42.1
7217.380	8th	N/A	28.7	37.6	66.3	1.0	56.8	36.8	92.9	-56.1
8119.551	9th	8025-8500	31.4	39.5	73.4	1.0	63.9	43.9	54.0	-10.1
9021.722	10th	9000-9200	34.2	39.2	70.9	1.0	61.4	41.4	54.0	-12.6

Notes: The results shown comply with the guidelines set out in DA 00-705 using a RBW of 1MHz and a 10Hz video bandwidth. All measurements were based on using a CW signal, without any modulation, having a 20dB bandwidth of 15Hz. Most frequencies were measured using a RBW of 1MHz and a VBW of 10Hz. In order to measure the Frequencies that are in the noise floor when using a RBW of 1MHz, these were re-measured using a RBW of 30Hz.

* These measurements were made using a RBW of 30Hz.

** The Peak Carrier detected was at 902.174MHz when using Antenna 0.



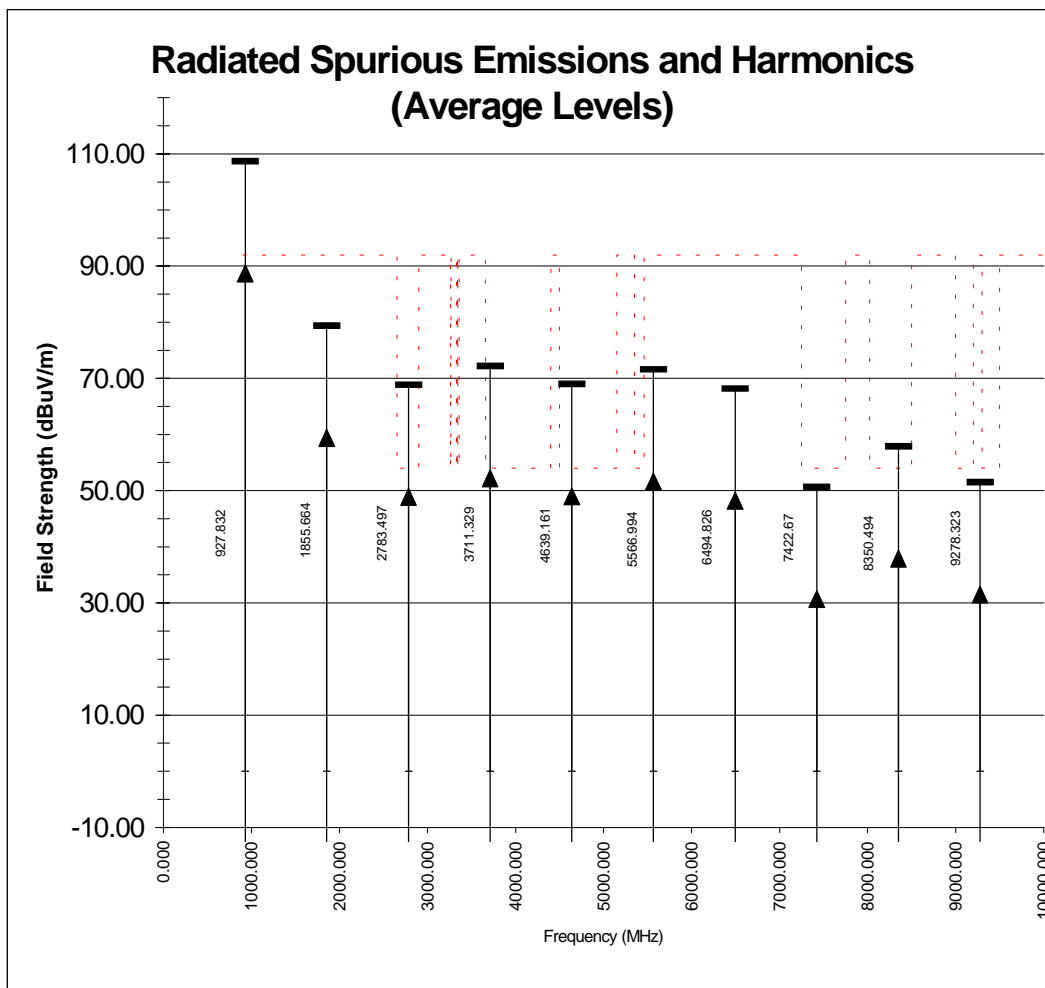
Plot 5: 15.247(b, c): Meter Type: 1S Serial Number: 5AFCB
915.0MHz, Antenna 1, Low Channel Harmonic and Spurious Emissions

Freq.	Har	Restricted bands (15.205(a))	Meas. Signal	Equipment Attenuation	Corrected Peak Signal at meas. distance	Meas. Distance	Corrected Peak Signal at 3m distance	Calculated Averaged Signal (with Duty Cycle Correction) **	Limit Lines FCC 15.247	Delta Limit FCC 15.247 (Average)
(MHz)			(dB μ V) (note 1)	(dB)	(dB μ V)	(m)	(dB μ V)	(dB μ V)	(dB μ V)	(dB)
915.003	fund	N/A	83.4	31.4	114.8	1.0	105.3	85.3	N/A	N/A
1830.006	2nd	N/A	53.3	38.6	91.9	1.0	82.4	62.4	92.9	-30.5
2745.008	3rd	2655-2900	24.7	45.9	70.6	1.0	61.1	41.1	54.0	-12.9
3660.011	4th	3600-4400	29.3	50.8	80.1	1.0	70.6	50.6	54.0	-3.4
4575.014	5th	4500-5150	25.5	55.0	80.5	1.0	71.0	51.0	54.0	-3.0
5490.017	6th	N/A	19.2	62.1	81.3	1.0	71.8	51.8	92.9	-41.1
6405.020	7th	N/A	13.1	68.3	81.4	1.0	71.9	51.9	92.9	-41.0
7320.022	8th	7250-7750	28.8	38.4	67.2	1.0	57.7	37.7	54.0	-16.3
8235.019	9th	8025-8500	24.1	39.7	68.3	1.0	58.8	38.8	54.0	-15.2
9150.021	10th	9000-9200	27.4	40.9	63.8	1.0	54.3	34.3	54.0	-19.7

Notes: The results shown comply with the guidelines set out in DA 00-705 using a RBW of 1MHz and a 10Hz video bandwidth. All measurements were based on using a CW signal, without any modulation, having a 20dB bandwidth of 15Hz. Most frequencies were measured using a RBW of 1MHz and a VBW of 10Hz. In order to measure the Frequencies that are in the noise floor when using a RBW of 1MHz, these were re-measured using a RBW of 30Hz.

* These measurements were made using a RBW of 30Hz.

** The Peak Carrier detected was at 902.174MHz when using Antenna 0.

**Plot 6:** 15.247(b, c): Meter Type: 1S Serial Number: 5AFCB**928.0MHz, Antenna 1, Low Channel Harmonic and Spurious Emissions**

Freq.	Har	Restricted bands (15.205(a))	Meas. Signal	Equipment Attenuation	Corrected Peak Signal at meas. distance	Meas. Distance	Corrected Peak Signal at 3m distance	Calculated Averaged Signal (with Duty Cycle Correction) **	Limit Lines FCC 15.247	Delta Limit FCC 15.247 (Average)
(MHz)			(dBμV) (note 1)	(dB)	(dBμV)	(m)	(dBμV)	(dBμV)	(dBμV)	(dB)
927.832	fund	N/A	87.2	31.0	118.2	1.0	108.7	88.7	N/A	N/A
1855.664	2nd	N/A	50.3	38.6	88.9	1.0	79.4	59.4	92.9	-33.5
2783.497	3rd	2655-2900	32.4	46.0	78.4	1.0	68.9	48.9	54.0	-5.1
3711.329	4th	3600-4400	30.7	51.0	81.7	1.0	72.2	52.2	54.0	-1.8
4639.161	5th	4500-5150	23.5	55.0	78.5	1.0	69.0	49.0	54.0	-5.0
5566.994	6th	N/A	17.8	63.3	81.1	1.0	71.6	51.6	92.9	-41.3
6494.826	7th	N/A	9.1	68.6	77.7	1.0	68.2	48.2	92.9	-44.7
7422.670	8th	7250-7750	21.8	38.4	60.2	1.0	50.7	30.7	54.0	-23.3
8350.494	9th	8025-8500	21.1	39.9	67.4	1.0	57.9	37.9	54.0	-16.1
9278.323	10th	9000-9200	27.1	40.3	61.0	1.0	51.5	31.5	54.0	-22.5

Notes: The results shown comply with the guidelines set out in DA 00-705 using a RBW of 1MHz and a 10Hz video bandwidth. All measurements were based on using a CW signal, without any modulation, having a 20dB bandwidth of 15Hz. Most frequencies were measured using a RBW of 1MHz and a VBW of 10Hz. In order to measure the Frequencies that are in the noise floor when using a RBW of 1MHz, these were re-measured using a RBW of 30Hz.

