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Addendum to Electromagnetic Emissions Test Report and Application for Grant of Equipment Authorization pursuant to FCC Part 15, Subpart E Specifications for Unlicensed National Information Infrastructure Devices on the CardAccess Model: CAWCB500

FCC ID:	CAWCB500
GRANTEE:	CardAccess 837 South 500 West, Suite 200 Bountiful, UT 84010
TEST SITE:	Elliott Laboratories, Inc. 684 W. Maude Avenue Sunnyvale, CA 94086
REPORT DATE:	August 7, 2001
FINAL TEST DATE:	August 6, 2001
AUTHORIZED SIGNATORY:	Mark Briggs Director of Engineering

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SCOPE

This addendum contains additional test results on the CardAccess model CAWCB500 with the device operating in turbo mode.

The test results recorded herein are based on a single type test of the CardAccess model CAWCB500 and therefore apply only to the tested sample. The sample was selected and prepared by Quinn Kunz of CardAccess

STATEMENT OF COMPLIANCE

The tested sample of CardAccess model CAWCB500 complied with the requirements of Subpart E of Part 15 of the FCC Rules for Unlicensed National Information Infrastructure Devices.

Maintenance of FCC compliance is the responsibility of the manufacturer. Any modification of the product may result in increased emissions and should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing or I/O cable changes, etc.).

EMISSION TEST RESULTS

The following emissions tests were performed on the CardAccess model CAWCB500. The actual test results are contained in an exhibit of this report.

OUTPUT POWER AND POWER SPECTRAL DENSITY - 15.407 (a)

The EUT tested complied with the output power limits detailed in FCC Rules Part 15 Section 15.407 (a) (1) for intentional signals generated in the 5.15 – 5.25 GHz band. Given a minimum signal bandwidth of 63 MHz and a maximum antenna gain of 1.45 dBi the maximum permitted output power is 17 dBm (50 mW) and the maximum permitted power spectral density is 4dBm/MHz. The measured output power was13.4 dBm (21.9 mW) and the measured power spectral density was –3.2 dBm/MHz.

The EUT tested complied with the output power limits detailed in FCC Rules Part 15 Section 15.407 (a) (2) for intentional signals generated in the 5.25 – 5.35 GHz band. Given a minimum signal bandwidth of 63 MHz and a maximum antenna gain of 1.45 dBi the maximum permitted output power is 24 dBm (250 mW) and the maximum permitted power spectral density is 11dBm/MHz. The actual power measured was 13.5 dBm (22.4 mW) and the measured power spectral density was –3.5 dBm/MHz.

PEAK EXCURSION RATIO - 15.407 (a) (6)

The ratio of the peak excursion of the modulation envelope to the peak transmit power did not exceed the 13dB limit detailed in 15.407 (a) (6). The actual ratio measured was 9.7 dB.

UNDESIRABLE EMISSIONS (SPURIOUS EMISSIONS) - 15.407 (b)

The EUT tested complied with the limits detailed in FCC Rules Part 15 Section 15.407 (b) (1). For spurious emissions falling outside of restricted bands the eirp limit detailed and 15.407 (b) (1) was used. For emissions falling within the restricted bands defined in 15.205 the field strength limit of 15.209 was used.

Spurious emissions were initially measured directly via the antenna port. For signals close to the band edges of allocated UNII bands which fell into restricted bands the field strength was calculated by measuring the band edge signal levels relative to the fundamental signal level and then applying a correction factor to the measured peak and average values for the fundamental signal.

The following measurement was extracted from the data recorded and represents the highest amplitude emission relative to the specification limit. The actual test data and any correction factors are contained in an exhibit of this report.

Radiated Emissions 1 – 40 GHz

Frequency MHz	Level dBuV/m	Pol v/h	FCC Subpart E Limit	Margin	Detector	Azimuth degrees	Height meters	Comments
15630.0	50.2	v	54.0	-3.8	Avg	284	1.5	Note 2; Analyzer noise floor

Spurious emissions in the 30MHz to 1GHz were measured while testing the digital device radiated emissions against the FCC Class B limits. The Digital device has been approved using the FCC's declaration of conformity procedure.

MEASUREMENT UNCERTAINTIES

ISO Guide 25 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level and were calculated in accordance with NAMAS document NIS 81.

Measurement Type	Frequency Range (MHz)	Calculated Uncertainty (dB)
Conducted Emissions	0.15 to 30	± 2.4
Radiated Emissions	30 to 1000	± 3.2

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The CardAccess model CAWCB500 is a PC Card bus standard UNII Radio designed to operate from 5.18 GHz to 5.32 GHz. The system is intended for indoor use only. Normally, the EUT would be placed in a laptop PC during normal use. The EUT was, therefore, placed in a laptop PC and treated as table-top equipment during testing to simulate the end user environment.

The sample was received on July 23, 2001 and tested on August 8, 2001. The EUT consisted of the following component(s):

Manufacturer	Model	Description	Serial Number	FCC ID
Card Access	CAWCB500	PCMCIA Card	N/A	CAWCB500

SUPPORT EQUIPMENT

The following equipment was used as local support equipment for emissions testing:

Manufacturer	Model	Description	Serial Number	FCC ID
Dell	PP01L	Laptop PC	TW-0791UH-12800-OB4-3546	DoC

EUT INTERFACE PORTS

The I/O cabling configuration during emissions testing was as follows:

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length (m)
Laptop Serial	Palm Pilot	Serial	Shielded	2.0
Laptop Parallel	Printer	Parallel	Shielded	3.0

EUT OPERATION

During the spurious emissions measurements the EUT was transmitting at its highest output power on channel 9, 13 or 17 as detailed in the test data. The data rate was 12 Mb/s.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken on July 23, 2001 at the Elliott Laboratories Open Area Test Site #4 located at 684 West Maude Avenue, Sunnyvale, California. The test sites contain separate areas for radiated and conducted emissions testing. Pursuant to section 2.948 of the Rules, construction, calibration, and equipment data has been filed with the Commission.

The FCC recommends that ambient noise at the test site be at least 6 dB below the allowable limits. Ambient levels are below this requirement with the exception of predictable local TV, radio, and mobile communications traffic. The test site contains separate areas for radiated and conducted emissions testing. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent FCC requirements.

RADIATED EMISSIONS CONSIDERATIONS

The FCC has determined that radiation measurements made in a shielded enclosure are not suitable for determining levels of radiated emissions. Radiated measurements are performed in an open field environment. The test site is maintained free of conductive objects within the CISPR defined elliptical area incorporated in ANSI C63.4 guidelines.

MEASUREMENT INSTRUMENTATION

RECEIVER SYSTEM

An EMI receiver as specified in CISPR 16-1 is used for emissions measurements. The receivers used can measure over the frequency range of 9 kHz up to 2000 MHz. These receivers allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary. The receiver automatically sets the required bandwidth for the CISPR detector used during measurements.

For measurements above the frequency range of the receivers, a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis. Average measurements above 1000MHz are performed on the spectrum analyzer using the linear-average method with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz.

INSTRUMENT CONTROL COMPUTER

The receivers utilize either a Rohde and Schwarz EZM Spectrum Monitor/Controller or contain an internal Spectrum Monitor/Controller to view and convert the receiver measurements to the field strength at an antenna or voltage developed at the LISN measurement port, which is then compared directly with the appropriate specification limit. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are printed in a graphic and/or tabular format, as appropriate. A personal computer is used to record all measurements made with the receivers.

The Spectrum Monitor provides a visual display of the signal being measured. In addition, the controller or a personal computer run automated data collection programs which control the receivers. This provides added accuracy since all site correction factors, such as cable loss and antenna factors are added automatically.

POWER METER

A power meter and thermister mount are used for all direct output power measurements from transmitters as they provide a broadband indication of the power output.

FILTERS/ATTENUATORS

External filters and precision attenuators are often connected between the receiving antenna or LISN and the receiver. This eliminates saturation effects and non-linear operation due to high amplitude transient events.

ANTENNAS

A biconical antenna is used to cover the range from 30 MHz to 300 MHz and a log periodic antenna is utilized from 300 MHz to 1000 MHz. Narrowband tuned dipole antennas are used over the entire 30 to 1000 MHz range for precision measurements of field strength. Above 1000 MHz, a horn antenna is used. The antenna calibration factors are included in site factors programmed into the test receivers.

ANTENNA MAST AND EQUIPMENT TURNTABLE

The antennas used to measure the radiated electric field strength are mounted on a non-conductive antenna mast equipped with a motor-drive to vary the antenna height.

ANSI C63.4 specifies that the test height above ground for table-mounted devices shall be 80 centimeters. Floor mounted equipment shall be placed on the ground plane if the device is normally used on a conductive floor or separated from the ground plane by insulating material from 3 to 12 mm if the device is normally used on a non-conductive floor. During radiated measurements, the EUT is positioned on a motorized turntable in conformance with this requirement.

INSTRUMENT CALIBRATION

All test equipment is regularly checked to ensure that performance is maintained in accordance with the manufacturer's specifications. All antennas are calibrated at regular intervals with respect to tuned half-wave dipoles. An exhibit of this report contains the list of test equipment used and calibration information.

TEST PROCEDURES

EUT AND CABLE PLACEMENT

The FCC requires that interconnecting cables be connected to the available ports of the unit and that the placement of the unit and the attached cables simulate the worst case orientation that can be expected from a typical installation, so far as practicable. To this end, the position of the unit and associated cabling is varied within the guidelines of ANSI C63.4, and the worst-case orientation is used for final measurements.

RADIATED EMISSIONS

Radiated emissions measurements are performed in two phases as well. A preliminary scan of emissions is conducted in which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed from 30 MHz up to the frequency required by the regulation specified on page 1. One or more of these is with the antenna polarized vertically while the one or more of these is with the antenna polarized horizontally. During the preliminary scans, the EUT is rotated through 360°, the antenna height is varied and cable positions are varied to determine the highest emission relative to the limit.

