



EMC Measurement / Technical Report

FCC Test Specification : Certification for FCC Part 15, Subpart C §15.249

Manufacturer : ITERIS

Equipment Under Test : Vantage Wireless Camera
Model CAM-RZ3W

Test Report No. : FR1318

Purchase Order No. : T40797

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EMC Measurement / Technical Report

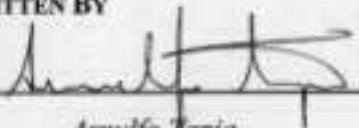
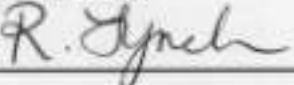
Document No. FR1318

From

**Garwood Laboratories, Inc.
World Compliance Division**

**Test for
ITERIS**

**Vantage Wireless Camera
Model No. CAM-RZ3W**

WRITTEN BY  <i>Arnulfo Tapia</i> EMC SR. Technician	REVIEWED BY  <i>Robert E. Lynch</i> Quality Manager	REVIEWED BY  <i>Ed Nakauchi</i> EMC Chief Engineer NARTE, Certified
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<i>Test Personnel</i>	<i>Test Dates</i>
Eric Nguyen – Lead EMC Engineer	December 20, 1999

Test Facility Address City, State, Zip Code Phone Fax	Garwood Laboratories, Inc. 565 Porter Way Placentia, CA 92870 (714) 572-2027 (714) 572-2025
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MEASUREMENT / TECHNICAL REPORT SUMMARY

Manufacturer Company Address City, State, Zip Country Contact Name Phone Fax	ITERIS 1515 S. Manchester Ave Anaheim, CA 92802-2907 USA Rick Crawshaw 714-780-7280 714-780-7266
Type of Authorization	Certification for an Intentional Radiator
Applicable FCC Rules	Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 Parts 0 to 19 (10-1-98 Edition). The following subparts are applicable to the results in this test report: Part 15, Subpart C – Intentional Radiators §15.249 Operation within the bands 902-928MHz, 2400-2483.5MHz, 5725-5875MHz, & 24.0-24.25GHz § 15.203 Antenna requirements § 15.207 Conducted limits § 15.209 Radiated emission limits; general requirements Part 2, Subpart J – Equipment Authorization Procedures Certification sections
Equipment Under Test	Vantage Wireless Camera Model No. CAM-RZ3W
Summary of Data	The EUT complied with all the applicable FCC rules as listed above.

EMC Test Laboratory Facility Address City, State, Zip Code Country Contact Name Title Phone Fax	Garwood Laboratories Incorporated World Compliance Division 565 Porter Way Placentia, CA 92870 USA Jason Armstrong General Manager (714) 572-2027 (714) 572-2025
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1. GENERAL INFORMATION

1.1 Product Description

<i>Equipment Under Test</i>	Vantage Wireless Camera
<i>Model Number</i>	CAM-RZ3W
<i>Description</i>	The EUT is a low power wireless camera that is used for vehicle detection for signal control systems (for example traffic lights). The recommended mounting location of the EUT is on the Safety Light Arm above the signal head. The safety light circuit provides power to the EUT. The modulation method used by the transmitter is Frequency Modulation. The antenna of the EUT is a 3" Omni-directional Rubber Duck Type that is not accessible to the user after installation.
<i>Transmitting Frequencies</i>	Camera Transmitting Frequencies - Channel 1 - 2400 MHz Channel 2 - 2427 MHz Channel 3 - 2454 MHz Channel 4 - 2481 MHz Note the EUT's transmitting frequency channel is determined by a Selector Shunt (jumper wire).
<i>EUT Clock Frequencies</i>	4.0 MHz, 6.0 MHz, and 6.5 MHz

Refer to the products data sheet, which has been included as an Attachment to this report for additional details about the EUT.

1.2 Related Submittal(s)/ Grant(s)

Peripherals tested with the EUT, which contain FCC ID numbers can be located in the table in Section 3.6 of this report.

1.3 Tested System Description

The Tested System was configured with all typical peripherals (or terminations) and operated to generate the maximum emissions during the test. Refer to Section 3.5 Tested System configuration and Section 3.6 table lists all the details for the tested system components and cabling information. FCC ID numbers are included if available for a tested system component.



1.4 Test Methodology

Conducted emissions tests were performed according to the general provisions of ANSI C63.4-1992 (American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz).

The Equipment Under Test (EUT) was setup in a shielded enclosure to perform the conducted emissions measurements in a typical installation configuration. The EUT was powered from the 50 μ H/50 Ω Line Impedance Stabilization Networks (LISN). The LISN's unused connections were terminated with a 50-ohm load. The amplitude level (dB μ V) of the emissions were maximized by varying the modes of operation of the EUT and its cables. The frequency range of 450 kHz to 30 MHz was measured with the receiver in peak detection.