* These measurements were made using a RBW of 30Hz.

** The Peak Carrier detected was at 902.174MHz when using Antenna 0.

Spurious Emission measurements on related models:

Freq.	Restricted bands (15.205(a))	Measured Signal	Equipment Attenuation	Corrected Peak Signal at measured distance	Meas. Distance	Corrected Peak Signal at 3m distance	Calculated Averaged Signal (with Duty Cycle Correction) (note 2)	Limit Lines FCC 15.247	Delta Limit FCC 15.247 (Average)
(MHz)		(dBμV) (note 1)	(dB)	(dBμV)	(m)	(dBμV)	(dBμV)	(dBμV)	(dB)
902									
3608.696	3600-4400	28.0	50.2	78.2	1.0	68.7	48.7	54.0	-5.3
4510.869	4500-5150	21.8	54.4	76.2	1.0	66.7	46.7	54.0	-7.3
5413.043	5350-5460	13.5	61.6	75.1	1.0	65.6	45.6	54.0	-8.4
6315.217	N/A	6.0	67.6	73.6	1.0	64.1	44.1	92.9	-48.8
915									
3660.035	3600-4400	29.2	50.8	80.0	1.0	70.5	50.5	54.0	-3.5
4575.041	4500-5150	23.2	55.0	78.2	1.0	68.7	48.7	54.0	-5.3
5490.048	N/A	16.7	62.1	78.8	1.0	69.3	49.3	92.9	-43.6
6405.055	N/A	12.6	68.3	80.9	1.0	71.4	51.4	92.9	-41.5
928									
3711.330	3600-4400	23.1	51.0	74.1	1.0	64.6	44.6	54.0	-9.4
4639.162	4500-5150	21.8	55.0	76.8	1.0	67.3	47.3	54.0	-6.7
5566.995	N/A	10.2	63.3	73.5	1.0	64.0	44.0	92.9	-48.9
6494.827	N/A	9.1	68.6	77.7	1.0	68.2	48.2	92.9	-44.7

15.247(b, c): Meter Type: Form 1S Serial Number: 5AE4C

Antenna 1, Low, Middle and High Channel Harmonic and Spurious Emissions, critical frequencies

Notes:

- 1) The results shown comply with the guidelines set out in DA 00-705 using a RBW of 1MHz and 10Hz video bandwidth. All measurements were based on using a CW signal, without any modulation, having a 20dB bandwidth of 15Hz. Most frequencies were measured using a RBW of 1MHz and a VBW of 10Hz. In order to measure the Frequencies that are in the noise floor when using a RBW of 1MHz, these were re-measured using a RBW of 30Hz.
- 2) The Peak Carrier detected was at 902.174MHz when using Antenna 0.

Freq.	Restricted bands (15.205(a))	Measured Signal	Equipment Attenuation	Corrected Peak Signal at measured distance	Meas. Distance	Corrected Peak Signal at 3m distance	Calculated Averaged Signal (with Duty Cycle Correction) (note 2)	Limit Lines FCC 15.247	Delta Limit FCC 15.247 (Average)
(MHz)		(dBμV) (note 1)	(dB)	(dBμV)	(m)	(dBμV)	(dBμV)	(dBμV)	(dB)
902									
3608.671	3600-4400	27.8	50.2	78.0	1.0	68.5	48.5	54.0	-5.5
4510.838	4500-5150	22.5	54.5	77.0	1.0	67.5	47.5	54.0	-6.5
5413.007	5350-5460	14.6	61.6	76.2	1.0	66.7	46.7	54.0	-7.3
6315.174	N/A	8.8	67.6	76.4	1.0	66.9	46.9	92.9	-46.0
915									
3659.986	3600-4400	29.8	50.8	80.6	1.0	71.1	51.1	54.0	-2.9
4574.983	4500-5150	23.9	55.0	78.9	1.0	69.4	49.4	54.0	-4.6
5489.980	N/A	14.4	62.1	76.5	1.0	67.0	47.0	92.9	-45.9
6404.977	N/A	10.4	68.3	78.7	1.0	69.2	49.2	92.9	-43.7
928									
3711.305	3600-4400	29.5	51.0	80.5	1.0	71.0	51.0	54.0	-3.0
4639.131	4500-5150	27.0	55.0	82.0	1.0	73.0	53.0	54.0	-1.0
5566.958	N/A	17.1	63.3	80.4	1.0	70.9	50.9	92.9	-42.0
6494.785	N/A	12.5	68.6	80.6	1.0	71.1	51.1	92.9	-41.8

15.247(b, c): Meter Type: Form 2S Class 320 Serial Number: 5D3C6

Antenna 1, Low, Middle and High Channel Harmonic and Spurious Emissions, critical frequencies

Notes:

- 1) The results shown comply with the guidelines set out in DA 00-705 using a RBW of 1MHz and a 10Hz video bandwidth. All measurements were based on using a CW signal, without any modulation, having a 20dB bandwidth of 15Hz. Most frequencies were measured using a RBW of 1MHz and a VBW of 10Hz. In order to measure the Frequencies that are in the noise floor when using a RBW of 1MHz, these were re-measured using a RBW of 30Hz.
- 2) The Peak Carrier detected was at 902.174MHz when using Antenna 0.

Spurious Emission measurements on related models:

Freq.	Restricted bands (15.205(a))	Measured Signal	Equipment Attenuation	Corrected Peak Signal at measured distance	Meas. Distance	Corrected Peak Signal at 3m distance	Calculated Averaged Signal (with Duty Cycle Correction) (note 2)	Limit Lines FCC 15.247	Delta Limit FCC 15.247 (Average)
(MHz)		(dBμV) (note 1)	(dB)	(dBμV)	(m)	(dBμV)	(dBμV)	(dBμV)	(dB)
902									
3608.658	3600-4400	29.2	50.2	79.4	1.0	69.9	49.9	54.0	-4.1
4510.823	4500-5150	27.4	54.5	81.9	1.0	72.4	52.4	54.0	-1.6
5412.988	5350-5460	18.4	61.6	80.0	1.0	70.5	50.5	54.0	-3.5
6315.154	N/A	13.0	67.6	80.6	1.0	71.1	51.1	92.9	-41.8
915									
3659.975	3600-4400	30.2	50.8	81.0	1.0	71.5	51.5	54.0	-2.5
4574.969	4500-5150	27.7	55.0	82.7	1.0	73.2	53.2	54.0	-0.8
5489.963	N/A	20.9	62.1	83.0	1.0	73.5	53.5	92.9	-39.4
6404.957	N/A	12.3	68.3	80.6	1.0	71.1	51.1	92.9	-41.8
928									
3711.292	3600-4400	29.8	51.0	80.8	1.0	71.3	51.3	54.0	-2.7
4639.112	4500-5150	21.9	55.0	76.9	1.0	67.4	47.4	54.0	-6.6
5566.934	N/A	16.1	63.3	79.4	1.0	69.9	49.9	92.9	-43.0
6494.756	N/A	13.2	68.6	81.8	1.0	72.3	52.3	92.9	-40.6

15.247(b, c): Meter Type: Form 2S Class 200 Serial Number: 5ADDD

Antenna 1, Low, Middle and High Channel Harmonic and Spurious Emissions, critical frequencies

Notes:

- 1) The results shown comply with the guidelines set out in DA 00-705 using a RBW of 1MHz and a 10Hz video bandwidth. All measurements were based on using a CW signal, without any modulation, having a 20dB bandwidth of 15Hz. Most frequencies were measured using a RBW of 1MHz and a VBW of 10Hz. In order to measure the Frequencies that are in the noise floor when using a RBW of 1MHz, these were re-measured using a RBW of 30Hz.
- 2) The Peak Carrier detected was at 902.174MHz when using Antenna 0.