A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

Final maximization is a phase in which the highest amplitude emissions identified in the spectral search are viewed while the EUT azimuth angle is varied from 0 to 360 degrees relative to the receiving antenna. The azimuth results in the highest emission maintained while varying the antenna height from one to four meters. The result is the identification of the highest amplitude for each of the highest peaks. Each recorded level is corrected in the receiver using appropriate factors for cables, connectors, antennas, and preamplifier gain. Emissions which have values close to the specification limit may also be measured with a tuned dipole antenna to determine compliance.

CONDUCTED EMISSIONS FROM ANTENNA PORT

Direct measurements are performed with the antenna port of the EUT connected to either the power meter or spectrum analyzer via a suitable attenuator and/or filter. These are used to ensure that the front end of the measurement instrument is not overloaded by the fundamental transmission.

Measurement bandwidths (video and resolution) are set in accordance with FCC procedures for the type of radio being tested.

SPECIFICATION LIMITS AND SAMPLE CALCULATIONS

The limits for conducted emissions from the AC power port are given in units of microvolts, the limits for radiated electric field emissions are given in units of microvolts per meter at a specified test distance and the output power limits are given in temrs of Watts, milliwatts or dBm. Data is measured in the logarithmic form of decibels relative to one microvolt, or dB microvolts (dBuV). For radiated emissions, the measured data is converted to the field strength at the antenna in dB microvolts per meter (dBuV/m). The results are then converted to the linear forms of uV and uV/m for comparison to published specifications.

Where the radiated electric field strength is expressed in terms of the equivalent isotropic radiated power (eirp) the following formula is used to determine the field strength limit in terms of microvolts per meter at a distance of 3m from the equipment under test:

$$E = \frac{1000000 \text{ v } 30\ P}{3} \quad \text{microvolts per meter}$$

where P is the eirp (Watts)

For reference, converting the voltage and electric field strength specification limits from linear to decibel form is accomplished by taking the base ten logarithm, then multiplying by 20. Conversion of power specification limits from linear units (in milliwatts) to decibel form (in dBm) is accomplished by taking the base ten logarithm, then multiplying by 10.

OUTPUT POWER LIMITS, SECTION 15.407 (a)

The table below shows the limits for output power and output power density. Where the signal bandwidth is less than 20 MHz the maximum output power is reduced to the power spectral density limit plus 10 times the log of the bandwidth (in MHz).

Operating Frequency (MHz)	Output Power	Power Spectral Density
5150 - 5250	200mW (17 dBm)	4 dBm/MHz
5250 - 5350	250 mW (24 dBm)	11 dBm/MHz
5725 – 5825	1 Watts (30 dBm)	17 dBm/MHz

For system using antennas with gains exceeding 6dBi, the output power and power spectral density limits are reduced by 1dB for every dB the antenna gain exceeds 6dBi.
Fixed point-to-point applications using the 5725 – 5825 MHz band may use antennas with gains of up to 23dBi without this limitation. If the gain exceeds 23dBi then the output power limit of 1 Watt is reduced by 1dB for every dB the gain exceeds 23dBi.

SPURIOUS RADIATED EMISSIONS LIMITS, SECTION 15.209

The table below shows the limits for unwanted (spurious) emissions falling in the restricted bands detailed in Part 15.205.

Frequency Range (MHz)	Limit (uV/m @ 3m)	Limit (dBuV/m @ 3m)
0.009-0.490	$2400/F_{KHz}$ @ 300m	$67.6-20*\log_{10}(F_{KHz})$ @ 300m
0.490-1.705	$24000/F_{KHz}$ @ 30m	$87.6-20*\log_{10}(F_{KHz})$ @ 30m
1.705 to 30	30 @ 30m	29.5 @ 30m
30 to 88	100	40
88 to 216	150	43.5
216 to 960	200	46.0
Above 960	500	54.0

SPURIOUS EMISSIONS SPECIFICATION LIMITS, SECTION 15.407 (b)

The table below shows the limits for unwanted (spurious) emissions outside of the allocated bands that do not fall in the restricted bands of 15.205.

Operating Frequency (MHz)	EIRP Limit (dBm)	Equivalent Field Strength At 3m (dBuV/m)
5150 - 5250	-27 dBm	68.3 dBuV/m
5250 - 5350	-27 dBm	68.3 dBuV/m
5725 – 5825	-27 dBm (note 1) -17 dBm (note 2)	68.3 dBuV/m 78.3 dBuV/m

Note 1: Applies to spurious signals separated by more than 10 MHz from the allocated band.
Note 2: Applies to spurious signals within 10 MHz of the allocated band.

AC POWER PORT CONDUCTED EMISSIONS LIMITS, SECTION 15.207

Frequency Range (MHz)	Limit (uV)	Limit (dBuV)
0.450 to 30.000	250	48

SAMPLE CALCULATIONS - CONDUCTED EMISSIONS

Receiver readings are compared directly to the conducted emissions specification limit (decibel form) as follows:

$$R_r - B = C$$

and

$$C - S = M$$

where:

R_r = Receiver Reading in dBuV

B = Broadband Correction Factor*

C = Corrected Reading in dBuV

S = Specification Limit in dBuV

M = Margin to Specification in +/- dB

* Broadband Level - Per ANSI C63.4, 13 dB may be subtracted from the quasi-peak level if it is determined that the emission is broadband in nature. If the signal level in the average mode is six dB or more below the signal level in the peak mode, the emission is classified as broadband.

SAMPLE CALCULATIONS - RADIATED EMISSIONS

Receiver readings are compared directly to the specification limit (decibel form). The receiver internally corrects for cable loss, preamplifier gain, and antenna factor. The calculations are in the reverse direction of the actual signal flow, thus cable loss is added and the amplifier gain is subtracted. The Antenna Factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements. A distance factor, when used for electric field measurements, is calculated by using the following formula:

$$F_d = 20*LOG_{10} (D_m/D_s)$$

where:

F_d = Distance Factor in dB

D_m = Measurement Distance in meters

D_s = Specification Distance in meters

Measurement Distance is the distance at which the measurements were taken and Specification Distance is the distance at which the specification limits are based. The antenna factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

The margin of a given emission peak relative to the limit is calculated as follows:

$$R_c = R_r + F_d$$

and

$$M = R_c - L_s$$

where:

R_r = Receiver Reading in dBuV/m

F_d = Distance Factor in dB

R_c = Corrected Reading in dBuV/m

L_s = Specification Limit in dBuV/m

M = Margin in dB Relative to Spec

EXHIBIT 1: Test Equipment Calibration Data

Antenna Conducted and Radiated Spurious Emissions, 06-Aug-01 08:07 AM
Engineer: Mark

Manufacturer	Description	Model #	Assett #	Cal interval	Last Calibrated	Cal Due
Hewlett Packard	Microwave EMI test system (SA40, 30Hz - 40GHz)	84125C	1149	12	2/5/2001	2/5/2002
Hewlett Packard	Preamplifier, 1-26.5 GHz	8449B	TY,84299	12	4/1/2001	4/1/2002
Hewlett Packard	Spectrum Analyzer, 9KHz - 22GHz	8593EM	1319	12	5/31/2001	5/31/2002
Boonton	Power Meter (client provided)	4531	100201	12	4/5/2001	4/5/2002
Boonton	Peak Power Sensor, 500 MHz - 18GHz (client provided)	57318	2110	12	4/5/2001	4/5/2002
EMCO	Horn Antenna, D. Ridge 1-18GHz	3115	487	12	3/31/2001	3/31/2002

EXHIBIT 2: Test Data Log Sheets

ELECTROMAGNETIC EMISSIONS

TEST LOG SHEETS

AND

MEASUREMENT DATA

T44330 25 Pages

Elliott

EMC Test Data

Client:	CardAccess	Job Number:	J44185
Model:	CAWCB500 (Turbo Mode)	T-Log Number:	T44330
		Proj Eng:	Mark Briggs
Contact:	Quinn Kunz		
Emissions Spec:	FCC Part 15 Subparts B and E	Class:	B
Immunity Spec:	N/A	Environment:	-

EMC Test Data

For The

CardAccess

Model

CAWCB500 (Turbo Mode)

Client:	CardAccess	Job Number:	J44185
Model:	CAWCB500 (Turbo Mode)	T-Log Number:	T44330
		Proj Eng:	Mark Briggs
Contact:	Quinn Kunz		
Emissions Spec:	FCC Part 15 Subparts B and E	Class:	B
Immunity Spec:	N/A	Environment:	-

EUT INFORMATION

General Description

The EUT is a PC Card bus standard UNII Radio which is designed to operate from 5.18 GHz to 5.32 GHz. The system is intended for indoor use only. Normally, the EUT would be placed in a laptop PC during normal use. The EUT was, therefore, placed in a laptop PC and treated as table-top equipment during testing to simulate the end user environment.

Equipment Under Test

Manufacturer	Model	Description	Serial Number	FCC ID
Card Access	CAWCB500	CardBus UNII Radio	N/A	CAWCB500

EUT Enclosure

The EUT enclosure is primarily constructed of fabricated sheet steel. It measures approximately 7 cm wide by .5 cm deep by 10 cm high.

Modification History

Mod. #	Test	Date	Modification
1			

Client:	CardAccess	Job Number:	J44185
Model:	CAWCB500 (Turbo Mode)	T-Log Number:	T44330
		Proj Eng:	Mark Briggs
Contact:	Quinn Kunz		
Emissions Spec:	FCC Part 15 Subparts B and E	Class:	B
Immunity Spec:	N/A	Environment:	-

Test Configuration #1

Local Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
Dell	PP01L	Laptop PC	TW-0791UH-12800-OB4-3546	DoC

Remote Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
None				

EUT Operation During Emissions (Radio)

The radio was transmitting at full power on the specified channels with a duty cycle of 99% (maximum allowed) and at a data rate of 12Mb/s in the mode described as "Turbo Mode" in the Theory of Operations. This mode utilizes two channels simultaneously and allows data rates of up to 72Mb/s. At data rates higher than the rate tested the PA gain is reduced to improve signal fidelity. The device was, therefore, tested in turbo mode at the data rate that produced the highest output power for turbo mode (12Mb/s).

