COMMUNICATION CERTIFICATION LABORATORY

1940 West Alexander Street
Salt Lake City, UT 84119
801-972-6146

Test Report

Certification

Test Of:

RM-1

FCC ID#:

W4YRM-1

Test Specification:

FCC PART 15, Subpart C

Test Report Serial No: 2098

Applicant:

Ring Engineering
7503 Pershing Road
Schereville, IN 46375

Date of Test: March 11, 2009

Issue Date: March 16, 2009

Accredited Testing Laboratory By:

NVLAP

NVLAP Lab Code 100272-0

CERTIFICATION OF ENGINEERING REPORT

This report has been prepared by Communication Certification Laboratory to document compliance of the device described below with the requirements of Federal Communications Commission (FCC) Part 15, Subpart C. This report may be reproduced in full. Partial reproduction may only be made with the written consent of the laboratory. The results in this report apply only to the sample tested.

- Applicant: Ring Engineering
- Manufacturer: Ring Engineering
- Brand Name: Ring Engineering
- Model Number: RM-1
- FCC ID Number: W4YRM-1

On this 16th day of March 2009, I, individually, and for Communication Certification Laboratory, certify that the statements made in this engineering report are true, complete, and correct to the best of my knowledge, and are made in good faith.

Although NVLAP has accredited the Communication Certification Laboratory EMC testing facilities, this report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

COMMUNICATION CERTIFICATION LABORATORY

Tested by: Norman P. Hansen
EMC Technician

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SECTION 1.0 CLIENT INFORMATION

1.1 Applicant:

Company Name: Ring Engineering
7503 Pershing Road
Schererville, IN 46375

Contact Name: Tim Ring
Title: President and CTO

1.2 Manufacturer:

Company Name: Ring Engineering
7503 Pershing Road
Schererville, IN 46375

Contact Name: Tim Ring
Title: President and CTO

SECTION 2.0 EQUIPMENT UNDER TEST (EUT)

2.1 Identification of EUT:

Brand Name: Ring Engineering
Model Number: RM-1
Serial Number: None
Country of Manufacture: U.S.A.

2.2 Description of EUT:

The RM-1 is a 2.4 GHz radio transceiver module designed for IEEE 802.15.4 applications. The RM-1 transmits on one of 16 channels in the 2400 to 2483.5 MHz frequency band. The RM-1 is designed to be incorporated into other assemblies to facilitate wireless communications. The RM-1 was connected to a Ring Engineering HC-1 for testing. A CUI Inc. EPS060100, 6.0 Vdc power supply was used to power and charge the batteries of the HC-1.

The transceiver of the RM-1 uses 16 channels in the 2400 to 2483.5 MHz band. The channels are shown in the table below.

Channel Designation	Frequency (MHz)	Channel Designation	Frequency (MHz)
11	2405	19	2445
12	2410	20	2450
13	2415	21	2455
14	2420	22	2460
15	2425	23	2465
16	2430	24	2470
17	2435	25	2475
18	2440	26	2480

This testing and report covers the requirements of FCC Part 15, Subpart C. The EUT is also required to meet the requirements of FCC Part 15, Subpart B which is to be covered in separate testing and report. See CCL test report #2097.

2.3 EUT and Support Equipment:

The FCC ID numbers for all the EUT and support equipment used during the test are listed below:

Brand Name Model Number	FCC ID Number	Description	Name of Interface Ports / Interface Cables
BN: Ring Engineering MN: RM-1 (Note 1)	W4YRM-1	Transmitter Module	See Section 2.4
BN: Ring Engineering MN: HC-1	None	Handheld Controller	DC/DC power cord from wall charger/power supply Transmitter interface/ribbon cable (Note 2)
BN: CUI Inc. MN: EPS060100	DoC	Power Supply	AC/Direct connection to AC outlet – 2 prong DC/2 conductor cord

Note: (1) EUT.
(2) Interface port connected to EUT (See Section 2.4)

The support equipment listed above was not modified in order to achieve compliance with this standard.

2.4 Interface Ports on EUT:

Name of Port	No. of Ports Fitted to EUT	Cable Descriptions/Length
Device Interface	1	10 conductor ribbon cable (8 conductors used)/20 cm Note: This port is normally soldered directly to the traces on the host device. The EUT was connected to the host system via the ribbon cable for testing as a modular device.

2.5 Modification Incorporated/Special Accessories on EUT:

There were no modifications or special accessories required to comply with the specification.

Signature: _____

Typed Name: Tim Ring

Title: President and CTO

SECTION 3.0 TEST SPECIFICATION, METHODS & PROCEDURES

3.1 Test Specification:

Title: FCC PART 15, Subpart C (47 CFR 15)
15.203, 15.207, 15.249

Limits and methods of measurement of radio interference characteristics of radio frequency devices.

FCC DA00-1407
Part 15 Unlicensed Modular Transmitter Approval Requirements

Purpose of Test: The tests were performed to demonstrate initial compliance.

3.2 Methods & Procedures:

3.2.1 §15.203 Antenna Requirement

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 a broken antenna can be replaced by the user, 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.

3.2.2 §15.207 Conducted Limits

(a) Except for Class A digital devices, for equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHZ to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization

network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the band edges.

Frequency of Emission (MHz)	Conducted Limit (dBμV)	
	Quasi-peak	Average
0.15 – 0.5*	66 to 56*	56 to 46*
0.5 – 5	56	46
5 - 30	60	50

*Decreases with the logarithm of the frequency.