Freq.	Restricted bands (15.205(a))	Measured Signal	Equipment Attenuation	Corrected Peak Signal at measured distance	Meas. Distance	Corrected Peak Signal at 3m distance	Calculated Averaged Signal (with Duty Cycle Correction) (note 2)	Limit Lines FCC 15.247	Delta Limit FCC 15.247 (Average)
(MHz)		(dBμV) (note 1)	(dB)	(dBμV)	(m)	(dBμV)	(dBμV)	(dBμV)	(dB)
902									
3608	3600-4400	10.2	50.2	60.4	1.0	50.9	30.9	54.0	-23.1
4510	4500-5150	8.6	54.5	63.1	1.0	53.6	33.6	54.0	-20.4
5412	5350-5460	9.0	61.6	70.6	1.0	61.1	41.1	54.0	-12.9
6315	N/A	8.6	67.6	76.2	1.0	66.7	46.7	92.9	-46.2
915									
3659	3600-4400	15.5	50.8	66.3	1.0	56.8	36.8	54.0	-17.2
4574	4500-5150	9.2	55.0	64.2	1.0	54.7	34.7	54.0	-19.3
5489	N/A	9.4	62.1	71.5	1.0	62.0	42.6	92.9	-50.3
6404	N/A	10.5	68.3	78.8	1.0	69.3	49.3	92.9	-43.6
928									
3711	3600-4400	14.8	51.0	65.8	1.0	56.3	36.3	54.0	-17.7
4639	4500-5150	10.4	55.0	65.4	1.0	55.9	35.9	54.0	-18.1
5566	N/A	8.3	63.3	71.6	1.0	62.1	42.1	92.9	-50.8
6494	N/A	8.6	68.6	77.2	1.0	67.7	47.7	92.9	-45.2

15.247(b, c): Meter Type: Form 4S 240Vac Serial Number: 5D3C8

Antenna 1, Low, Middle and High Channel Harmonic and Spurious Emissions, critical frequencies

Notes:

- 1) The results shown comply with the guidelines set out in DA 00-705 using a RBW of 1MHz and a 10Hz video bandwidth. All measurements were based on using a CW signal, without any modulation, having a 20dB bandwidth of 15Hz. Most frequencies were measured using a RBW of 1MHz and a VBW of 10Hz. In order to measure the Frequencies that are in the noise floor when using a RBW of 1MHz, these were re-measured using a RBW of 30Hz.
- 2) The Peak Carrier detected was at 902.174MHz when using Antenna 0.

Spurious Emission measurements on related models:

Freq.	Restricted bands (15.205(a))	Measured Signal	Equipment Attenuation	Corrected Peak Signal at measured distance	Meas. Distance	Corrected Peak Signal at 3m distance	Calculated Averaged Signal (with Duty Cycle Correction) (note 2)	Limit Lines FCC 15.247	Delta Limit FCC 15.247 (Average)
(MHz)		(dBμV) (note 1)	(dB)	(dBμV)	(m)	(dBμV)	(dBμV)	(dBμV)	(dB)
902									
3608	3600-4400	14.5	50.2	64.7	1.0	55.2	35.2	54.0	-18.8
4510	4500-5150	8.1	54.5	62.6	1.0	53.4	33.4	54.0	-20.6
5412	5350-5460	8.7	61.6	70.3	1.0	60.8	40.8	54.0	-13.2
6315	N/A	10.9	67.6	78.5	1.0	69.0	49.0	92.9	-43.9
915									
3659	3600-4400	15.9	50.8	66.7	1.0	57.2	37.2	54.0	-16.8
4574	4500-5150	9.5	55.0	64.5	1.0	55.0	35.0	54.0	-19.0
5489	N/A	9.4	62.1	71.5	1.0	62.0	42.0	92.9	-50.9
6404	N/A	9.7	68.3	78.0	1.0	68.5	48.5	92.9	-44.4
928									
3711	3600-4400	14.9	51.0	65.9	1.0	56.4	36.4	54.0	-17.6
4639	4500-5150	10.9	55.0	65.9	1.0	56.4	36.4	54.0	-17.6
5566	N/A	9.4	63.3	72.7	1.0	63.2	43.2	92.9	-49.7
6494	N/A	9.1	68.6	77.7	1.0	68.2	48.2	92.9	-44.7

15.247(b, c): Meter Type: Form 3S 240Vac Serial Number: 5AFBB

Antenna 1, Low, Middle and High Channel Harmonic and Spurious Emissions, critical frequencies

Notes:

- 1) The results shown comply with the guidelines set out in DA 00-705 using a RBW of 1MHz and a 10Hz video bandwidth. All measurements were based on using a CW signal, without any modulation, having a 20dB bandwidth of 15Hz. Most frequencies were measured using a RBW of 1MHz and a VBW of 10Hz. In order to measure the Frequencies that are in the noise floor when using a RBW of 1MHz, these were re-measured using a RBW of 30Hz.
- 2) The Peak Carrier detected was at 902.174MHz when using Antenna 0

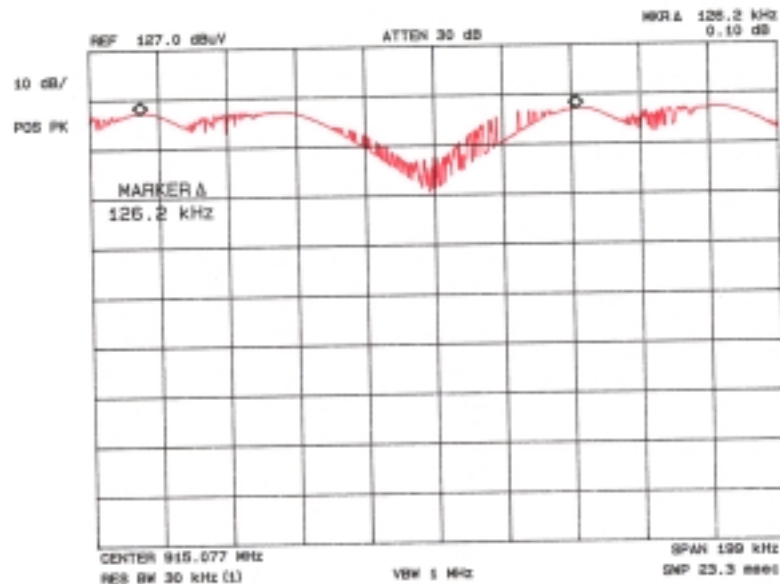
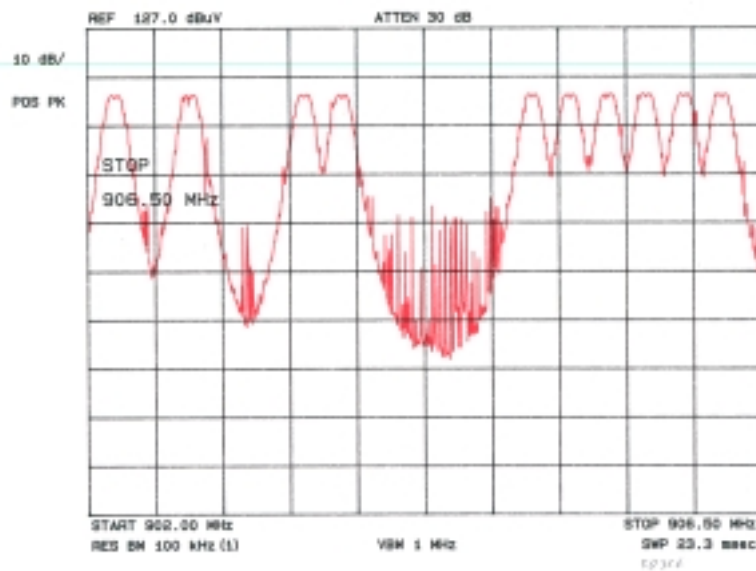
Freq.	Restricted bands (15.205(a))	Measured Signal	Equipment Attenuation	Corrected Peak Signal at measured distance	Meas. Distance	Corrected Peak Signal at 3m distance	Calculated Averaged Signal (with Duty Cycle Correction) (note 2)	Limit Lines FCC 15.247	Delta Limit FCC 15.247 (Average)
(MHz)		(dBμV) (note 1)	(dB)	(dBμV)	(m)	(dBμV)	(dBμV)	(dBμV)	(dB)
902									
3608	3600-4400	22.3	50.2	72.5	1.0	63.0	43.0	54.0	-11.0
4510	4500-5150	16.8	54.5	71.3	1.0	61.8	41.8	54.0	-12.2
5413	5350-5460	8.9	61.6	70.5	1.0	61.0	41.0	54.0	-13.0
6315	N/A	8.0	67.6	75.6	1.0	66.1	46.1	92.9	-46.8
915									
3660	3600-4400	23.7	50.8	74.5	1.0	65.0	45.0	54.0	-9.0
4575	4500-5150	11.7	55.0	66.7	1.0	57.2	37.2	54.0	-16.8
5490	N/A	8.6	62.1	70.7	1.0	61.2	41.2	92.9	-51.7
6405	N/A	8.4	68.3	76.7	1.0	67.2	47.2	92.9	-45.7
928									
3711	3600-4400	17.2	51.0	68.2	1.0	58.7	38.7	54.0	-15.3
4639	4500-5150	13.8	55.0	68.8	1.0	59.3	39.3	54.0	-14.7
5566	N/A	8.5	63.3	71.8	1.0	62.3	42.3	92.9	-50.6
6494	N/A	8.3	68.6	76.9	1.0	67.4	47.4	92.9	-45.5