The test for unwanted emissions was performed according to the general provisions of ANSI C63.4-1992 (American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz).

The EUT was setup on a non-conductive table, 1.0 x 1.5m, in the Open Area Test Site. The test for unwanted emissions was performed at an EUT to receiving antenna distance of 3 meters. The radiated emissions were maximized by rotating the turntable 360 degrees and varying the antenna height from 1 to 4 meters. The field strength of the fundamental frequency and harmonics, up to the 10th harmonic, were measured utilizing a BiLog and Double Ridge Guide Horn antenna. Measurements were made in both, vertical and horizontal antenna polarizations.



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1.5 Test Facility

The Open Area Test Site (OATS) and measurement facilities used to collect the test data are located at Garwood Laboratories, Inc. World Compliance Division test facility in Placentia, CA. This facility has been fully described in a report submitted to the FCC and accepted in a letter dated 29 January 1999 (31040/SIT 1300F2) registration #90681.

The test facility is also recognized and accredited from following accreditation organizations:

NVLAP

Garwood Laboratories, Inc. is recognized under the National Voluntary Laboratory Accreditation Program (NVLAP/NIST) for satisfactory compliance with criteria established in Title 15, Part 285 Code of Federal Regulations. These criteria encompass the requirements of ISO/IEC Guide 25 and the relevant requirements of ISO 9002 (ANSI/ASQC Q92-1987) as suppliers of calibration or test results. NVLAP Code: 200119-0, Effective through December 31, 2000.

FCC

This site has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Reference : 31040/SIT 1300F2, Registration #90681, January 29, 1999. With the above and NVLAP, Garwood Laboratories is an authorized test laboratory for the DoC process.

Technology International (I²T)

Garwood Laboratories, Inc. has been assessed in accordance with ISO Guide 25 and with ITI's assessment criteria. Based upon this assessment, Technology International (Europe), Ltd. Has granted approval for specifications implementing the EU Directive on EMC (89/336/EEC). The scope of the approval was provided on a Schedule of Assessment supplied with a certificate and is available upon request. Certificate #99-051, Dated: May 5, 1999.

ACA

Garwood Laboratories, Inc. can also perform testing for the Australian C-Tick mark as a result of our NVLAP accreditation and the MRA (Mutual Recognition Agreement) between the US and Australia.

VCCI

Garwood Laboratories, Inc. has been accepted as a member to the VCCI. Our conducted and radiated measurement facilities have been registered in accordance with Regulations for Voluntary Control Measures. Registration C574, C575, C576, R561 Effective through February 4, 2000.

Industry Canada

Garwood Laboratories, Inc. is registered by Industry Canada for performance of measurements and complies with RSP 100. Reference IC 3298, Dated: March 11, 1999.

BSMI (Formerly known as BCIQ)

Garwood Laboratories, Inc. can perform testing for Taiwan to the CNS requirements. This is as a result of our NVLAP accreditation and the MRA (Mutual Recognition Agreement) between the US and Taiwan.



2. PRODUCT LABELING

2.1 FCC ID Label

All devices authorized under the certification procedures are required to display an identification label showing the FCC Identifier (FCC ID) under which they are authorized.

Example:

FCC ID: XXX CAM-RZ3W

XXX Indicates Manufacturer's Grantee Code

In addition, the manufacturer (or importer) is responsible for having the compliance label produced, and for having it affixed to each unit that is marketed or imported.

FCC Compliance Label:

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference including interference that may cause undesired operation.

2.2 Location of Label on EUT

As stated in §15.19, the label shall be located in a conspicuous location on the device. When the device is so small or for such use that it is not practicable to place the compliance label on it, the information required should be placed in a prominent location in the instruction manual or pamphlet supplied to the user. Alternatively, the compliance label can be placed on the container in which the device is marketed. However, the FCC identifier must be displayed on the device.

2.3 Information to the user

The users manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.



3. SYSTEM TEST CONFIGURATION

3.1 Justification

The EUT was used in a system configured for testing in a typical fashion, as a customer would normally use it.

3.2 EUT Exercise Software/Equipment

The following operating mode was used during testing to exercise the functions of the EUT.

1. Upon power up, all the functions of the EUT were activated. For example, the camera was ON and the transmitter was continuously transmitting.