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EMC Test Data

Client:	CardAccess	Job Number:	J44185
Model:	CAWCB500 (Turbo Mode)	T-Log Number:	T44330
		Proj Eng:	Mark Briggs
Contact:	Quinn Kunz		
Spec:	FCC Part 15 Subparts B and E	Class:	B

FCC Part 15 Subpart E Tests

Test Specifics

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test:	8/6/2001	Config. Used:	#1
Test Engineer:	Mark Briggs & Jmartinez	Config Change:	
Test Location:	SVOATS #4	Host Unit Voltage	120V/60Hz

General Test Configuration

The EUT was located on the turntable for radiated spurious emissions testing.

For radiated emissions testing the measurement antenna was located 3 meters from the EUT unless stated otherwise.

When measuring the conducted emissions from the EUT's antenna port, the antenna port of the EUT was connected to the spectrum analyzer or power meter via a suitable attenuator to prevent overloading the measurement system. All measurements are corrected to allow for the external attenuators and cables used.

Ambient Conditions:

Temperature: 24°C

Rel. Humidity: 80%

Summary of Results

Run #	Test Performed	Limit	Result	Comments
1	Output Power	15.407(a) (1), (2)	Pass	13.5 dBm
2	Power Spectral Density (PSD)	15.407(a) (1), (2)	Pass	-3.2dBm/MHz
3	26dB Bandwidth	15.407	Pass	> 20 MHz
4	Peak Excursion Envelope	15.407(a) (6)	Pass	Peak to average excursion < 13dB
5	Antenna Conducted - Out of Band Spurious	15.407(b)	Pass	All emissions below the 27dBm/MHz limit
6	RE, 1000 - 40000 MHz - Spurious Emissions	15.407(b)(6)	Pass	-3.8dB @ 15630MHz

Client:	CardAccess	Job Number:	J44185
Model:	CAWCB500 (Turbo Mode)	T-Log Number:	T44330
		Proj Eng:	Mark Briggs
Contact:	Quinn Kunz		
Spec:	FCC Part 15 Subparts B and E	Class:	B

Modifications Made During Testing:

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Run #1: Output Power

The radio utilizes an integral antenna with a gain of approximtaley 1.45 dBi.

Maximum Antenna Gain: 1.45 dBi

Channel	Frequency (MHz)	99.7% Signal BW	Output Power	FCC Limit (dBm) (note 3)	Comments
Low (#9)	5210	64.2	12.7	17.0	Note 2
	5210	64.2	13.4	17.0	Note 1
Center (#13)	5250	63.2	12.6	17.0	Note 2
	5250	63.2	13.3	17.0	Note 1
High (#17)	5290	67.7	12.9	24.0	Note 2
	5290	67.7	13.5	24.0	Note 1

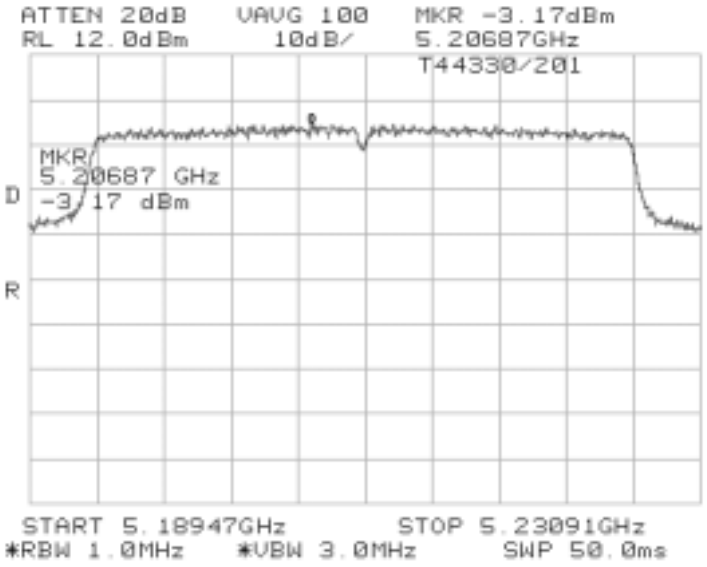
Note 1:	Measured using spectrum analyzer's power measurement function (RBW = 1MHz, VBW = 30kHz)
Note 2:	Measured using a Boonton Power Meter with a peak power sensor in average mode
Note 3:	RSS 210 limit is 23dBm in the 5.15 to 5.25 GHz band, 6dB higher than the FCC limit.

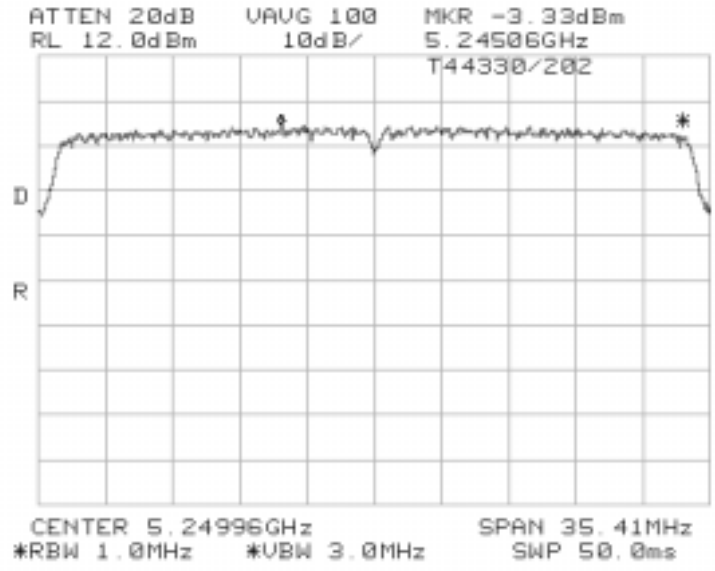
Run #2: Power Spectral Density

Channel	Frequency (MHz)	Power Spectral Density (dBm/MHz)	FCC Limit (dBm)	Graph Reference	
9	5210	-3.2	4.0	T44330/201	See note
13	5250	-3.3	4.0	T44330/202	See note
17	5290	-3.5	11.0	T44330/203	See note

Note: The above measurements were made using RBW = 1MHz, VBW = 3MHz, video averaging on. To demonstrate compliance with RSS 210, the peak PSD was also measured using RBW= VBW=1MHz, video averaging off during the peak excursion measurements (run #4). The peak PSD of **6.4dBm** did not exceed the maximum permitted average PSD of 10dBm (5.15 to 5.25 GHz band) or 11dBm (5.25-5.35GHz band) so no restriction is placed on the output power or average PSD with respect to RSS 210.

Client:	CardAccess	Job Number:	J44185
Model:	CAWCB500 (Turbo Mode)	T-Log Number:	T44330
		Proj Eng:	Mark Briggs
Contact:	Quinn Kunz		
Spec:	FCC Part 15 Subparts B and E	Class:	B





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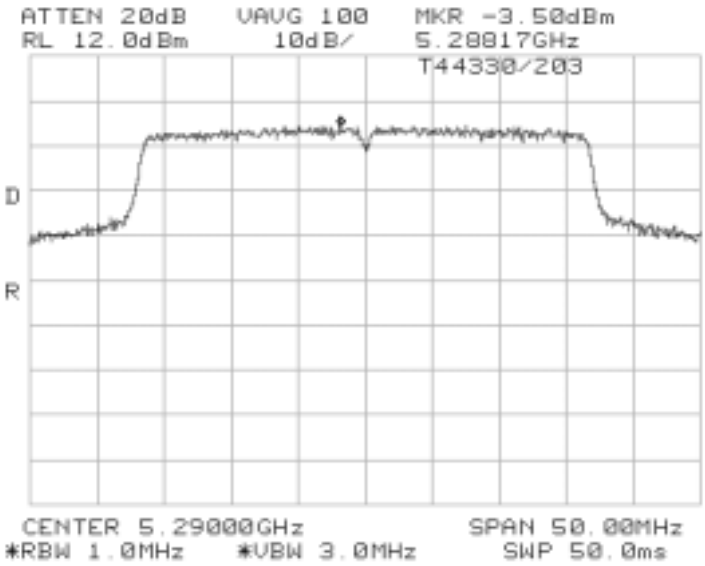
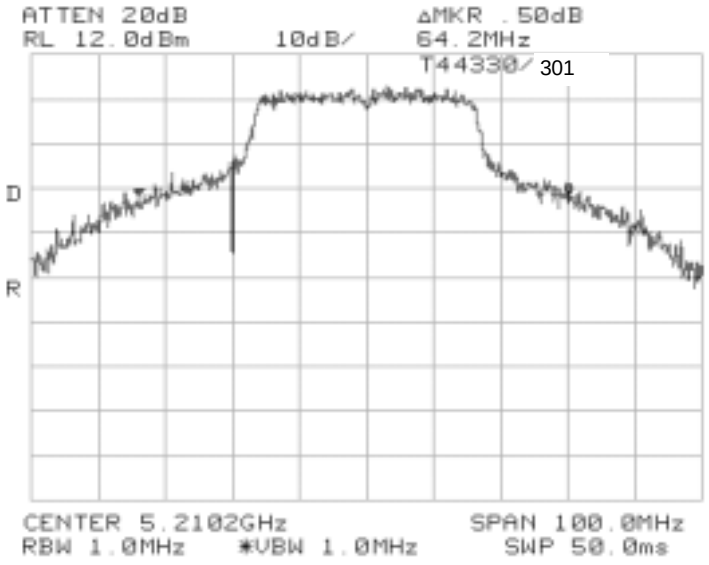
Model:	CAWCB500 (Turbo Mode)	T-Log Number:	T44330
		Proj Eng:	Mark Briggs
Contact:	Quinn Kunz		
Spec:	FCC Part 15 Subparts B and E	Class:	B