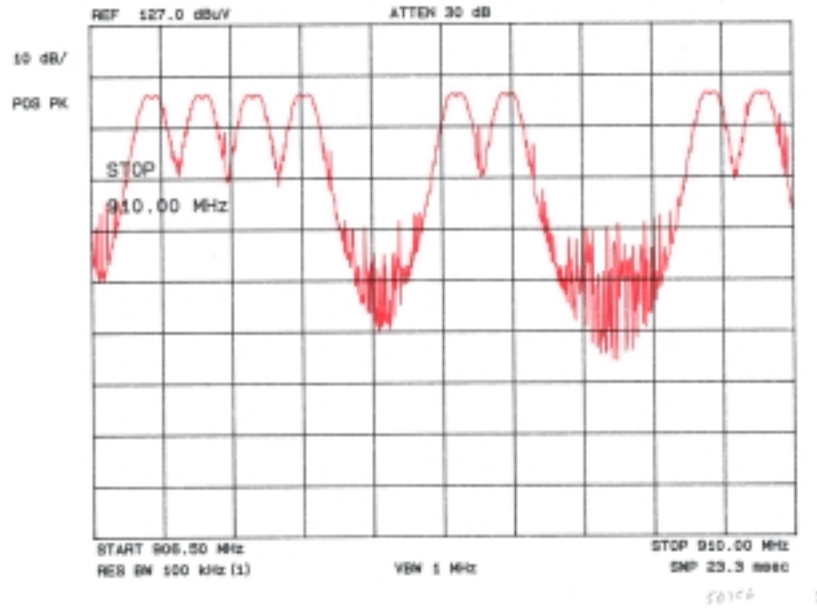
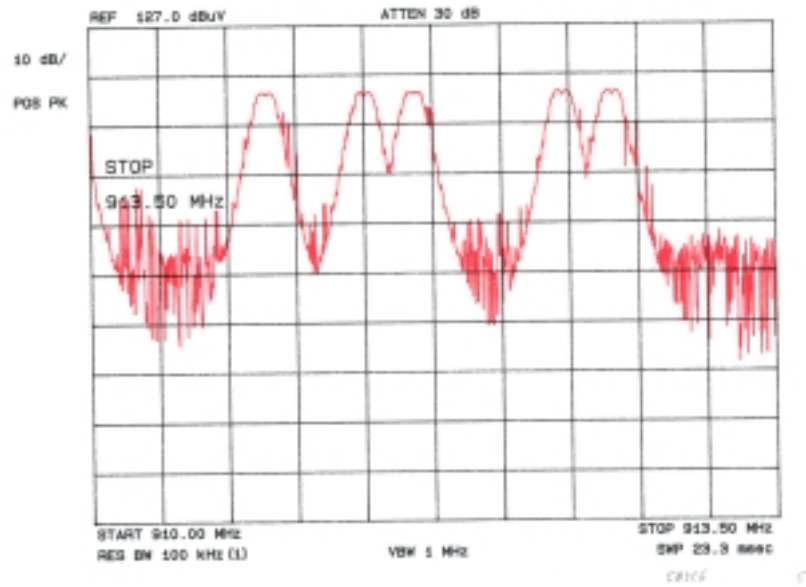
15.247(b, c): Meter Type: Form 3S 120Vac Serial Number: 5BB3A

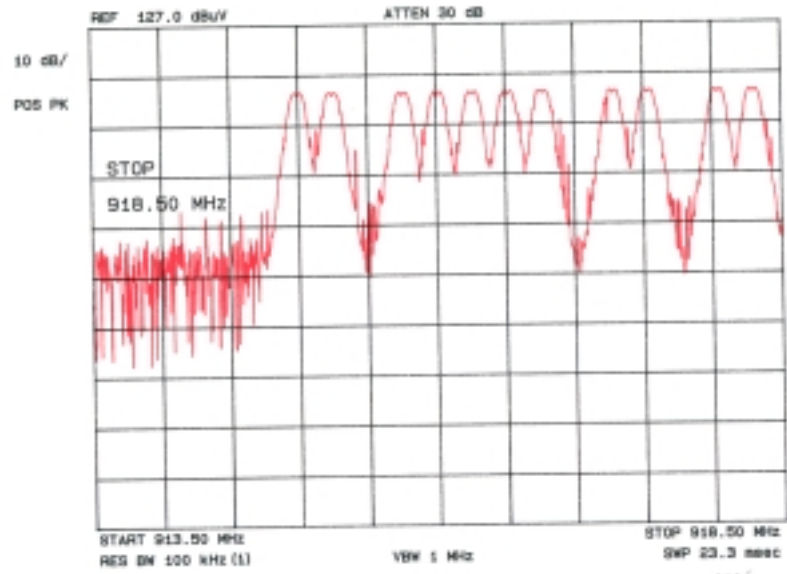
Antenna 1, Low, Middle and High Channel Harmonic and Spurious Emissions, critical frequencies

Notes:

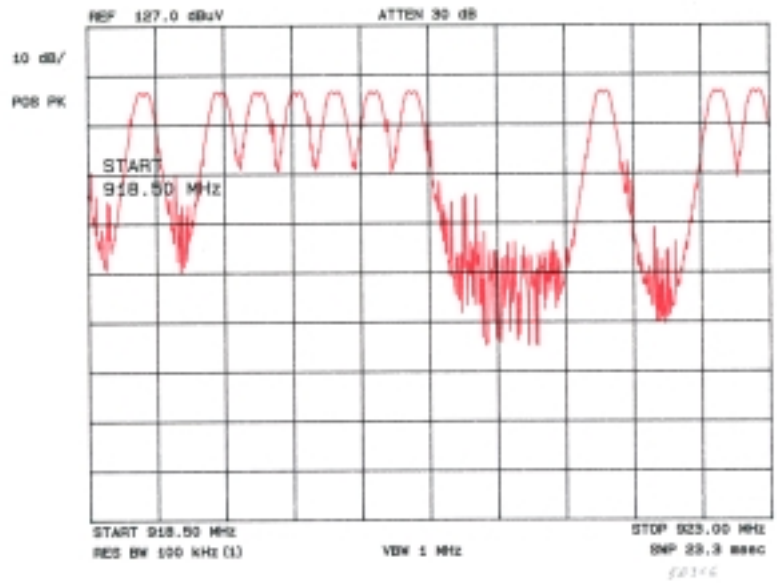
- 1) The results shown comply with the guidelines set out in DA 00-705 using a RBW of 1MHz and a 10Hz video bandwidth. All measurements were based on using a CW signal, without any modulation, having a 20dB bandwidth of 15Hz. Most frequencies were measured using a RBW of 1MHz and a VBW of 10Hz. In order to measure the Frequencies that are in the noise floor when using a RBW of 1MHz, these were re-measured using a RBW of 30Hz.
- 2) The Peak Carrier detected was at 902.174MHz when using Antenna 0.