3.2.3 §15.249 Operation within the bands of 902 -928 MHZ, 2400 – 2483.5 MHz, 5725 -5875 MHz, and 24.0 – 24.25 GHz

(a) Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental Frequency	Field Strength of Fundamental (millivolts/meter)	Field Strength of Harmonics (microvolts/meter)
902 – 928 MHz	50	500
2400 – 2483.5 MHz	50	500
5725 – 5875 MHz	50	500
24.0 – 24.25 GHz	250	2500

(b) Fixed, point-to-point operation as referred to in this paragraph shall be limited to systems employing a fixed transmitter transmitting to a fixed remote location. Point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information are not allowed. Fixed, point-to-point operation is permitted in the 24.05-24.25 GHz band subject to the following conditions:

(1) The field strength of emissions in this band shall not exceed 2500 millivolts/meter.

(2) The frequency tolerance of the carrier signal shall be maintained within + 0.001% of the operating frequency over a temperature variation of –20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

(3) Antenna gain must be at least 33 dBi. Alternatively, the main lobe beamwidth must not exceed

3.5 degrees. The beamwidth limit shall apply to both the azimuth and elevation planes. At antenna gains over 33 dBi or beamwidths narrower than 3.5 degrees, power must be reduced to ensure that the field strength does not exceed 2500 millivolts/meter.

(c) Field strength limits are specified at a distance of 3 meters.

(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in Section 15.209, whichever is the lesser attenuation.

(e) As shown in Section 15.35(b), for frequencies above 1000 MHz, the above field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For point-to-point operation under paragraph (b) of this section, the peak field strength shall not exceed 2500 millivolts/meter at 3 meters along the antenna azimuth.

(f) Parties considering the manufacture, importation, marketing or operation of equipment under this section should also note the requirement in Section 15.37(d).

3.2.4 Modular Approval Requirements

The requirements for obtaining a modular approval are listed below. A cover letter requesting modular approval and addressing the items below must be submitted.

1. The modular transmitter must have its own RF shielding. This is intended to ensure that the module does not have to rely upon the shielding provided by the device into which it is installed in order for all modular transmitter emissions to comply with Part 15 limits. It is also intended to prevent coupling between the RF circuitry of the module and any wires or circuits in the device into which the module is installed. Such coupling may result in non-compliant operation.

2. The modular transmitter must have buffered modulation/data inputs (if such inputs are provided) to ensure that the module will comply with Part 15 requirements under conditions of excessive data rates or over-modulation.

3. The modular transmitter must have its own power supply regulation. This is intended to ensure that the module will comply with Part 15 requirements regardless of the design of the power supplying circuitry in the device into which the module is installed.

4. The modular transmitter must comply with the antenna requirements of Section 15.203 and 15.204(c). The antenna must either be permanently attached or employ a "unique" antenna coupler (at all connections between the module and the antenna, including the cable). Any antenna used with the module must be approved with the module, either at the time of initial authorization or through a Class II permissive change. The "professional installation" provision of Section 15.203 may not be applied to modules.

5. The modular transmitter must be tested in a stand-alone configuration, i.e., the module must not be inside another device during testing. This is intended to demonstrate that the module is capable of complying with Part 15 emission limits regardless of the device into which it is eventually installed. Unless the transmitter module will be battery powered, it must comply with the AC line conducted requirements found in Section 15.207. AC or DC power lines and data input/output lines connected to the module must not contain ferrites, unless they will be marketed with the module (see Section 15.27(a)). The length of these lines shall be length typical of actual use or, if that length is unknown, at least 10 centimeters to insure that there is no coupling between the case of the module and supporting equipment. Any accessories, peripherals, or support equipment connected to the module during testing shall be unmodified or commercially available (see Section 15.31(i)).

6. The modular transmitter must be labeled with its own FCC ID number, and, if the FCC ID is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following: "Contains Transmitter Module FCC ID: XYZMODEL1" or "Contains FCC ID: XYZMODEL1." Any similar wording that expresses the same meaning may be used. The Grantee may either provide such a label, an example of which must be included in the application for equipment authorization, or, must provide adequate instructions along with the module which explain this requirement. In the latter case, a copy of these instructions must be included in the application for

equipment authorization.

7. The modular transmitter must comply with any specific rule or operating requirements applicable to the transmitter and the manufacturer must provide adequate instructions along with the module to explain any such requirements. A copy of these instructions must be included in the application for equipment authorization. For example, there are very strict operational and timing requirements that must be met before a transmitter is authorized for operation under Section 15.231. For instance, data transmission is prohibited, except for operation under Section 15.231(e), in which case there are separate field strength level and timing requirements. Compliance with these requirements must be assured.

8. The modular transmitter must comply with any applicable RF exposure requirements. For example, FCC Rules in Sections 2.1091, 2.1093 and specific Sections of Part 15, including 15.319(i), 15.407(f), 15.253(f) and 15.255(g), require that Unlicensed PCS, UNII and millimeter wave devices perform routine environmental evaluation for RF Exposure to demonstrate compliance. In addition, spread spectrum transmitters operating under Section 15.247 are required to address RF Exposure compliance in accordance with Section 15.247(b)(4). Modular transmitters approved under other Sections of Part 15, when necessary, may also need to address certain RF Exposure concerns, typically by providing specific installation and operating instructions for users, installers and other interested parties to ensure compliance.