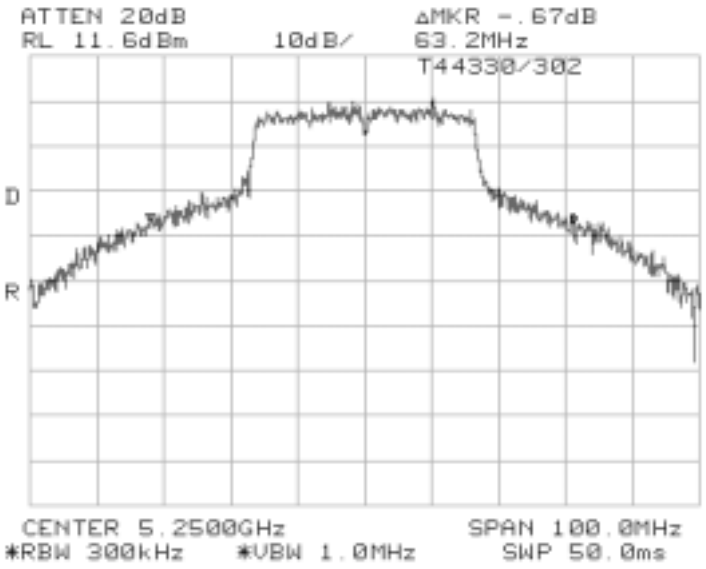
Client:	CardAccess	Job Number:	J44185
Model:	CAWCB500 (Turbo Mode)	T-Log Number:	T44330
		Proj Eng:	Mark Briggs
Contact:	Quinn Kunz		
Spec:	FCC Part 15 Subparts B and E	Class:	B

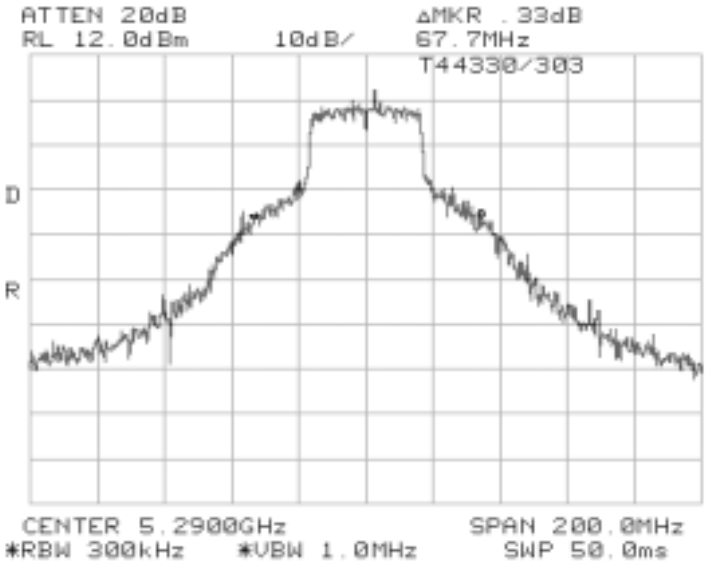
Run #3: Signal Bandwidth

Channel	Frequency (MHz)	Resolution Bandwidth	26dB Signal Bandwidth (MHz)	Graph reference #
9	5210	300 kHz	64.2	T4430/301
13	5250	300 kHz	63.2	T4430/302
17	5290	300 kHz	67.7	T4430/303



Client:	CardAccess	Job Number:	J44185
Model:	CAWCB500 (Turbo Mode)	T-Log Number:	T44330
		Proj Eng:	Mark Briggs
Contact:	Quinn Kunz		
Spec:	FCC Part 15 Subparts B and E	Class:	B



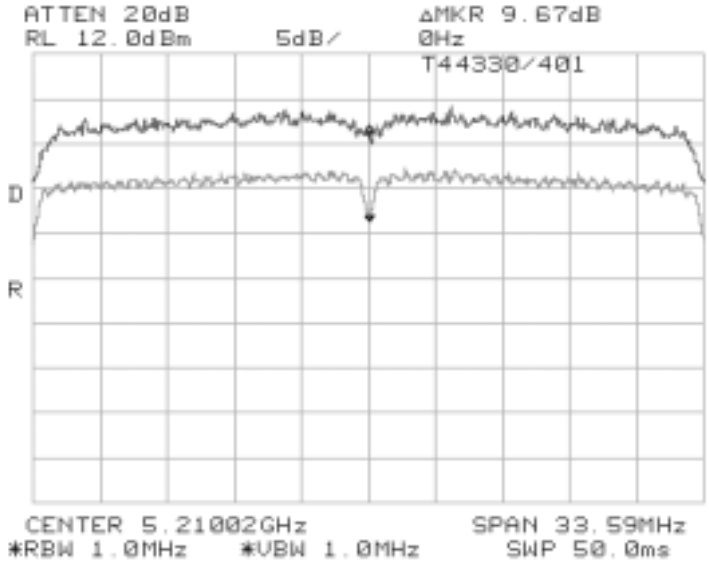


Client:	CardAccess	Job Number:	J44185
Model:	CAWCB500 (Turbo Mode)	T-Log Number:	T44330
		Proj Eng:	Mark Briggs
Contact:	Quinn Kunz		
Spec:	FCC Part 15 Subparts B and E	Class:	B

Run #4: Peak Excursion Measurement

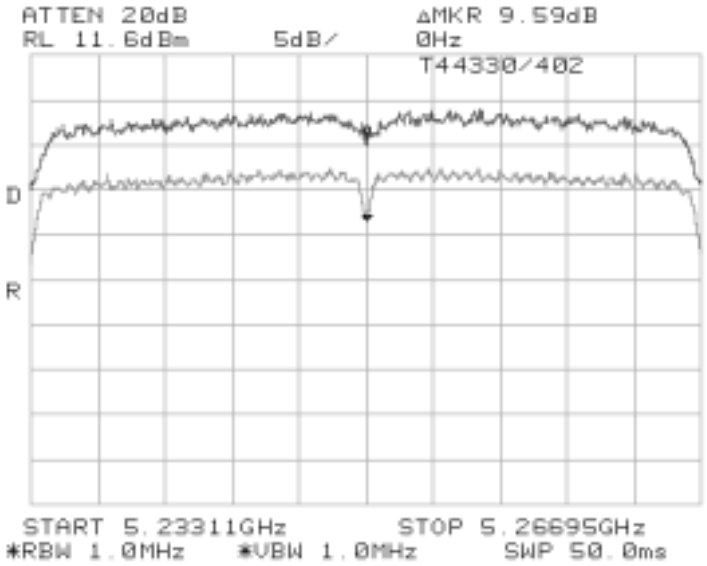
The plots below show that the peak excursion was less than 13dB on all three channels tested.

Peak Excursion = 9.7 dB. Peak power spectral density (RSS210 only) = 6.3dBm.

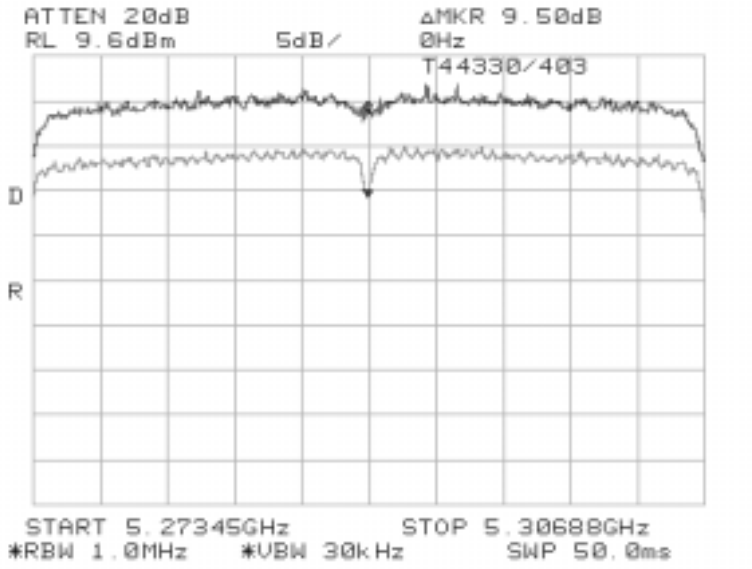


Client:	CardAccess	Job Number:	J44185
Model:	CAWCB500 (Turbo Mode)	T-Log Number:	T44330
		Proj Eng:	Mark Briggs
Contact:	Quinn Kunz		
Spec:	FCC Part 15 Subparts B and E	Class:	B

Peak Excursion = 9.6 dB. Peak power spectral density (RSS210 only) = 5.5dBm.



Peak Excursion = 9.5 dB. Peak power spectral density (RSS210 only) = 6.4dBm.



Client:	CardAccess	Job Number:	J44185
Model:	CAWCB500 (Turbo Mode)	T-Log Number:	T44330
		Proj Eng:	Mark Briggs
Contact:	Quinn Kunz		
Spec:	FCC Part 15 Subparts B and E	Class:	B

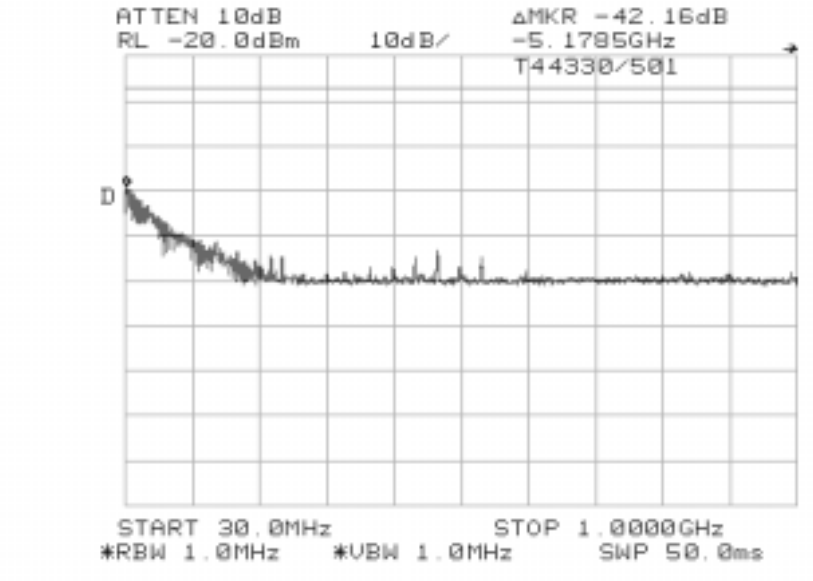
Run #5: Out Of Band Spurious Emissions - Antenna Conducted

The antenna gain of the radios integral antenna is 1.45dBi. The EIRP limit is -27dBm/MHz for all out of band signals that do not fall in restricted bands. A limit of -28.5 dBm was, therefore, used for signals not in restricted bands and close to the intentional band with the assumption that the antenna gain was equal to 1.45 within 100 MHz of the upper and lower band edges. For signals removed from the band edge by more than 100MHz, radiated measurements were made (refer to run #6) if the signal amplitude exceeded -37dBm.