15.247(a)(1) –Channel Spacing**Plot 1: Channel Separation Antenna 0****15.247(a)(1)(i) – Number of Hopping Channels****Plot 2A: Number of Hopping Channels 902-906 MHz Antenna 0**

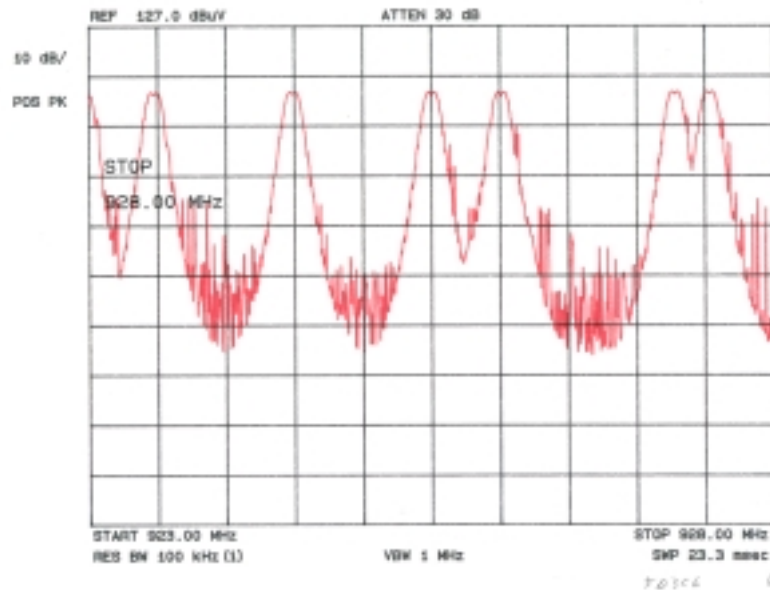
**Plot 2B:** Number of Hopping Channels 906 – 910 MHz Antenna 0**Plot 2C:** Number of Hopping Channels 910 – 913 MHz Antenna 0



Plot 2D: Number of Hopping Channels 913 – 918 MHz Antenna 0

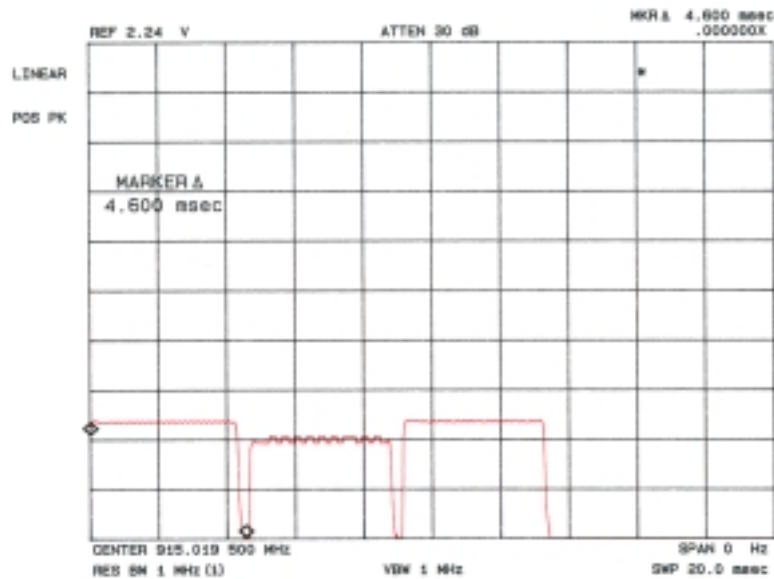


Plot 2E: Number of H.C. 918 – 923 MHz Antenna 0

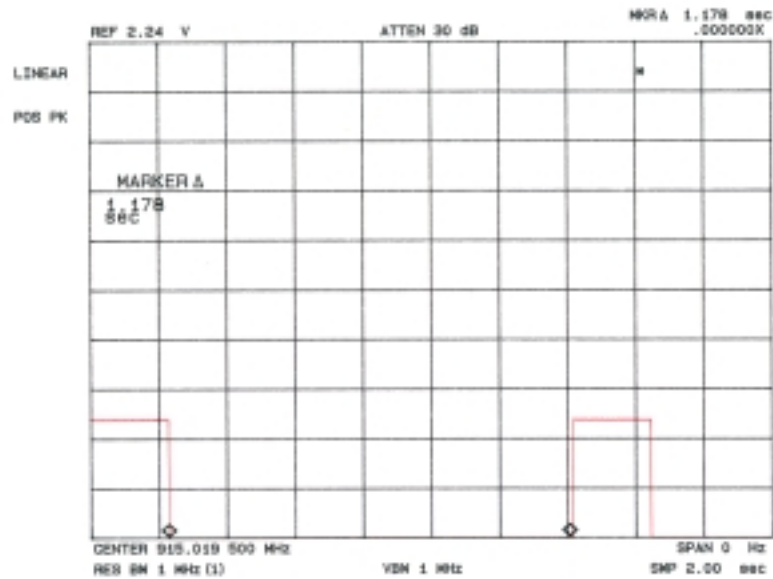


Plot 2F: Number of H.C. 923 – 928 MHz Antenna 0

15.247(a)(1)(i) – Time of Occupancy and Dwell Time

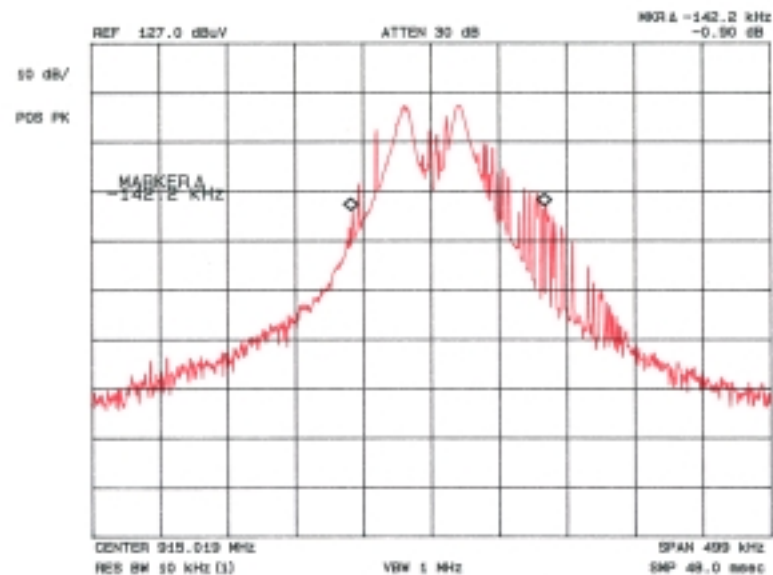


Plot 3: Dwell Time – Pulse Duration Antenna 0]

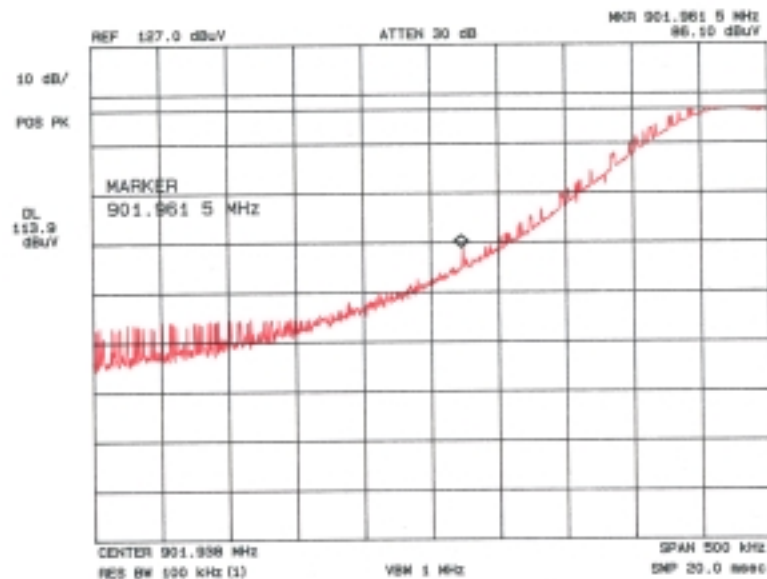
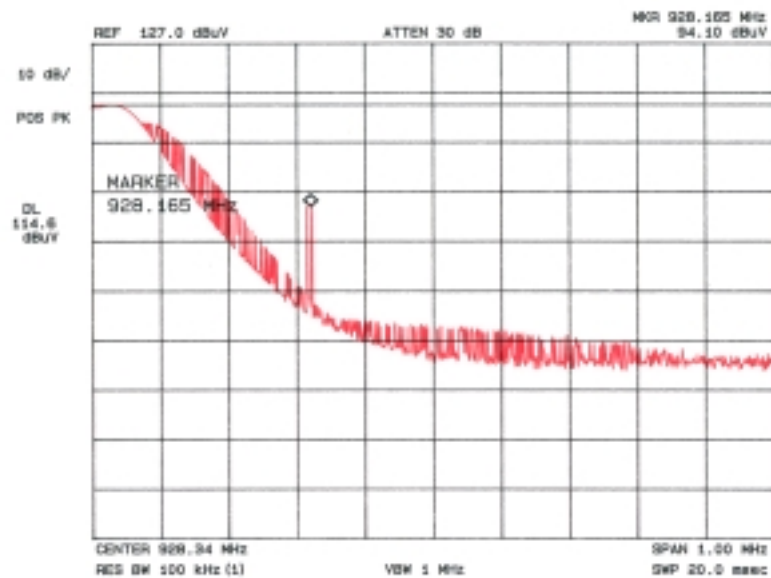