3.2.5 Test Procedure

The line conducted and radiated emissions testing was performed according to the procedures in ANSI C63.4 (2003). Testing was performed at CCL's Wanship open area test site #2, located at 29145 Old Lincoln Highway, Wanship, UT. This site has been fully described in a report submitted to the FCC, and was accepted in a letter dated June 6, 2006 (90504).

CCL participates in the National Voluntary Laboratory Accreditation Program (NVLAP) and has been accredited under NVLAP Lab Code: 100272-0, which is effective until September 30, 2009.

For radiated emissions testing at 30 MHz or above that is performed at distances closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

SECTION 4.0 OPERATION OF EUT DURING TESTING

4.1 Operating Environment:

Power Supply: HC-1 powered by 6 Vdc from CUI Inc. power supply or 4.5 Vdc from 3 – AA batteries

3.3 Vdc supplied from HC-1 to RM-1

4.2 Operating Modes:

The EUT was tested on 3 orthogonal axes. The EUT was tested while constantly transmitting at channel 11, channel 18, or channel 26.

4.3 EUT Exercise Software:

Ring Engineering software was used to exercise the EUT.

SECTION 5.0 SUMMARY OF TEST RESULTS

5.1 FCC Part 15, Subpart C

5.1.1 Summary of Tests:

Section	Requirement	Frequency Range (MHz)	Result
15.203	Antenna Requirements	N/A	Complied
15.207	Conducted Disturbance at Mains Ports (Neutral Lead to Ground)	0.15 to 30	Complied
15.249(a)	Field Strength of Fundamental	2400 – 2483.5	Complied
15.249(a)	Field Strength of Harmonics	4800 – 24835.0	Complied
15.249(b)	Fixed Point-to-Point Operation	N/A	Not Applicable
15.249(d)	Radiated Spurious Emissions	30 – 24835.0	Complied
DA 00-1407	Modular Transmitter Requirements	N/A	Complied

5.2 Result

In the configuration tested, the EUT complied with the requirements of the specification.

SECTION 6.0 MEASUREMENTS, EXAMINATIONS AND DERIVED RESULTS

6.1 General Comments:

This section contains the test results only. Details of the test methods used and a list of the test equipment used during the measurements can be found in Appendix 1 of this report.

6.2 Test Results:

6.2.1 §15.203 Antenna Requirements

The antenna is a Ring Engineering IVT1261 antenna soldered directly to the PCB and is not user replaceable. See the photos of Appendix 2.

6.2.2 §15.207 Conducted Disturbance at the AC Mains Ports

Frequency (MHz)	AC Mains Lead	Detector	Measured Level (dBμV)	Limit (dBμV)	Margin (dB)
0.54	Hot Lead	Peak (Note 1)	40.8	46.0	-5.2
0.67	Hot Lead	Quasi-Peak (Note 2)	49.6	56.0	-6.4
0.67	Hot Lead	Average (Note 2)	39.5	46.0	-6.5
6.78	Hot Lead	Peak (Note 1)	45.8	50.0	-4.2
20.03	Hot Lead	Quasi-Peak (Note 2)	56.2	60.0	-3.8
20.03	Hot Lead	Average (Note 2)	49.6	50.0	-0.4
20.65	Hot Lead	Quasi-Peak (Note 2)	51.7	60.0	-8.3
20.65	Hot Lead	Average (Note 2)	44.9	50.0	-5.1
21.30	Hot Lead	Peak (Note 1)	44.2	50.0	-5.8
0.54	Neutral	Peak (Note 1)	41.6	46.0	-4.4
0.67	Neutral	Quasi-Peak (Note 2)	46.7	56.0	-9.3
0.67	Neutral	Average (Note 2)	34.7	46.0	-11.3
1.08	Neutral	Peak (Note 1)	40.1	46.0	-5.9
20.20	Neutral	Peak (Note 1)	44.5	50.0	-5.5
20.35	Neutral	Quasi-Peak (Note 2)	54.1	60.0	-5.9
20.35	Neutral	Average (Note 2)	46.8	50.0	-3.2
20.85	Neutral	Peak (Note 1)	43.7	50.0	-6.3
25.00	Neutral	Peak (Note 1)	44.0	50.0	-6.0

Frequency (MHz)	AC Mains Lead	Detector	Measured Level (dBμV)	Limit (dBμV)	Margin (dB)

Note 1: The reference detector used for the measurements was Quasi-Peak or Peak and the data was compared to the average limit; therefore, the EUT was deemed to meet both the average and quasi-peak limits.

Note 2: The reference detector used for the measurements was quasi-peak and average and the data was compared to the respective limits.

6.2.3 §15.249 Radiated Emissions (Harmonics and Spurious)

The radiated emissions from the fundamental frequency must not exceed 94.0 dBμV/m. Emissions from harmonics and spurious emissions must not exceed 54.0 dBμV/m. The peak emission is limited by paragraph §15.249(e). The measurement distance specified using these limits is 3 meters. The testing was performed at a 3 meter distance for frequencies below 12500 MHz. A 1 meter measurement distance was used at frequencies above 12500 MHz. The tables below show the worst-case emissions from testing. The plots following the data tables show the lowest and highest fundamental frequencies residing totally within the specified operating band.