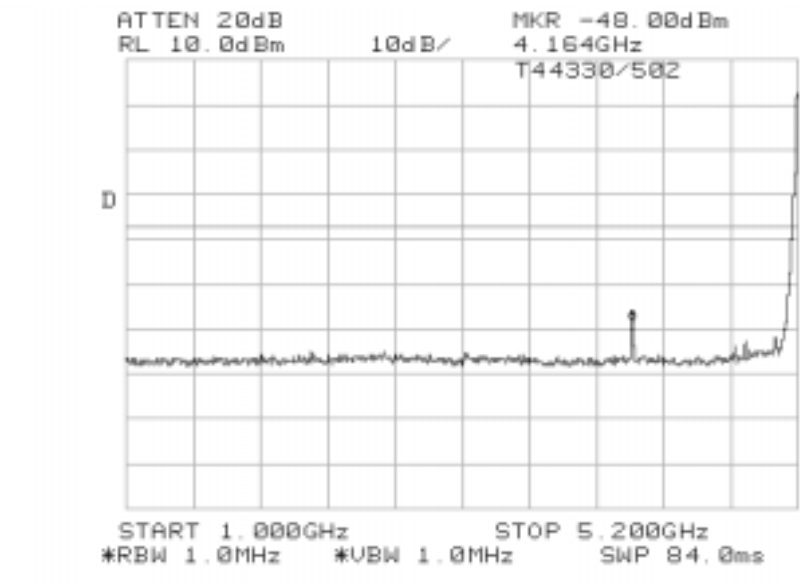
Channel	Frequency (MHz)	Frequency Range	Highest Spurious Signal	Graph reference #
9	5210	30 - 1000 MHz	Note 4	T44330/501
		1 to 5.2 GHz	-48dBm @ 4.1682 GHz (Note 1)	T44330/502
		5.3 to 10 GHz	-45.7 dBm @ 6.2521 GHz (Note 2)	T44330/503
		10 GHz to 20 GHz	-40.3 dBm @ 10.420GHz	T44330/504
		20 GHz to 40 GHz	No signals observed	T44330/505
13	5250	30 - 1000 MHz	Note 4	T44330/506
		1 to 5.2 GHz	-46.7dBm @ 4.200 GHz (note 1)	T44330/507
		5.3 to 10 GHz	-47.5dBm @ 6.300 GHz (Note 2)	T44330/508
		10 GHz to 20 GHz	-46.7dBm @ 10.4925 GHz (Note 3)	T44330/509
		20 GHz to 40 GHz	No signals observed	T44330/510
17	5290	30 - 1000 MHz	Note 4	T44330/511
		1 to 5.2 GHz	-44.2dBm @ 4.2321 GHz (Note 1)	T44330/512
		5.3 to 10 GHz	-47.2dBm @ 6.34817GHz (Note 2)	T44330/513
		10 GHz to 20 GHz	-51.7dBm @ 10.5825 GHz (Note 3)	T44330/514
		20 GHz to 40 GHz	No signals observed	T44330/515

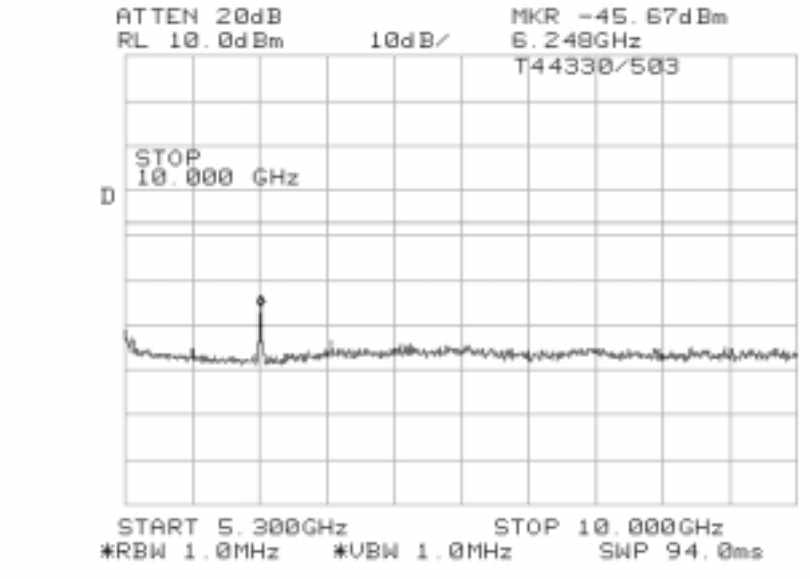
Client:	CardAccess	Job Number:	J44185
Model:	CAWCB500 (Turbo Mode)	T-Log Number:	T44330
		Proj Eng:	Mark Briggs
Contact:	Quinn Kunz		
Spec:	FCC Part 15 Subparts B and E	Class:	B

Note 1:	Signal is in a restricted band. Refer to run #6 for field strength measurements.
Note 2:	Signal is not in restricted band. Limit is -27dBm eirp. As the signal strength is significantly lower than -27dBm no field strength measurements required.
Note 3:	Signal is not in restricted band. Limit is -27dBm eirp. Although the signal strength is significantly lower than -27dBm field strength measurements were made (refer to run #6)
Note 4:	Signals in this frequency band measured during digital device radiated emissions test.

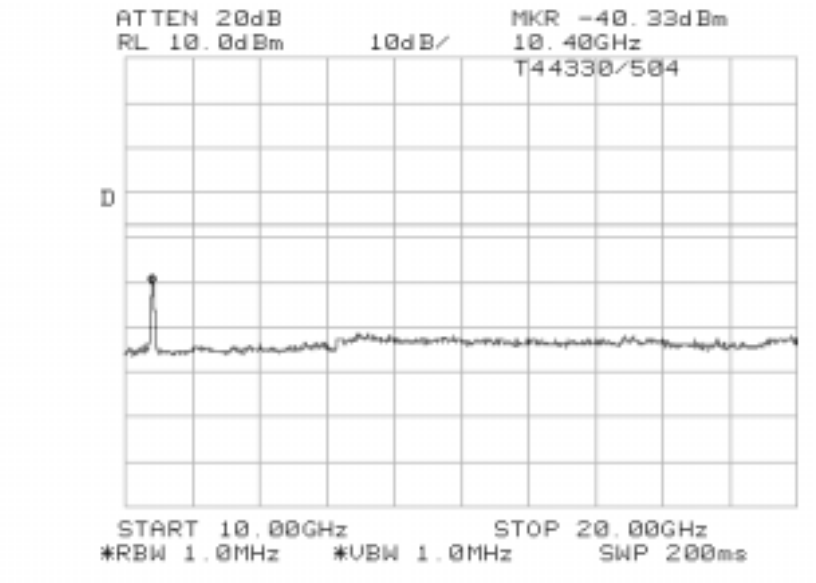


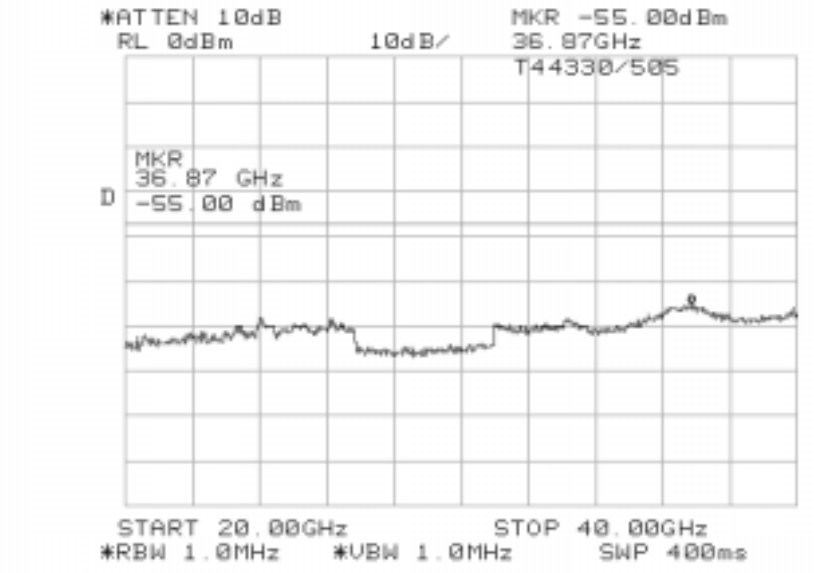
Client:	CardAccess	Job Number:	J44185
Model:	CAWCB500 (Turbo Mode)	T-Log Number:	T44330
		Proj Eng:	Mark Briggs
Contact:	Quinn Kunz		
Spec:	FCC Part 15 Subparts B and E	Class:	B