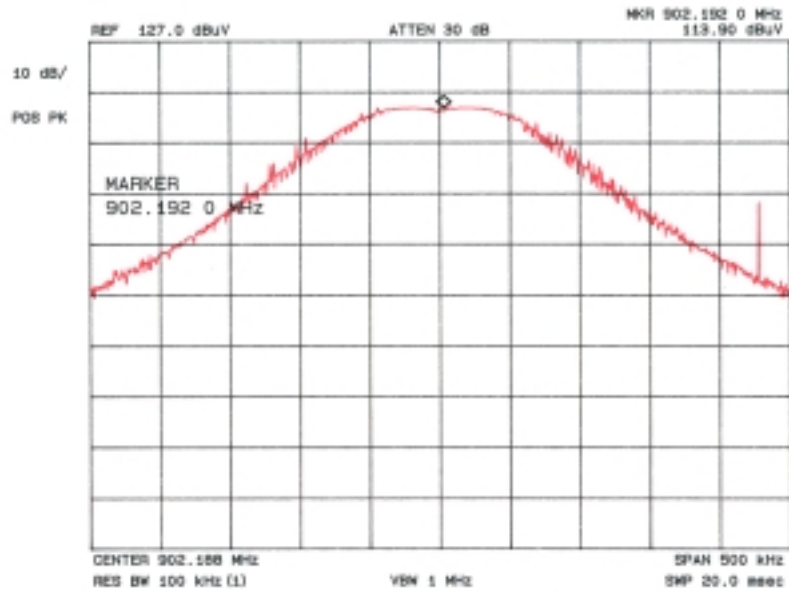
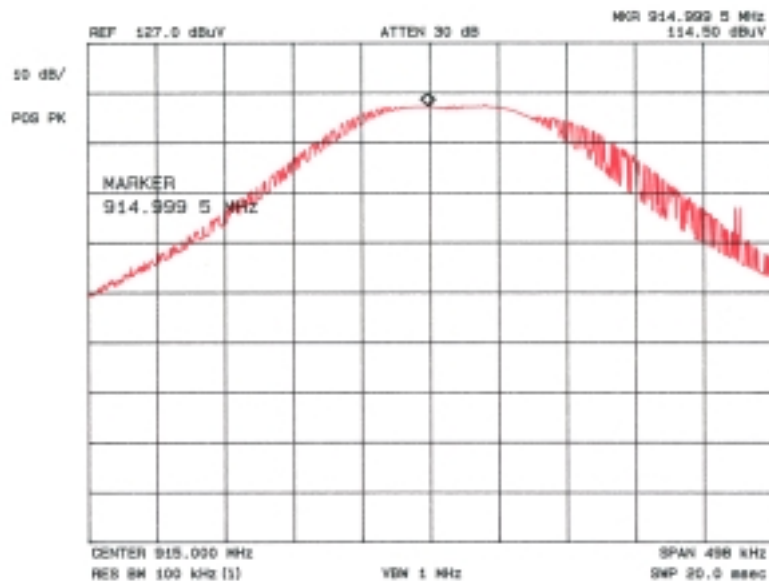
Plot 4: Dwell Time – Silent Period Antenna 0

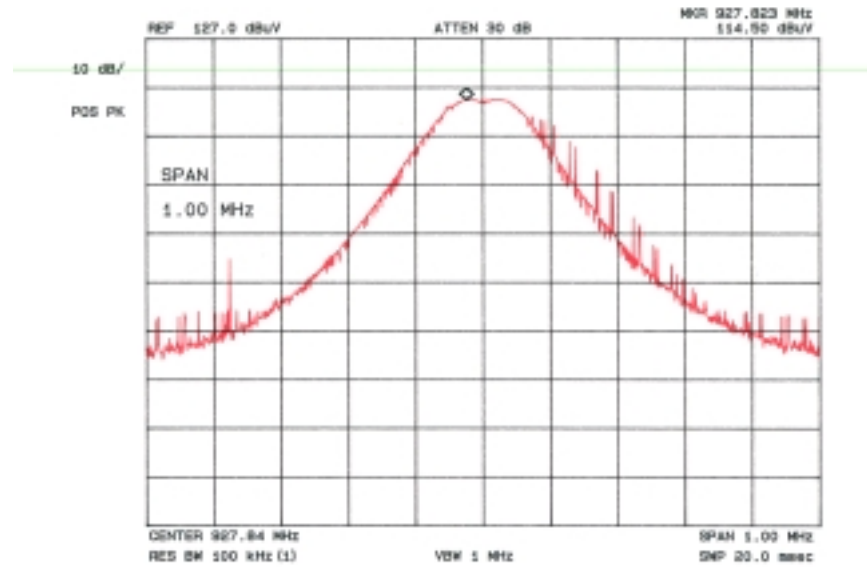
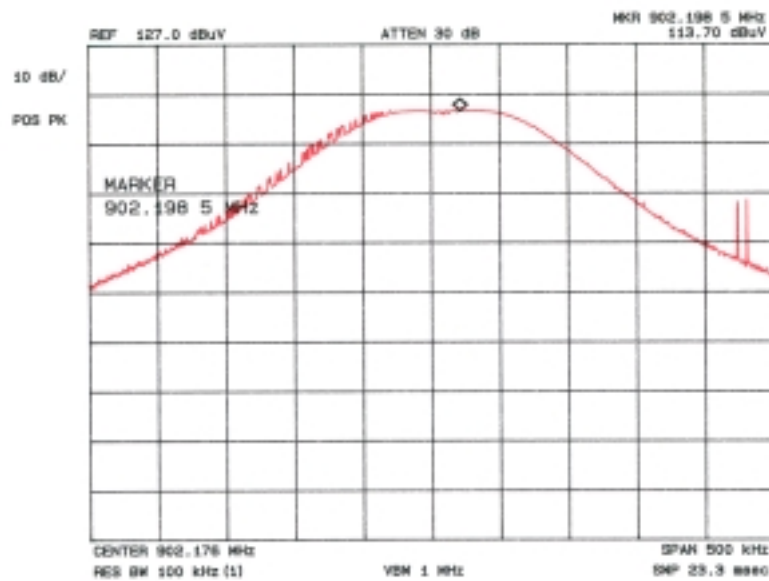
15.247(a)(2) – 20dB Bandwidth