6.2.3.1 Radiated Emission Data Transmitting at 2405 MHz

Frequency (MHz)	Detector	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB/m)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2405.0	Peak	Vertical	58.5	31.4	89.9	94.0	-4.1
2405.0	Peak	Horizontal	57.7	31.4	89.1	94.0	-4.9
4810.0	Peak	Vertical	13.3	37.4	50.7	74.0	-23.3
4810.0	Average	Vertical	3.8	37.4	41.2	54.0	-12.8
4810.0	Peak	Horizontal	12.7	37.4	50.1	74.0	-23.9
4810.0	Average	Horizontal	3.5	37.4	40.9	54.0	-13.1
7215.0	Peak	Vertical	10.4	41.3	51.7	74.0	-22.3
7215.0	Average	Vertical	4.4	41.3	45.7	54.0	-8.3
7215.0	Peak	Horizontal	5.5	41.3	46.8	74.0	-27.2
7215.0	Average	Horizontal	0.2	41.3	41.5	54.0	-12.5
9620.0	Peak	Vertical	3.9	44.2	48.1	74.0	-25.9
9620.0	Average	Vertical	-4.3	44.2	39.9	54.0	-14.1
9620.0	Peak	Horizontal	1.2	44.2	45.4	74.0	-28.6
9620.0	Average	Horizontal	-8.3	44.2	35.9	54.0	-18.1
12025.0	Peak	Vertical	-0.5	45.9	45.4	74.0	-28.6
12025.0	Average	Horizontal	-11.5	45.9	34.4	54.0	-19.6

Frequency (MHz)	Detector	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB/m)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
12025.0	Peak	Vertical	0.0	45.9	45.9	74.0	-28.1
12025.0	Average	Horizontal	-11.1	45.9	34.8	54.0	-19.2
Note: When only a peak measurement is shown for a frequency, the peak measurement was compared to the average limit.							

6.2.3.2 Radiated Emission Data Transmitting at 2440 MHz

Frequency (MHz)	Detector	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB/m)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2440.0	Peak	Vertical	56.0	31.5	87.5	94.0	-6.5
2440.0	Peak	Horizontal	58.8	31.5	90.3	94.0	-3.7
4880.0	Peak	Vertical	13.6	37.5	51.1	74.0	-22.9
4880.0	Average	Vertical	5.2	37.5	42.7	54.0	-11.3
4880.0	Peak	Horizontal	12.1	37.5	49.6	74.0	-24.4
4880.0	Average	Horizontal	2.6	37.5	40.1	54.0	-13.9
7320.0	Peak	Vertical	11.8	41.6	53.4	74.0	-20.6
7320.0	Average	Vertical	5.4	41.6	47.0	54.0	-7.0
7320.0	Peak	Horizontal	6.7	41.6	48.3	74.0	-25.7
7320.0	Average	Horizontal	-0.6	41.6	41.0	54.0	-13.0
9760.0	Peak	Vertical	5.8	44.3	50.1	74.0	-23.9
9760.0	Average	Vertical	-3.3	44.3	41.0	54.0	-13.0
9760.0	Peak	Horizontal	4.2	44.3	48.5	74.0	-25.5
9760.0	Average	Horizontal	-5.7	44.3	38.6	54.0	-15.4
12200.0	Peak	Vertical	3.6	45.8	49.4	74.0	-24.6
12200.0	Average	Vertical	-7.4	45.8	38.4	54.0	-15.6
12200.0	Peak	Horizontal	2.9	45.8	48.7	74.0	-25.3
12200.0	Average	Horizontal	-7.5	45.8	38.3	54.0	-15.7
Note: When only a peak measurement is shown for a frequency, the peak measurement was compared to the average limit.							

6.2.3.3 Radiated Emission Data Transmitting at 2480 MHz

Frequency (MHz)	Detector	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB/m)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2480.0	Peak	Vertical	53.5	31.6	85.1	94.0	-8.9
2480.0	Peak	Horizontal	55.6	31.6	87.2	94.0	-6.8
4960.0	Peak	Vertical	13.9	37.7	51.6	74.0	-22.4
4960.0	Average	Vertical	7.4	37.7	45.1	54.0	-8.9
4960.0	Peak	Horizontal	11.3	37.7	49.0	74.0	-25.0

Frequency (MHz)	Detector	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB/m)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4960.0	Average	Horizontal	4.3	37.7	42.0	54.0	-12.0
7440.0	Peak	Vertical	14.1	42.0	56.1	74.0	-17.9
7440.0	Average	Vertical	9.1	42.0	51.1	54.0	-2.9
7440.0	Peak	Horizontal	7.6	42.0	49.6	74.0	-24.4
7440.0	Average	Horizontal	1.9	42.0	43.9	54.0	-10.1
9920.0	Peak	Vertical	3.6	44.5	48.1	74.0	-25.9
9920.0	Average	Vertical	-3.3	44.5	41.2	54.0	-12.8
9920.0	Peak	Horizontal	-0.4	44.5	44.1	74.0	-29.9
9920.0	Average	Horizontal	-7.5	44.5	37.0	54.0	-17.0
12400.0	Peak	Vertical	-1.5	45.8	44.3	74.0	-29.7
12400.0	Average	Vertical	-10.3	45.8	35.5	54.0	-18.5
12400.0	Peak	Horizontal	-0.8	45.8	45.0	74.0	-29.0
12400.0	Average	Horizontal	-9.6	45.8	36.2	54.0	-17.8
Note: When only a peak measurement is shown for a frequency, the peak measurement was compared to the average limit.							