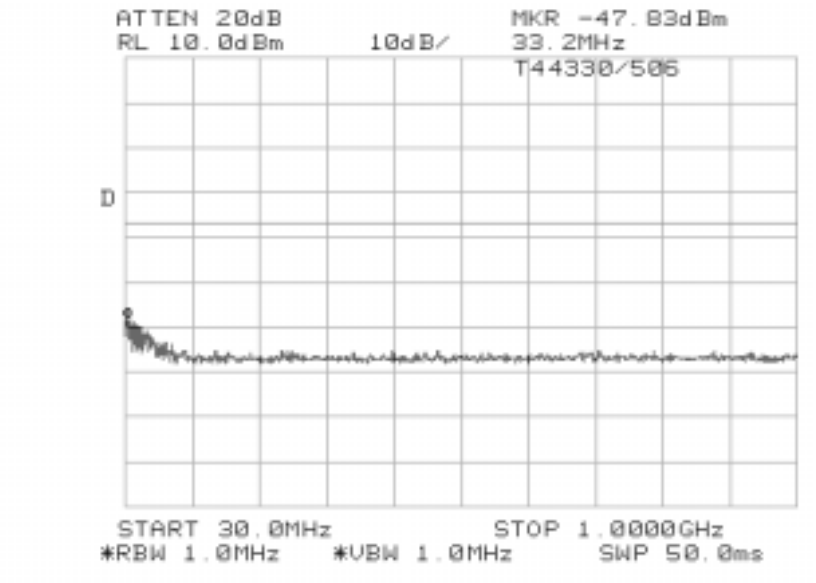


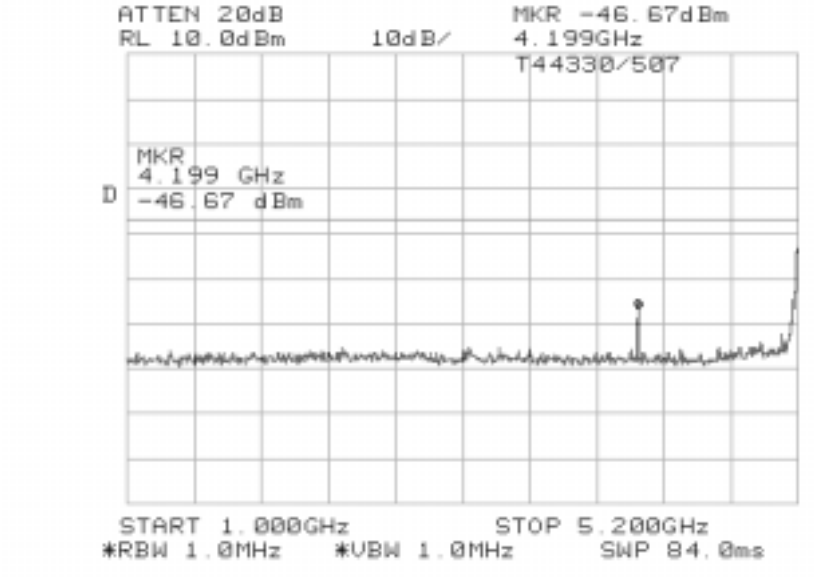
Client:	CardAccess	Job Number:	J44185
Model:	CAWCB500 (Turbo Mode)	T-Log Number:	T44330
		Proj Eng:	Mark Briggs
Contact:	Quinn Kunz		
Spec:	FCC Part 15 Subparts B and E	Class:	B



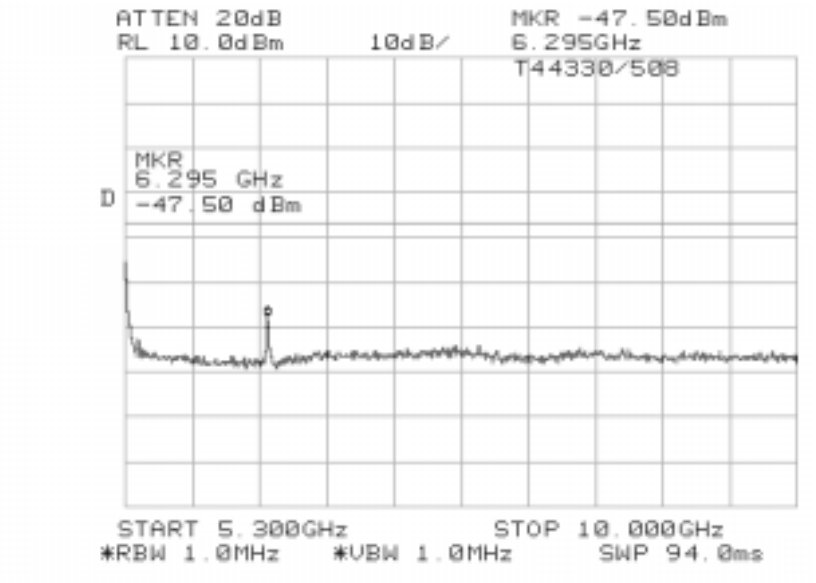


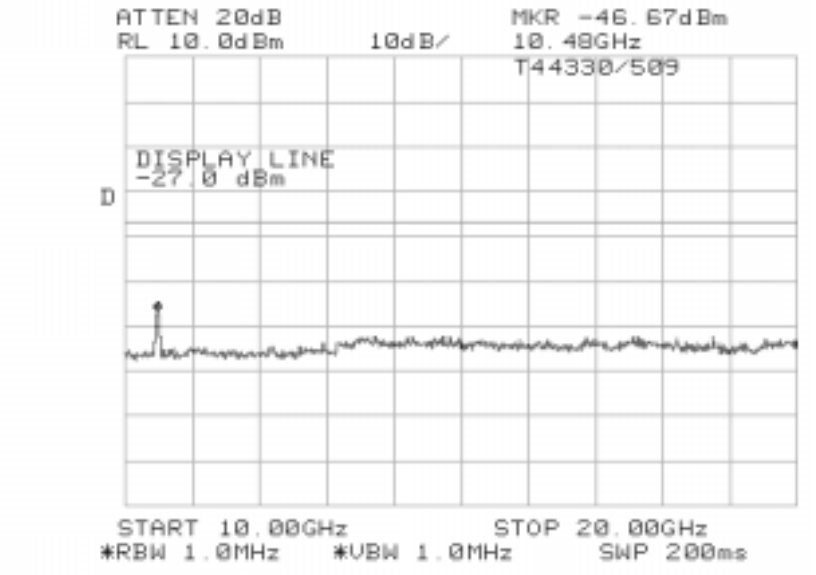
Client:	CardAccess	Job Number:	J44185
Model:	CAWCB500 (Turbo Mode)	T-Log Number:	T44330
		Proj Eng:	Mark Briggs
Contact:	Quinn Kunz		
Spec:	FCC Part 15 Subparts B and E	Class:	B



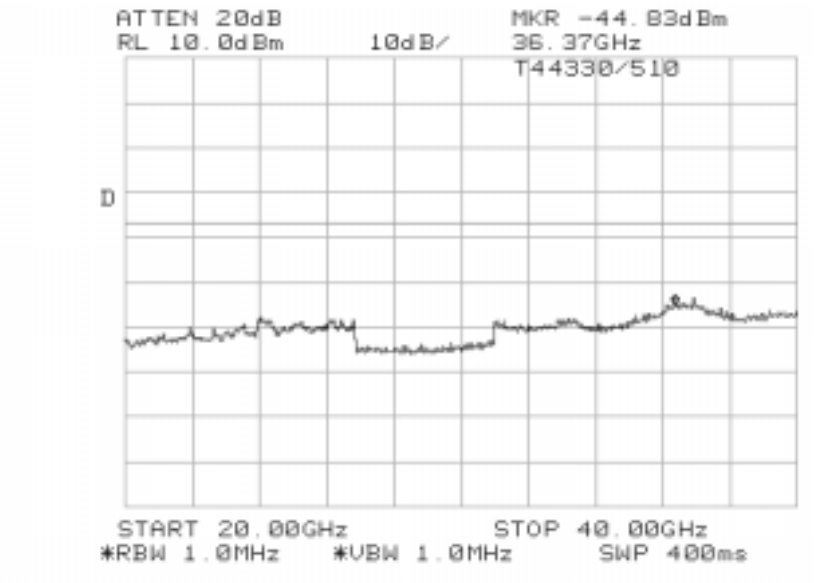


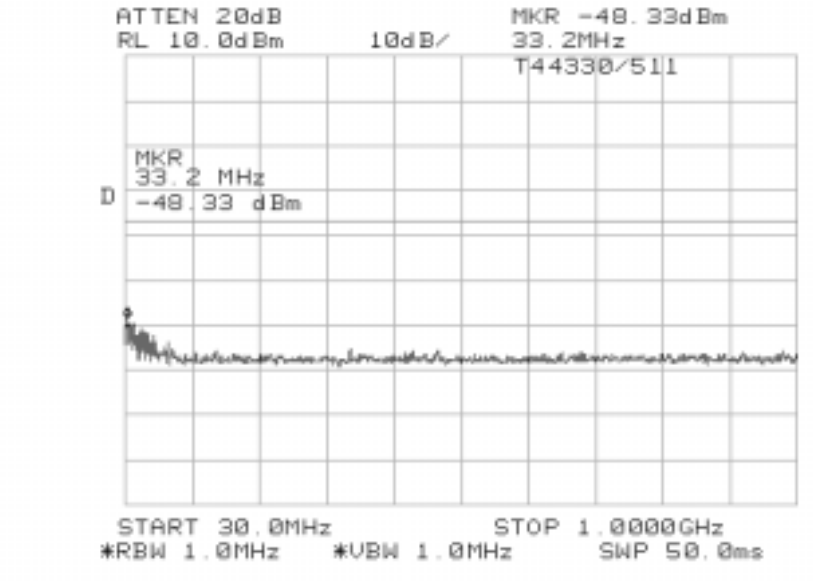
Client:	CardAccess	Job Number:	J44185
Model:	CAWCB500 (Turbo Mode)	T-Log Number:	T44330
		Proj Eng:	Mark Briggs
Contact:	Quinn Kunz		
Spec:	FCC Part 15 Subparts B and E	Class:	B