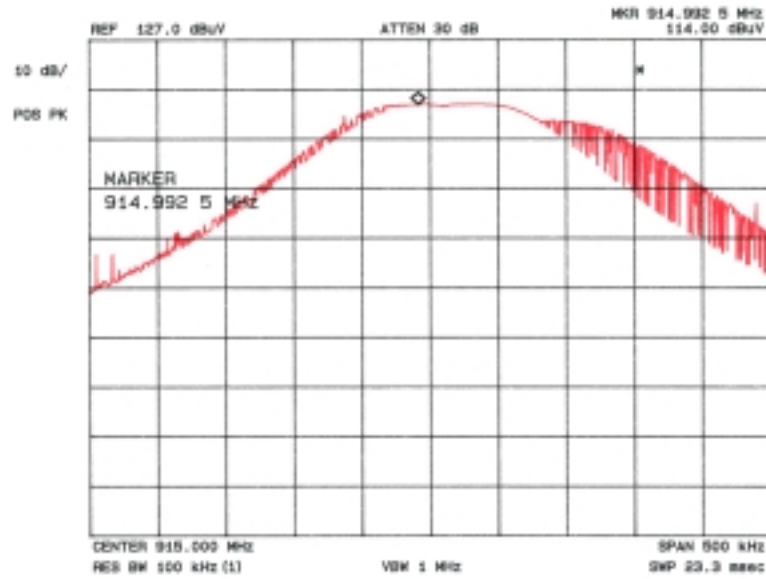
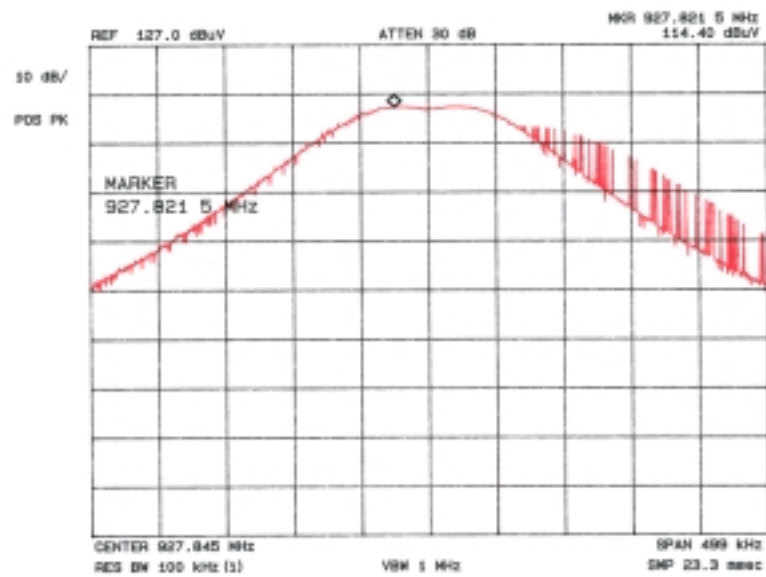


Plot 5: 20dB Bandwidth Antenna 0

15.247(c) – Band-edge compliance test**Plot 6: Low Channel Bandedge Antenna 0****Plot 7: High Channel Bandedge Antenna 0**

15.247(c) – Power Level**Plot 8: Low Channel Peak Power Level Antenna 0****Plot 9: Mid Channel Peak Power Level Antenna 0**

**Plot 10: High Channel Peak Power Level Antenna 0****Plot 11: Low Channel Peak Power Antenna 1**

**Plot 12: Middle Channel Peak Power Antenna 1****Plot 13: High Channel Peak Power Antenna 1**

Appendix B: EUT Photos



Emissions Test Setup for Conducted Emission



Emissions Test Setup for Radiated Emissions with Battery Cable



Emissions Test Setup Side View Showing Antennas O on Bottom



Emissions Test Setup Side View Showing Antenna 1 on Top



Emissions Test Setup Radiated Showing Battery

Appendix C: Measurement Data and Plots

Conducted Emissions - Tantalus Systems Corporation –TC1116 & TC-1216

Standard: FCC part 15/C 15.207; CISPR22 Class B - AC Power Conducted Emissions: Since Transmit mode only operates for 0.25 sec. every 6 to 10 sec. A Prescan with Max holds for 1 min. in each region and found nothing of concern. The plot is based on a 5. sec/MHz sweep rate and 3 sweeps

TC-1116 Form 1S SN: 5AFCB

Table 1: Line 1 Receive Mode Peaks 120V, 60Hz

Frequency (MHz)	Limit (dBμV)	DelLim-Pk (dB)
9.977	40.1	-9.9
12.66	37.2	-12.8
4.188	31.1	-14.9
16.76	34.7	-15.3
11.76	34.4	-15.6
8.378	33.7	-16.3

Table 3: Line 1 Transmit Mode Peaks 120V,60Hz

Frequency (MHz)	Limit (dBμV)	DelLim-Pk (dB)
12.73	36.8	-13.2
4.21	31.8	-14.2
9.513	34.6	-15.4
16.76	34.6	-15.4
11.88	34.1	-15.9
8.378	33.6	-16.4

Table 2: Line 2 Receive Mode Peaks 120V,60Hz

Frequency (MHz)	Limit (dBμV)	DelLim-Pk (dB)
12.73	37.1	-11.9
4.188	31.3	-14.7
16.76	35.0	-15.0
13.63	34.0	-16.0
13.78	33.8	-16.2
8.378	33.5	-16.5

Table 4: Line 2 Transmit Mode Peaks 120V,60Hz

Frequency (MHz)	Limit (dBμV)	DelLim-Pk (dB)
9.563	45.6	-4.4
12.66	37.7	-12.3
11.88	37.2	-12.8
5.753	36.3	-13.7
4.188	32.2	-13.8
16.76	35.1	-14.9

TC-1216 Form 2S SN: 5D3C6

Table 5: Line 1 Receive Mode Peaks 208V, 60Hz

Frequency (MHz)	Limit (dBμV)	DelLim-Pk (dB)
9.513	39.3	-10.7
5.753	39.0	-11.0
12.66	36.1	-13.9
0.5604	30.0	-16.0
11.76	33.8	-16.2
0.6533	28.8	-17.2

Table 7: Line 1 Transmit Mode Peaks 208V, 60Hz

Frequency (MHz)	Limit (dBμV)	DelLim-Pk (dB)
9.563	47.8	-2.2
5.753	36.7	-13.3
9.819	35.2	-14.8
0.5574	30.7	-15.3
0.4681	30.1	-16.4
0.6499	29.3	-16.7

Table 6: Line 2 Receive Mode Peaks 208V, 60Hz

Frequency (MHz)	Limit (dBμV)	DelLim-Pk (dB)
12.66	36.8	-13.2
0.5574	30.0	-10.0
9.513	33.3	-10.7
0.4681	29.4	-17.1
7.496	32.7	-17.3
0.6499	28.7	-17.3

Table 8: Line 2 Transmit Mode Peaks 208V, 60Hz

Frequency (MHz)	Limit (dBμV)	DelLim-Pk (dB)
9.513	40.8	-9.2
5.876	36.0	-14.0
9.716	35.6	-14.4
0.5604	30.8	-15.2
0.4681	30.3	-16.2
0.6499	29.8	-16.2

Radiated Emissions – 120Vac, 60Hz

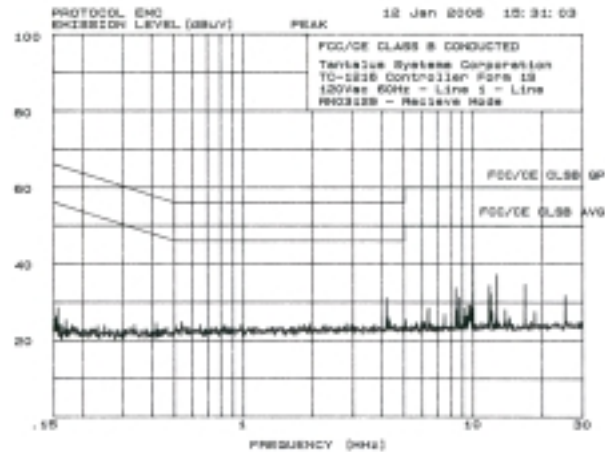
Table 9: FCC Class B Emissions while in idle/receive mode– 3-m

Frequency (MHz)	Pol	Hgt (m)	Ang (deg)	Uncor-Pk (dBμV)	Tot Corr (dB)	Peak (dBμV/m)	QP Lmt (dBμV/m)	DelLim-Pk (dB)	QP (dBμV/m)	DelLim-QP (dB)
39.00000	Vert	0.0	180.0	27.60	13.38	40.98	40.00	0.98	23.81	-16.19
48.74600	Vert	0.0	90.0	19.40	11.61	31.01	40.00	-8.99	26.85	-13.15
58.49800	Vert	0.0	180.0	20.60	10.79	31.39	40.00	-8.61	22.03	-17.97
117.00000	Vert	0.0	180.0	9.40	13.27	22.67	43.50	-20.83	16.48	-27.02
126.74800	Horz	3.0	200.0	13.10	13.64	26.74	43.50	-16.76	24.40	-19.10
136.50000	Horz	2.0	90.0	20.60	14.04	34.64	43.50	-8.86	23.30	-20.20
165.74800	Horz	2.0	170.0	14.90	15.09	29.99	43.50	-13.51	28.27	-15.23