No emissions from the EUT were seen above 12500 MHz using a 1 meter measurement distance. The noise floor was more than 6 dB below the limits.

6.2.3.4 Sample Field Strength Calculation:

The field strength is calculated by adding the Correction Factor (Antenna Factor + Cable Factor) and the Average Factor to the measured level of the receiver. The receiver amplitude reading is compensated for any amplifier gain.

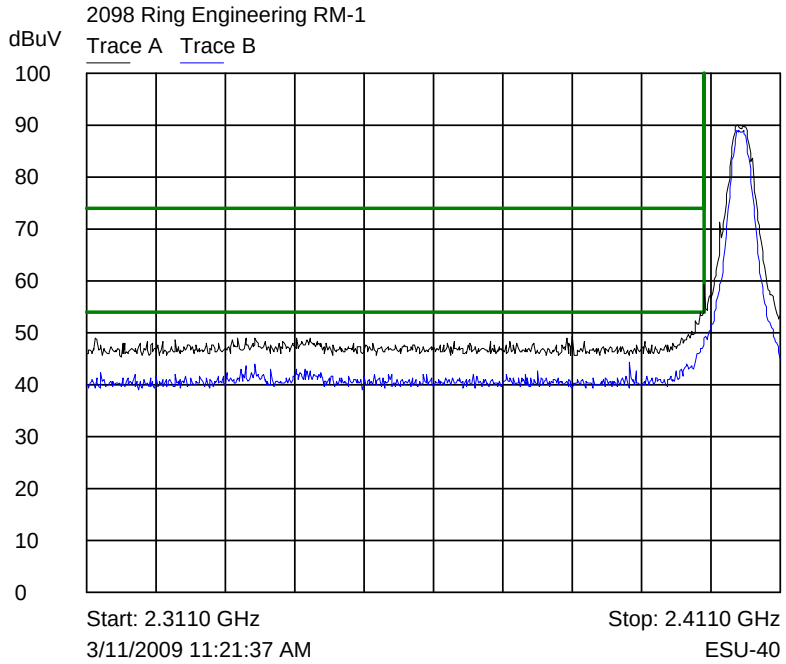
The basic equation with a sample calculation is shown below:

FS = (RA + AV) + CF Where

FS = Field Strength
RA = Receiver Amplitude Reading
CF = Correction Factor (Antenna Factor + Cable Factor)
AV = Averaging Factor

Assume a receiver reading of 44.2 dBμV is obtained from the receiver, with an average factor of –8.6 dB and a correction factor of 17.5 dB. The field strength is calculated by adding the correction factor and the average factor, giving a field strength of 53.1 dBμV/m, FS = (44.2 + (-8.6)) + 17.5 = 53.1 dBμV/m

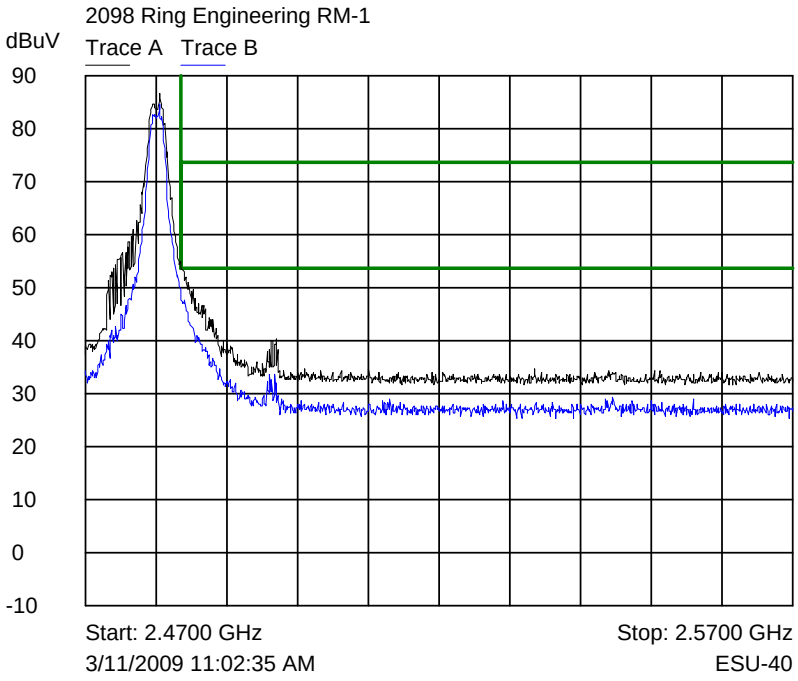
6.2.3.5 Operating Band Compliance Plots



Lowest channel - bnad edge

Trace A peak detection trace - corrected

Trace B Average detection - corrected



Highest channel - band edge

Trace A peak detection trace - corrected

Trace B Average detection - corrected

6.3 DA 00-1407 Modular Approval Compliance

6.3.1 RF Shielding

The EUT has a metal RF shield so the module does not rely on the host system in which it is installed to provide shielding.

6.3.2 Data I/0

Data inputs are buffered by serial peripheral interface (SPI) bus circuitry.

6.3.3 Power Supply

The module receives 3.3 Vdc from the host system and the transmitter IC has its own regulator.