3.3 Special Accessories

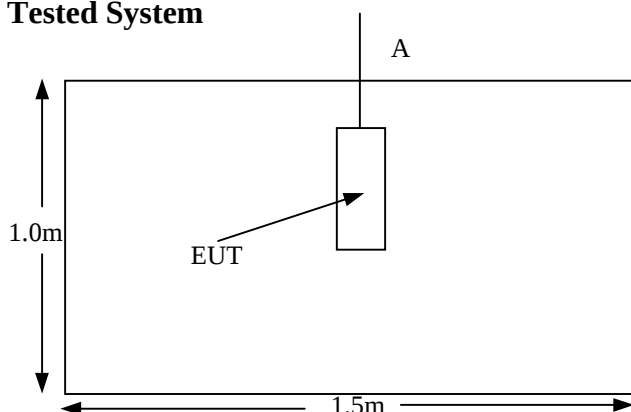
The EUT requires no special accessories to comply with the limits.

3.4 Equipment Modifications

No modifications were made to achieve the required specification limit.



3.5 Configuration of Tested System



The EUT Model CAM-RZ3W was tested as a standalone system

3.6 Details of Tested System

The following table lists all of the components of the tested system. FCC ID numbers are included if available for a tested system component. Refer to the table following Tested System Details for cabling information.

<i>Item No.</i>	<i>Manufacturer</i>	<i>Description</i>	<i>Identification Numbers</i>
1	None	None	Model No: Not applicable Serial No.: Not applicable

The EUT was tested as a standalone system. No accessory/peripheral equipment was used during testing.

The following table lists all of the cabling details for the tested system.

<i>Cabling of The Tested System</i>					
<i>Item No.</i>	<i>Description</i>	<i>Length (m)</i>	<i>Type Shielded-S Unshielded-US</i>	<i>Connected From</i>	<i>Connected To</i>
A	Camera Power Cable	2.3	Unshielded	EUT	AC Source



4. BLOCK DIAGRAM(S) OF EUT

Please refer to the Attachment Section of this report for a Block Diagram of the EUT.



5. TEST MEASUREMENT PHOTOS

Photo: Conducted Emissions (Front View)

Photo: Conducted Emissions (Rear View)



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Photo: Radiated Emissions (Front View)

Photo: Radiated Emissions (Rear View)



6. TEST DATA

6.1 Conducted Emissions Limits

<i>FCC Pt.15 Class A</i>		
<i>Frequency (MHz)</i>	<i>Quasi Peak Limit (dBuV)</i>	<i>Remarks</i>
0.45 – 1.705	60	None
1.705 - 30.0	69.5	None

6.2 Conducted Emissions Results

The initial step in collecting data is a spectrum analyzer peak scan of the measurement range. Significant peaks are then marked as shown on the data page, and these signals are then quasi-peaked if necessary. The following data lists the significant emission frequencies and measured levels from the EUT.

<i>Sensor Location</i>	<i>Frequency Band (MHz)</i>	<i>Measured* (dBμV)</i>	<i>Delta To Limit (dB)</i>
Line	1.016	50.5	-9.5
	0.5104	48.7	-11.3
	6.066	55.7	-13.8
	6.117	55.2	-14.3
	10.160	53.6	-15.9
	4.599	52.7	-16.8
Neutral	1.007	47.1	-12.9
	0.5082	45.3	-14.7
	6.015	53.1	-16.4
	3.061	51.8	-17.7
	11.050	51.5	-18.0
	10.080	51.4	-18.1

- All readings are peak with specified CISPR bandwidth unless stated otherwise.

Test Personnel:

Eric Nguyen – Lead EMC Engineer



6.3 General Radiated Emissions Requirements

Emissions that are radiated outside of the specified frequency bands, except for harmonics, should be attenuated by at least 50 dB below the level of the fundamental or to the general radiated limits in §15.209, whichever is the lesser attenuation.

6.4 General Radiated Emissions Results

The following data lists the significant emission frequencies, measured levels, correction factor (includes cable, preamplifier and antenna corrections), the corrected reading, plus the limit.

<i>Worst-Case Radiated Emissions from 30 – 1000MHz</i>				
	<i>Frequency (MHz)</i>	<i>Detection Mode</i>	<i>Corrected Reading (dBμV/m)</i>	<i>Delta to the 10m Quasi-Peak Limit(dB)</i>
1.	NDS	-	-	-

- All readings are peak with specified CISPR bandwidth unless stated otherwise.
- NDS: There were no detectable signals from the EUT from 30 – 1000MHz.