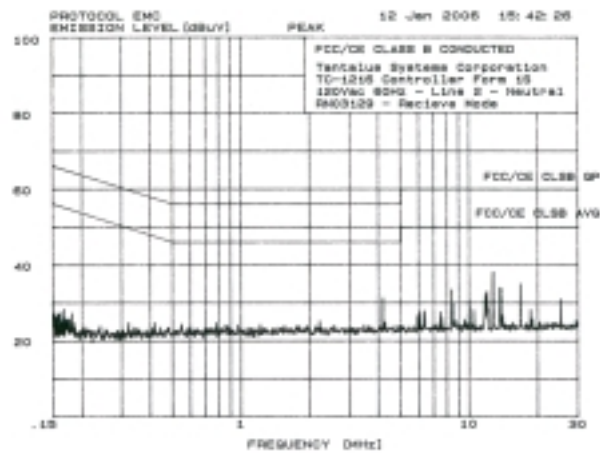
Table 10: CISPR 22 Class B Emissions while in idle/receive mode – 3-m

Frequency (MHz)	Pol	Hgt (m)	Ang (deg)	Uncor-Pk (dBμV)	Tot Corr (dB)	Peak (dBμV/m)	QP Lmt (dBμV/m)	DelLim-Pk (dB)	QP (dBμV/m)	DelLim-QP (dB)
39.00000	Vert	0.0	180.0	27.60	13.38	40.98	39.50	1.48	23.81	-15.69
48.74600	Vert	0.0	90.0	19.40	11.61	31.01	39.50	-8.49	26.85	-12.65
58.49800	Vert	0.0	180.0	20.60	10.79	31.39	39.50	-8.11	22.03	-17.47
117.00000	Vert	0.0	180.0	9.40	13.27	22.67	39.50	-16.83	16.48	-23.02
126.74800	Horz	3.0	200.0	13.10	13.64	26.74	39.50	-12.76	24.40	-15.10
136.50000	Horz	2.0	90.0	20.60	14.04	34.64	39.50	-4.86	23.30	-16.20
165.74800	Horz	2.0	170.0	14.90	15.09	29.99	39.50	-9.51	28.27	-11.23

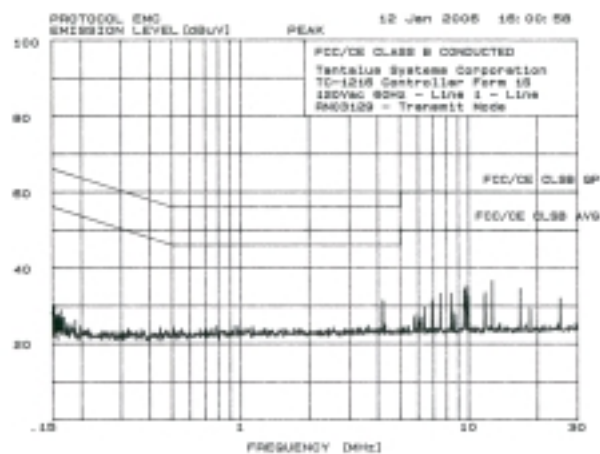
Conducted Emission Plots



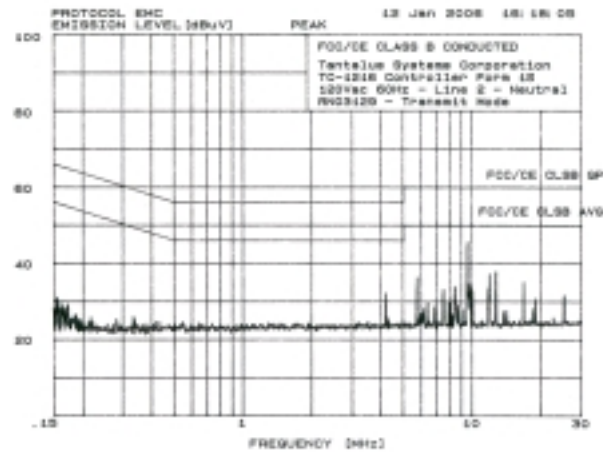
Conducted Emissions TC-1116 Line 1 Receive Mode 120Vac, 60 Hz



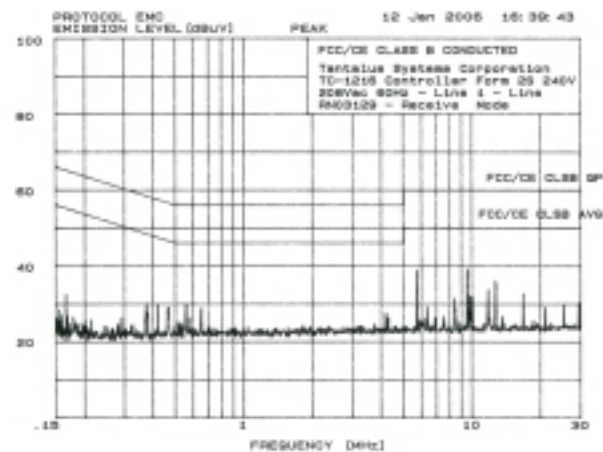
Conducted Emissions TC-1116 Line 2 Receive Mode 120Vac, 60 Hz



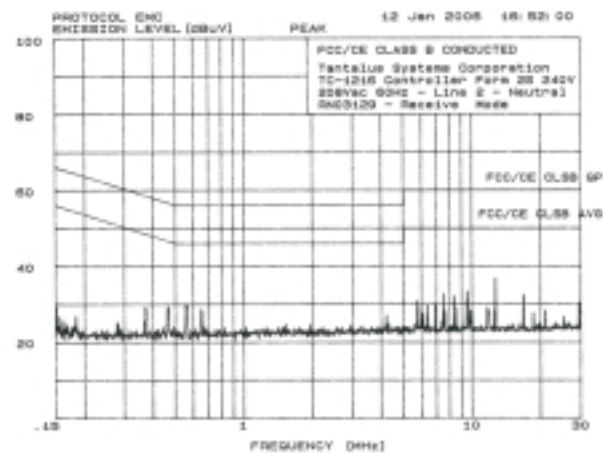
Conducted Emissions TC-1116 Line 1 Transmit Mode 120Vac, 60 Hz



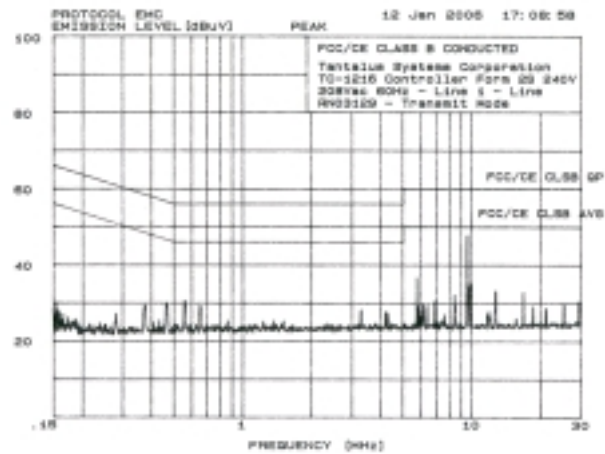
Conducted Emissions TC-1116 Line 2 Transmit Mode 120Vac, 60 Hz



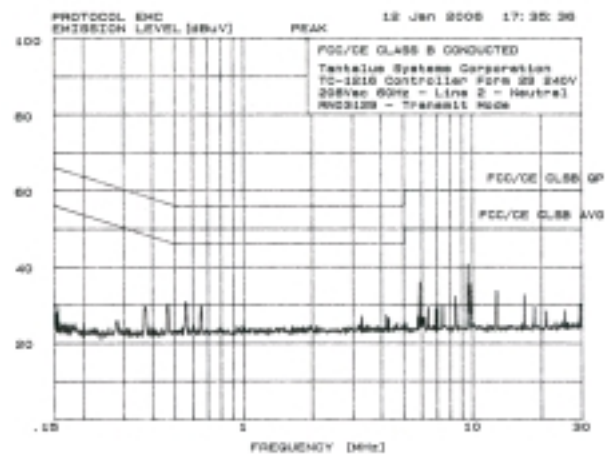
Conducted Emissions TC-1216 Line 1 Receive Mode 208Vac, 60 Hz



Conducted Emissions TC-1216 Line 2 Receive Mode 208Vac, 60Hz



Conducted Emissions TC-1216 Line 1 Transmit Mode 208Vac, 60 Hz



Conducted Emissions TC-1216 Line 2 Transmit Mode 208Vac, 60 Hz