6.3.4 Antenna

The antenna is a Ring Engineering IVT1261 antenna soldered to the PCB and is not replaceable.

6.3.5 Testing

The module was tested as a stand-alone device utilizing its own shielding and filtering to achieve compliance.

6.3.6 Labeling and User Manual

The module has a label with the FCC ID# on the back side of the PCB. The User's manual contains information on host system requirements, labeling requirements, instructions, and the FCC ID# of the module. The instructions state that when the module is installed inside another product, an additional label containing the following wording is placed on the outside of the final product:

This device contains FCC ID: W4YRM-1

There is also a statement on end user compliance responsibility.

6.3.7 RF Exposure

MPE data and calculations are not required for this transmitter.

APPENDIX 1 TEST PROCEDURES AND TEST EQUIPMENT

A1.1 Conducted Disturbance at Mains Ports:

The conducted disturbance at mains ports from the EUT was measured using a spectrum analyzer with a quasi-peak adapter for peak, quasi-peak and average readings. The quasi-peak adapter uses a bandwidth of 9 kHz, with the spectrum analyzer's resolution bandwidth set at 100 kHz, for readings in the 150 kHz to 30 MHz frequency ranges.

The conducted disturbance at mains ports measurements are performed in a screen room using a (50 Ω/50 μH) Line Impedance Stabilization Network (LISN).

Where mains flexible power cords are longer than 1 m, the excess cable is folded back and forth as far as possible so as to form a bundle not exceeding 0.4 m in length.

Where the EUT is a collection of devices with each device having its own power cord, the point of connection for the LISN is determined from the following rules:

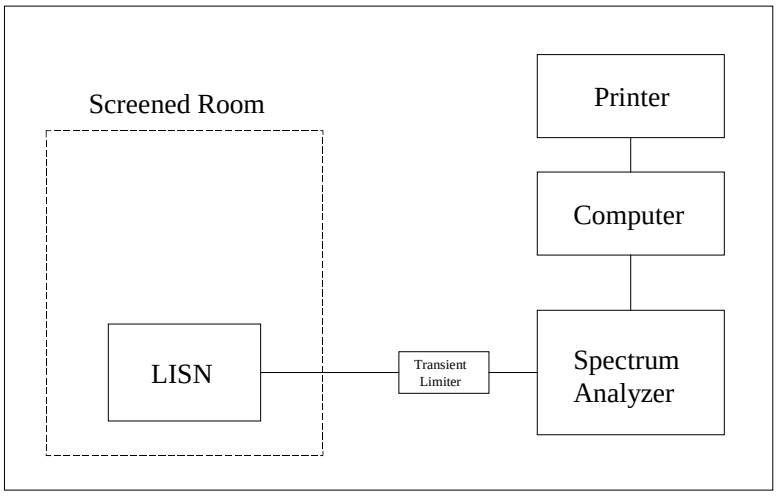
a) Each power cord, which is terminated in a mains supply plug, shall be tested separately.
b) Power cords, which are not specified by the manufacturer to be connected via a host unit, shall be tested separately.
c) Power cords which are specified by the manufacturer to be connected via a host unit or other power supplying equipment shall be connected to that host unit and the power cords of that host unit connected to the LISN and tested.
d) Where a special connection is specified, the necessary hardware to effect the connection is supplied by the manufacturer for the testing purpose.
e) When testing equipment with multiple mains cords, those cords not under test are connected to an artificial mains network (AMN) different than the AMN used for the mains cord under test.

For AC mains port testing, desktop EUT are placed on a non-conducting table at least 0.8 meters from the metallic floor and placed 40 cm from the vertical coupling plane (copper plating in the wall behind EUT table). Floor standing equipment is placed directly on the earth grounded floor.

Type of Equipment	Manufacturer	Model Number	Serial Number	Date of Last Calibration
Wanship Open Area Test Site #2	CCL	N/A	N/A	10/08/2008
Test Software	CCL	Conducted Emissions	Revision 1.2	N/A
Spectrum Analyzer	Hewlett Packard	8566B	2230A01711	10/31/2008
Quasi-Peak Detector	Hewlett Packard	85650A	2043A00137	11/05/2008
LISN	EMCO	3825/2	9305-2099	03/09/2009
Conductance Cable Wanship Site #2	CCL	Cable J	N/A	12/31/2008
Transient Limiter	Hewlett Packard	11947A	3107A02266	12/31/2008

An independent calibration laboratory or CCL personnel calibrates all the equipment listed above at intervals defined in ANSI C63.4:2003 Section 4.4 following outlined calibration procedures. All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Supporting documentation relative to tractability is on file and is available for examination upon request.

Conducted Emissions Test Setup



A1.2 Radiated Disturbance:

The radiated disturbance from the EUT was measured using a spectrum analyzer with a quasi-peak adapter for peak and quasi-peak readings. A preamplifier with a fixed gain of 26 dB and a power amplifier with a fixed gain of 22 dB were used to increase the sensitivity of the measuring instrumentation. The quasi-peak adapter uses a bandwidth of 120 kHz, with the spectrum analyzer's resolution bandwidth set at 1 MHz, for readings in the 30 to 1000 MHz frequency ranges.