Test Personnel:

Eric Nguyen – Lead EMC Engineer



6.5 Field Strength Requirements for Intentional Radiators

<i>FCC Part 15, Subpart C, § 15.249</i>		
Fundamental frequency	Field Strength of Fundamental (millivolts/meter)	Field Strength of Harmonics (microvolts/meter)
902 – 928 MHz	50	500
2400 – 2486.5 MHz	50	500
5725 – 5875 MHz	50	500
24.0 – 24.25 GHz	250	2500

The applicable limits for the EUT are those listed for fundamental operating frequencies falling within the band of 2400-2486.5 MHz.



6.6 Summary Table for Highest Field Strength Levels for an Intentional Radiator

The following table lists the fundamental and harmonic emission frequencies, spectrum analyzer measured levels, correction factor (includes cable loss, preamplifier gain and antenna factor), the corrected reading, and the specification limit.

EUT Name: Vantage Wireless Camera

Operating Frequency Channel 1 – 2400 MHz

Test (1) Results:

Wireless Camera A, #52 Fundamental Frequency - 2400MHz								
Antenna Polarity (V or H)	Tuned Frequency (MHz)	S.A. Peak Reading (dBμV)	S.A. Average Reading (dBμV)	Correction Factor (dB)	Field Strength @3m Peak (dBμV/m)	Field Strength @3m Average (dBμV/m)	FCC Limit @3m Average (dBμV/m)	Delta to Limit (Average) (dB)
V	2400	61.7	53.9	30.9	92.6	84.8	94.0	-9.2

Note only the fundamental frequency was measured. There were no harmonics of the fundamental frequency detected.

EUT Name: Vantage Wireless Camera

Operating Frequency Channel 4 – 2481 MHz

Test (2) Results:

Wireless Camera B, #33 Fundamental Frequency – 2481MHz								
Antenna Polarity (V or H)	Frequency (MHz)	S.A. Peak Reading (dBμV)	S.A. Average Reading (dBμV)	Correction Factor (dB)	Field Strength @3m Peak (dBμV/m)	Field Strength @3m Average (dBμV/m)	FCC Limit @3m Average (dBμV/m)	Delta to Limit (Average) (dB)
V	2481	63.5	56.5	30.9	94.4	87.4	94.0	-6.6

Note only the fundamental frequency was measured. There were no harmonics of the fundamental frequency detected.

Notes:

- As per §15.249 (d) & as shown in §15.35 (b), for frequencies above 1000MHz, the field strength limits set forth in §15.249 (a) are based on average limits. However, the peak field strength of any emission should not exceed the maximum permitted average limits specified by more than 20dB. Average emission measurements were made with the following Spectrum Analyzer settings (RBW 1MHz VBW 10Hz)



6.7 Field Strength Calculation

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

$$FS = RA + AF + CF - AG$$

Where: FS = Field strength

RA = Receiver Amplitude

AF = Antenna Factor

CF = Cable Attenuation Factor

AG = Amplifier gain

Example:

Assume a receiver reading of 52.5 dB μ V is obtained. The Antenna Factor of 7.4 and a Cable Factor of 1.1 is added. The Amplifier Gain of 29 dB is subtracted, giving a field strength of 32 dB μ V/m.

$$FS = 52.5 + 7.4 + 1.1 - 29 = 32 \text{ dB}\mu\text{V/m}$$



APPENDIX A - TEST EQUIPMENT USED

The absolute performance calibration of equipment requiring calibration is performed on an as needed basis in accordance with MIL-STD 45662A. However, calibration periods do not exceed one (1) year. The test equipment is capable of making measurements within tolerances of at least +/- 2dB amplitude and +/- 2% frequency deviation. Equipment certifications showing traceability to NIST (National Institute of Standards and Technology) are maintained on file at Garwood Laboratories, Inc. Placentia, CA. All equipment is checked and verified for proper operation before and after each series of tests.

A.1 Specific Equipment Used

<i>Test</i>	<i>Instrument</i>	<i>MFG / Model No.</i>	<i>Asset No.</i>	<i>CAL. Due Date</i>
<i>Conducted Emission Test</i>				
	EMI Receiver System	Hewlett Packard	System 1	07/15/00
	RF Coax Cable	Pasternack / RG 223	20170	03/05/00
	Line Impedance Stabilization Network	ISCI/3PH-20A	20071	03/16/00
<i>Radiated Emission Test</i>				
	EMI Receiver System	Hewlett Packard	System 3	10/14/00
	RF Coax Cable	Times Microwave / LMR 600	20180	03/05/00
	BiLog Antenna	Chase / CBL6111A	20062	07/09/00
	Pre-Amplifier	ISCI / RFPA/Z FL-2000	20007	03/05/00
	Spectrum Analyzer	Hewlett Packard / 8566B	20257	01/09/00
	Preamplifier (Above 1000MHz)	Hewlett Packard / 8449B	20003	10/14/00
	Double Ridge Guide Horn Antenna	Emco / 3115	20056	01/27/00