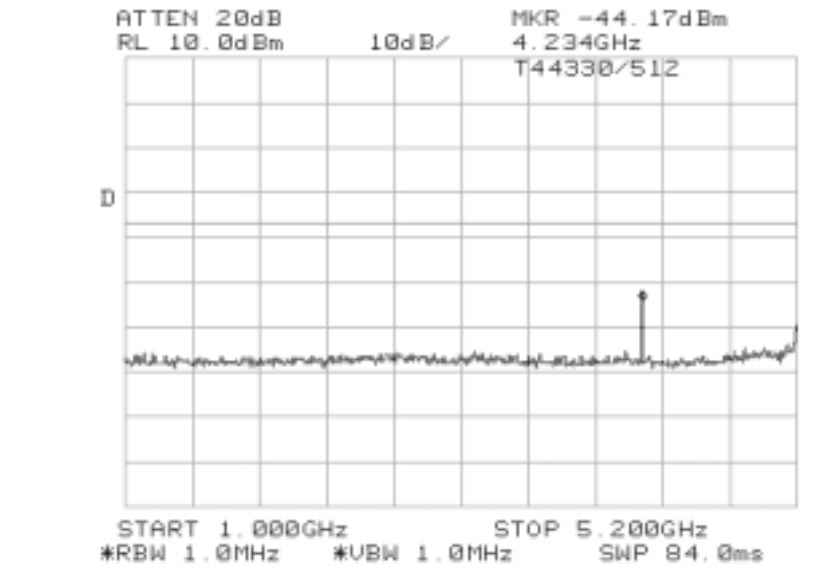


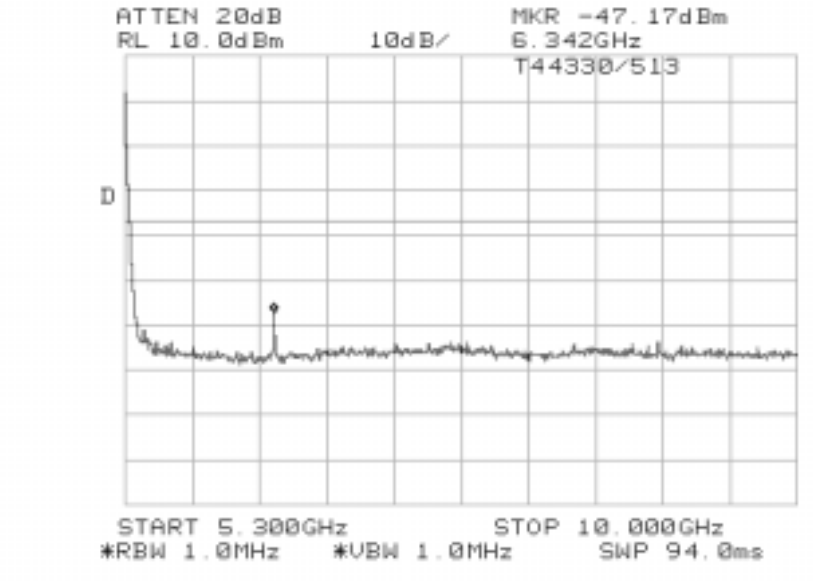
Client:	CardAccess	Job Number:	J44185
Model:	CAWCB500 (Turbo Mode)	T-Log Number:	T44330
		Proj Eng:	Mark Briggs
Contact:	Quinn Kunz		
Spec:	FCC Part 15 Subparts B and E	Class:	B



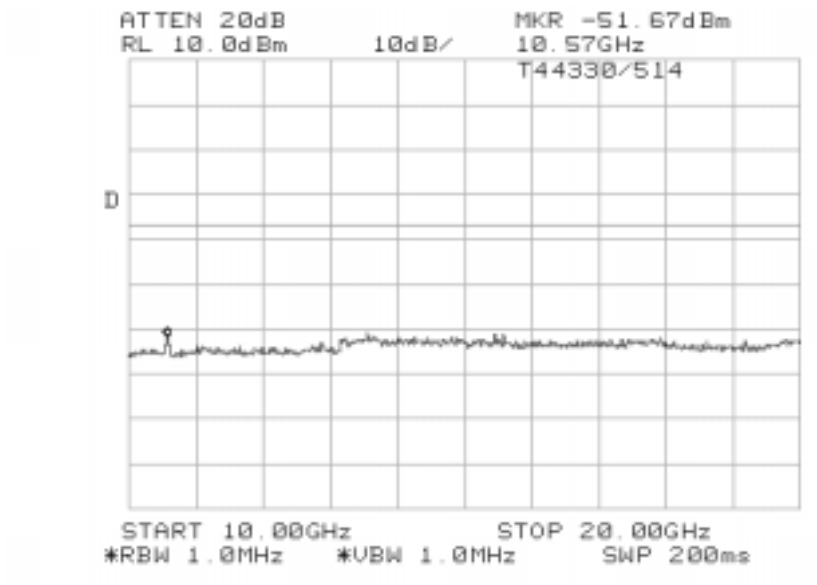


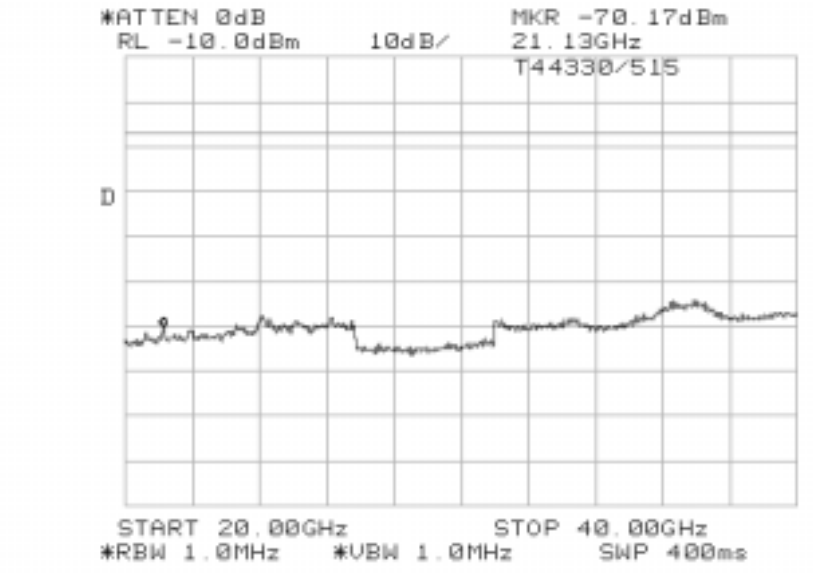
Client:	CardAccess	Job Number:	J44185
Model:	CAWCB500 (Turbo Mode)	T-Log Number:	T44330
		Proj Eng:	Mark Briggs
Contact:	Quinn Kunz		
Spec:	FCC Part 15 Subparts B and E	Class:	B





Client:	CardAccess	Job Number:	J44185
Model:	CAWCB500 (Turbo Mode)	T-Log Number:	T44330
		Proj Eng:	Mark Briggs
Contact:	Quinn Kunz		
Spec:	FCC Part 15 Subparts B and E	Class:	B



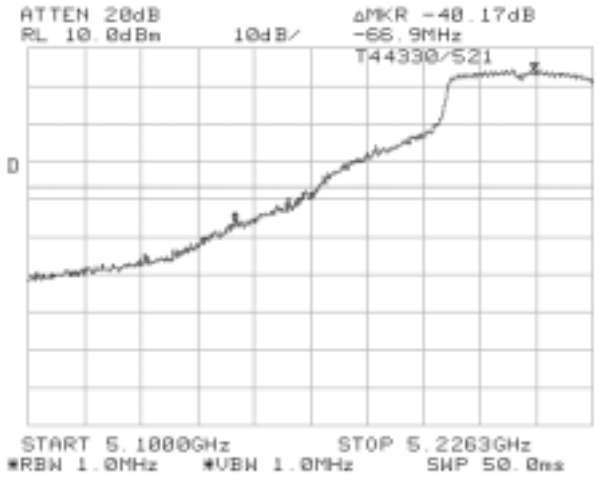


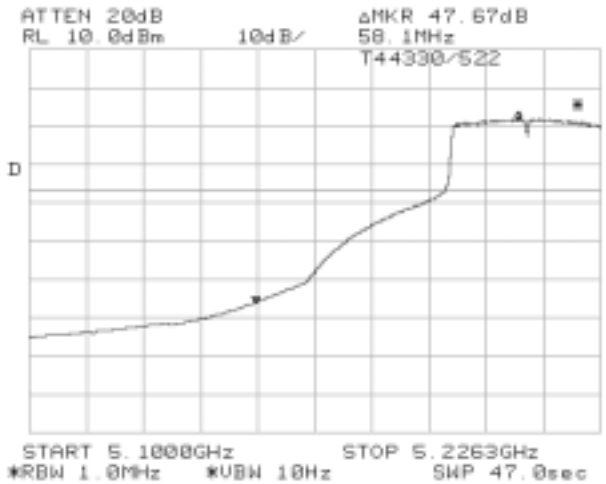
Client:	CardAccess	Job Number:	J44185
Model:	CAWCB500 (Turbo Mode)	T-Log Number:	T44330
		Proj Eng:	Mark Briggs
Contact:	Quinn Kunz		
Spec:	FCC Part 15 Subparts B and E	Class:	B

Band Edge Measurements:

For signals in the restricted bands immediately above and below the 5.15 to 5.35 GHz allocated band a measurement was made of the amplitude of the spurious emissions with respect to the intentional signals. The relative amplitude, in dBc, was then applied to the average and peak field strength of the intentional signal made on the OATS to calculate the field strength of the unintentional signals.

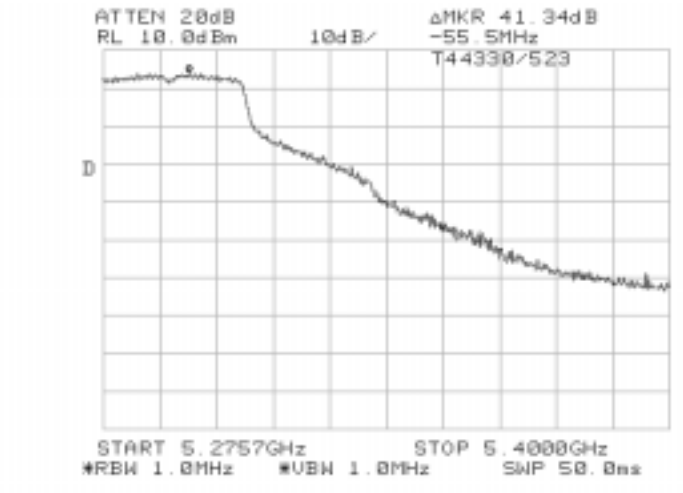
5.15 GHz band edge EUT operating on channel 9 (lowest channel in turbo mode):
The highest signal in the 4.5 to 5.15 GHz band was -40.2dBc (Peak) / -47.7dBc (Average)





Client:	CardAccess	Job Number:	J44185
Model:	CAWCB500 (Turbo Mode)	T-Log Number:	T44330
		Proj Eng:	Mark Briggs
Contact:	Quinn Kunz		
Spec:	FCC Part 15 Subparts B and E	Class:	B

5.35 GHz band edge EUT operating on channel 17 (highest channel):
The highest signal in the 5.35 to 5.46 GHz band was -41.3dBc (Peak) / - 47.7dBc (Average)



Client:	CardAccess	Job Number:	J44185
Model:	CAWCB500 (Turbo Mode)	T-Log Number:	T44330
		Proj Eng:	Mark Briggs
Contact:	Quinn Kunz		
Spec:	FCC Part 15 Subparts B and E	Class:	B

Run #6a: Radiated Spurious Emissions, 1000 - 40000 MHz

Spurious emissions from 30 - 1000 MHz were measured while performing emissions measurements of the digital device. The emissions were below the FCC Class B limit.