A biconilog antenna was used to measure the frequency range of 30 to 1000 MHz, at a distance of 3 or 10 meters from the EUT. The readings obtained by these antennas are correlated to the levels obtained with a tuned dipole antenna by adding antenna factors. A double-ridged guide antenna was used to measure the emissions at frequencies above 1000 MHz at a distance of 3 and/or 1 meter from the EUT.

The configuration of the EUT was varied to find the maximum radiated emission. The EUT was connected to the peripherals listed in Section 2.3 via the interconnecting cables listed in Section 2.4. A technician manually manipulated these interconnecting cables to obtain worst-case radiated disturbance. The EUT was rotated 360 degrees, and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission. Where there was multiple interface ports all of the same type, cables are either placed on all of the ports or cables added to these ports until the emissions do not increase by more than 2 dB.

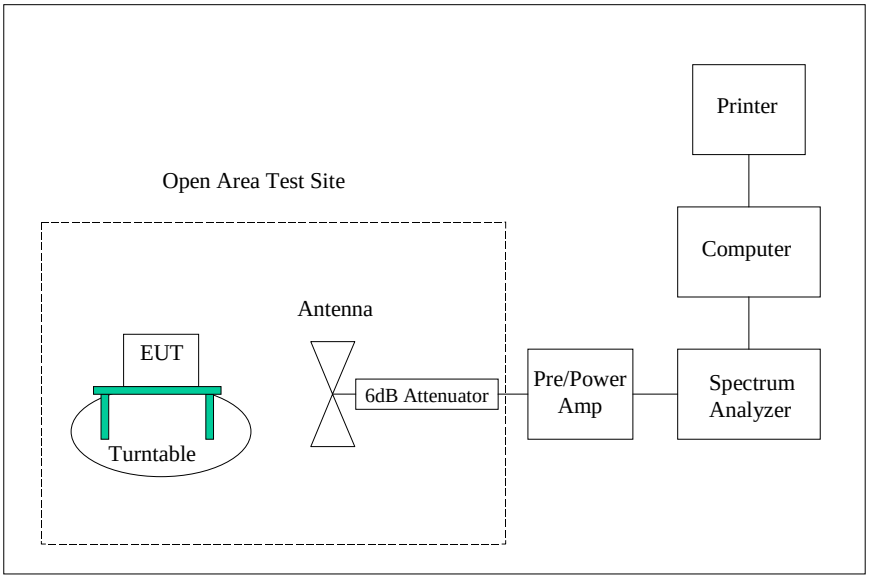
Desktop EUT are measured on a non-conducting table 0.8 meters above the ground plane. The table is placed on a turntable, which is level with the ground plane. For equipment normally placed on floors, the equipment shall be placed directly on the turntable.

Type of Equipment	Manufacturer	Model Number	Serial Number	Date of Last Calibration
Wanship Open Area Test Site #2	CCL	N/A	N/A	10/08/2008
Test Software	CCL	Radiated Emissions	Revision 1.3	N/A
Spectrum Analyzer/Receiver	Rhode & Schwarz	1302.6005.40	100064	06/23/2008
Spectrum Analyzer	Hewlett Packard	8566B	2230A01711	10/31/2008
Quasi-Peak Detector	Hewlett Packard	85650A	2043A00137	11/05/2008

Type of Equipment	Manufacturer	Model Number	Serial Number	Date of Last Calibration
Biconilog Antenna	EMCO	3142	9601-1008	9/26/2008
Double Ridged Guide Antenna	EMCO	3115	9604-4779	03/17/2008
High Frequency Amplifier	Miteq	AFS4-01001800-43-10P-4	1096455	05/29/2007
20’ High Frequency Cable	Utiflex	UFA210A-1-2400-30050U	1175	04/01/2008
3 Meter Radiated Emissions Cable Wanship Site #2	CCL	Cable K	N/A	12/31/2008
Pre/Power-Amplifier	Hewlett Packard	8447F	3113A05161	08/28/2008
6 dB Attenuator	Hewlett Packard	8491A	32835	12/31/2008

An independent calibration laboratory or CCL personnel calibrates all the equipment listed above at intervals defined in ANSI C63.4:2003 Section 4.4 following outlined calibration procedures. All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Supporting documentation relative to tractability is on file and is available for examination upon request.