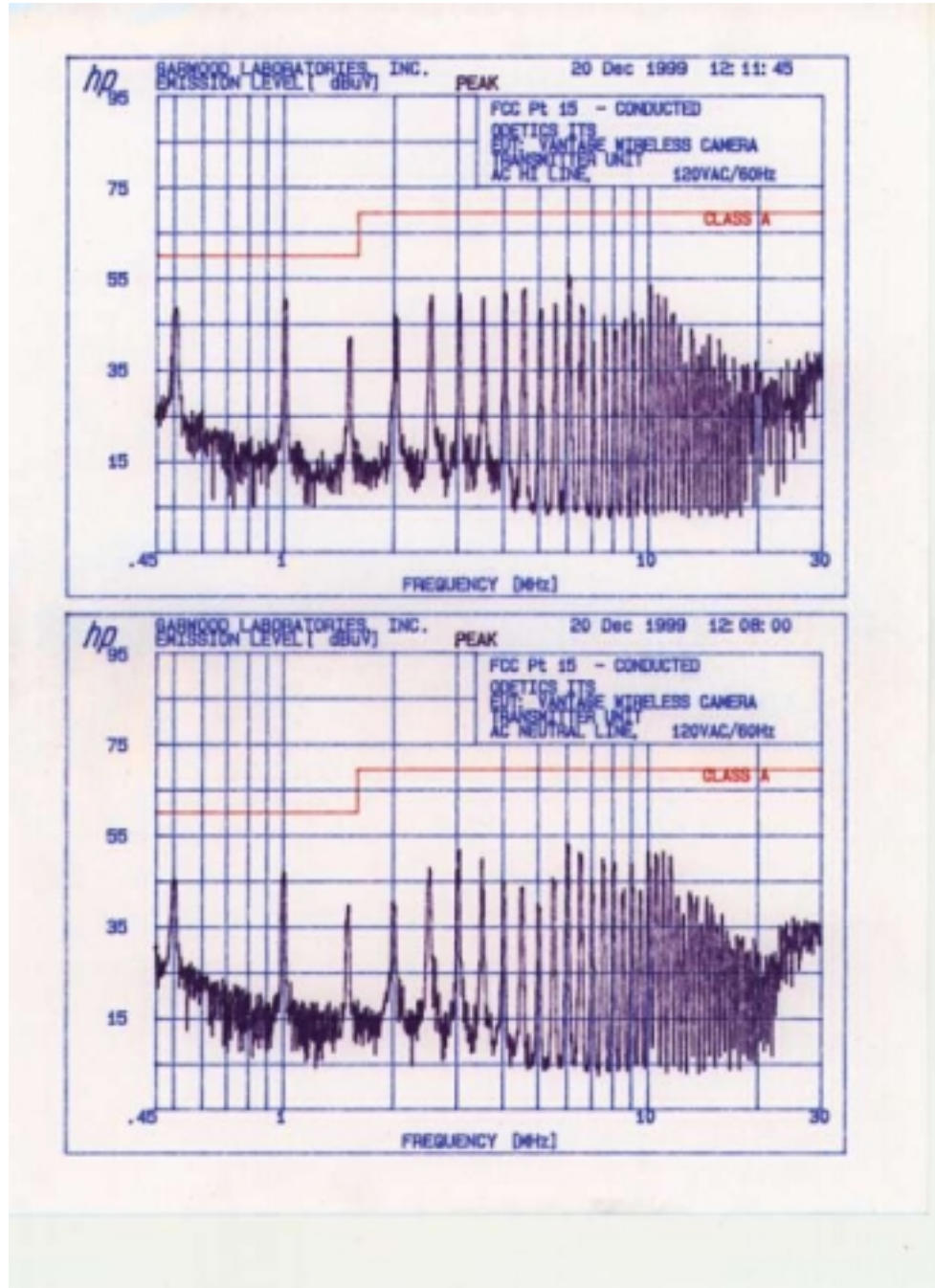
APPENDIX B – SUPPLEMENTAL TEST DATA

<i>Test Type</i>	<i>Basic Standard</i>	<i>Details</i>	<i>Data Format</i>	<i>Page No.</i>
Conducted Emissions	FCC Pt.15 Class A	Vantage Wireless Camera Conducted Emissions Test plots. The EUT was tested at 120VAC 50Hz	Plotted	D1



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D1





ATTACHMENTS

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