Limit for emissions in restricted bands:	54dBuV/m (Average)	74dBuV/m (Peak)
Limit for emissions outside of restricted bands:	EIRP < -27dBm/MHz	

Fundamental signal measurements (to calculate the band edge field strengths):

Frequency	Level	Pol	15.209 / 15.407		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
5210.0	102.2	v	-	-	Pk	336	1.7	RBW = VBW = 1 MHz
5210.0	91.7	v	-	-	Avg	336	1.7	RBW = 1MHz, VBW = 10Hz
5210.0	99.5	h	-	-	Pk	310	2.2	RBW = VBW = 1 MHz
5210.0	88.9	h	-	-	Avg	310	2.2	RBW = 1MHz, VBW = 10Hz
5290.0	104.7	v	-	-	Pk	310	1.5	RBW = VBW = 1 MHz
5290.0	94.6	v	-	-	Avg	310	1.5	RBW = 1MHz, VBW = 10Hz
5290.0	99.4	h	-	-	Pk	311	2.2	RBW = VBW = 1 MHz
5290.0	89.0	h	-	-	Avg	311	2.2	RBW = 1MHz, VBW = 10Hz

Band Edge Field Strength Calculations

Frequency	Level	Pol	15.209 / 15.407		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
5350.0	46.9	v	54.0	-7.1	Avg	313	1.5	Note 2
5150.0	44.0	v	54.0	-10.0	Avg	336	1.7	Note 1
5350.0	63.4	v	74.0	-10.6	Pk	313	1.5	Note 2
5150.0	62.0	v	74.0	-12.0	Pk	336	1.7	Note 1

Note 1:	EUT operating on channel **9** (lowest channel). Signal level calculated using the relative measurements in run #5 (-40.2dBc for peak and -47.7dBc for average) applied to the highest peak and average field strength measurements of the fundamental signal level.
Note 2:	EUT operating on channel **17** (highest channel). Signal level calculated using the relative measurements in run #5 (-41.3dBc for peak and -47.7dBc for average) applied to the highest peak and average field strength measurements of the fundamental signal level.

Client:	CardAccess	Job Number:	J44185
Model:	CAWCB500 (Turbo Mode)	T-Log Number:	T44330
		Proj Eng:	Mark Briggs
Contact:	Quinn Kunz		
Spec:	FCC Part 15 Subparts B and E	Class:	B

Run #6b: Radiated Spurious Emissions, 1000 - 40000 MHz
Other Spurious Emissions: EUT On Channel 9 (5.21 GHz)

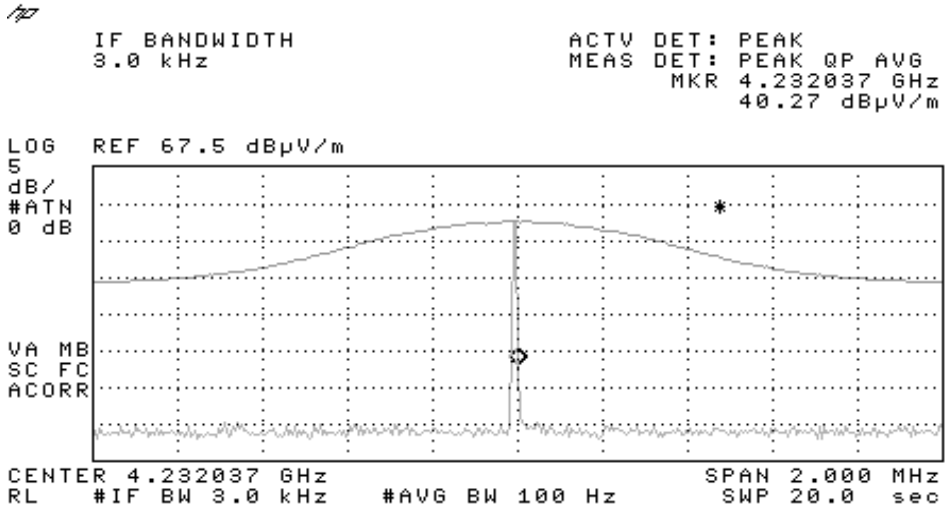
Frequency	Level	Pol	15.209 / 15.407		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
15630.0	50.2	v	54.0	-3.8	Avg	284	1.5	Note 2; Analyzer noise floor
15630.0	49.9	h	54.0	-4.1	Avg	295	1.7	Note 2; Analyzer noise floor
4168.2	45.4	h	54.0	-8.6	Pk	361	1.2	Note 2; Analyzer noise floor
15630.0	62.9	h	74.0	-11.1	Pk	295	1.7	Note 2; Analyzer noise floor
15630.0	62.6	v	74.0	-11.4	Pk	284	1.5	Note 2; Analyzer noise floor
4168.2	42.4	v	54.0	-11.6	Pk	275	1.2	Note 2; Analyzer noise floor
10420.0	56.0	h	68.3	-12.3	Note 3	303	1.7	Not in restricted band
10420.0	56.0	v	68.3	-12.3	Note 3	252	1.4	Not in restricted band
4168.2	39.8	h	54.0	-14.2	Avg	361	1.2	Note 2; Analyzer noise floor
4168.2	38.9	v	54.0	-15.1	Avg	275	1.2	Note 2; Analyzer noise floor
6252.1	49.5	v	68.3	-18.8	Note 3	297	1.3	Not in restricted band
EUT On Channel 13 (5.25 GHz)								
15750.0	50.0	v	54.0	-4.0	Avg	247	1.6	Note 2; Analyzer Noise Floor
15750.0	49.8	h	54.0	-4.2	Avg	308	1.5	Note 2; Analyzer Noise Floor
4200.0	49.5	h	54.0	-4.5	Pk	267	1.4	Note 2,4
4200.0	48.4	v	54.0	-5.6	Pk	352	1.8	Note 2,4
10492.5	60.7	v	68.3	-7.6	Note 3	279	1.5	Not in restricted band
10492.5	59.8	h	68.3	-8.5	Note 3	265	1.6	Not in restricted band
15750.0	62.3	v	74.0	-11.7	Pk	247	1.6	Note 2; Analyzer Noise Floor
15750.0	62.3	h	74.0	-11.7	Pk	308	1.5	Note 2; Analyzer Noise Floor
4200.0	41.4	v	54.0	-12.6	Avg	352	1.8	Note 2
4200.0	39.4	h	54.0	-14.6	Avg	267	1.4	Note 2
6300.0	51.4	v	68.3	-16.9	Note 3	301	1.5	Not in restricted band
EUT On Channel 17 (5.29 GHz)								
15870.0	50.0	h	54.0	-4.0	Avg	258	1.6	Note 2; Analyzer Noise Floor
15870.0	49.9	v	54.0	-4.1	Avg	293	1.6	Note 2; Analyzer Noise Floor
4232.1	49.1	v	54.0	-4.9	Pk	313	1.6	Note 2,4
4232.1	49.1	h	54.0	-4.9	Pk	260	1.8	Note 2,4
10582.5	63.3	v	68.3	-5.0	Note 3	281	1.4	Not in restricted band
4232.1	47.5	v	54.0	-6.5	Avg	313	1.6	Note 2,4
4232.1	46.9	h	54.0	-7.1	Avg	260	1.8	Note 2,4
10582.5	59.9	h	68.3	-8.4	Note 3	291	1.6	Not in restricted band
15870.0	62.8	v	74.0	-11.2	Pk	293	1.6	Note 2; Analyzer Noise Floor
15870.0	62.5	h	74.0	-11.5	Pk	258	1.6	Note 2; Analyzer Noise Floor
6348.2	54.0	h	68.3	-14.4	Note 3	316	1.5	Not in restricted band; Noise Floor

See following page for test notes...

Client:	CardAccess	Job Number:	J44185
Model:	CAWCB500 (Turbo Mode)	T-Log Number:	T44330
		Proj Eng:	Mark Briggs
Contact:	Quinn Kunz		
Spec:	FCC Part 15 Subparts B and E	Class:	B

...test notes for run 6b

Note 1:	For emissions falling in the restricted bands detailed in 15.205 the general limits of 15.209 apply. For all other emissions the limit is EIRP < -27dBm (equivalent to a field strength at 3m of 68dBuV/m)
Note 2:	Signal is in a restricted band
Note 3:	Restricted Band Peak Measurements: Resolution and Video BW: 1 MHz, Restricted Band Average Measurements: Resolution Bw: 1MHz and Video Bw: 10 Hz. All other measurements, RBW = 1MHz and VBW = 3MHz, video averaging on (100 samples).
Note 4:	This measurement was made using a resolution bandwidth of 3 kHz The instrumentation noise floor was too high to allow measurements with RBW = 1MHz because a preamplifier could not be used (with the EUT operating the intentional signal would overload the amplifier and there is no low pass filter with sufficient shape factor to reject the intentionally trasmitted signal but pass the spuroius signal). The signal was a narrowband signal (as verified during the conducted antenna measurements) and so the amplitude (peak/average) in a 3kHz bandwidth would be the same as that in a 1MHz bandwidth (please refer to the plot below). The peak reading has been compared with the average limit.



Plot showing LO signal at 4GHz measured using RBW = 1MHz and RBW = 3kHz. Amplitude of the signal does not change with resolution bandwidth.