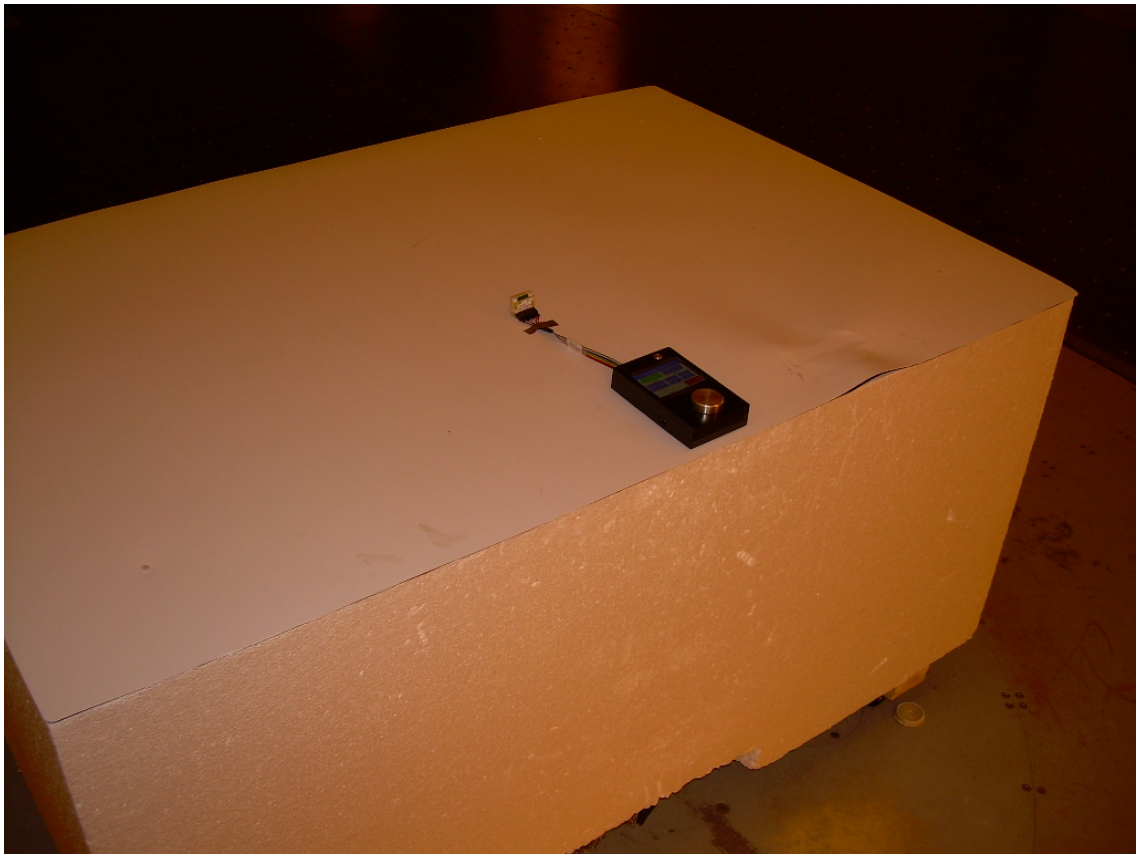
Radiated Emissions Test Setup



APPENDIX 2 PHOTOGRAPHS

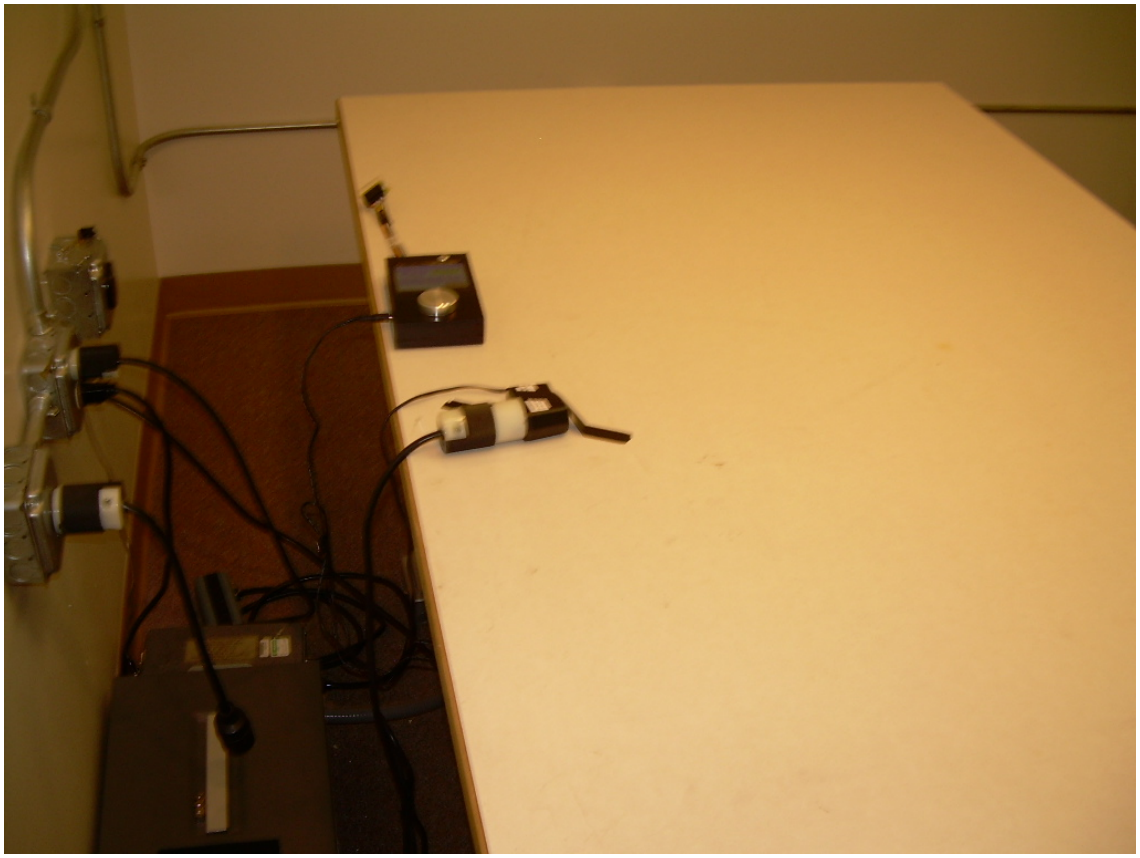
Photograph 1 – Front View Radiated Emissions Worst Case Configuration

Photograph 2 – Back View Radiated Emissions Worst Case Configuration

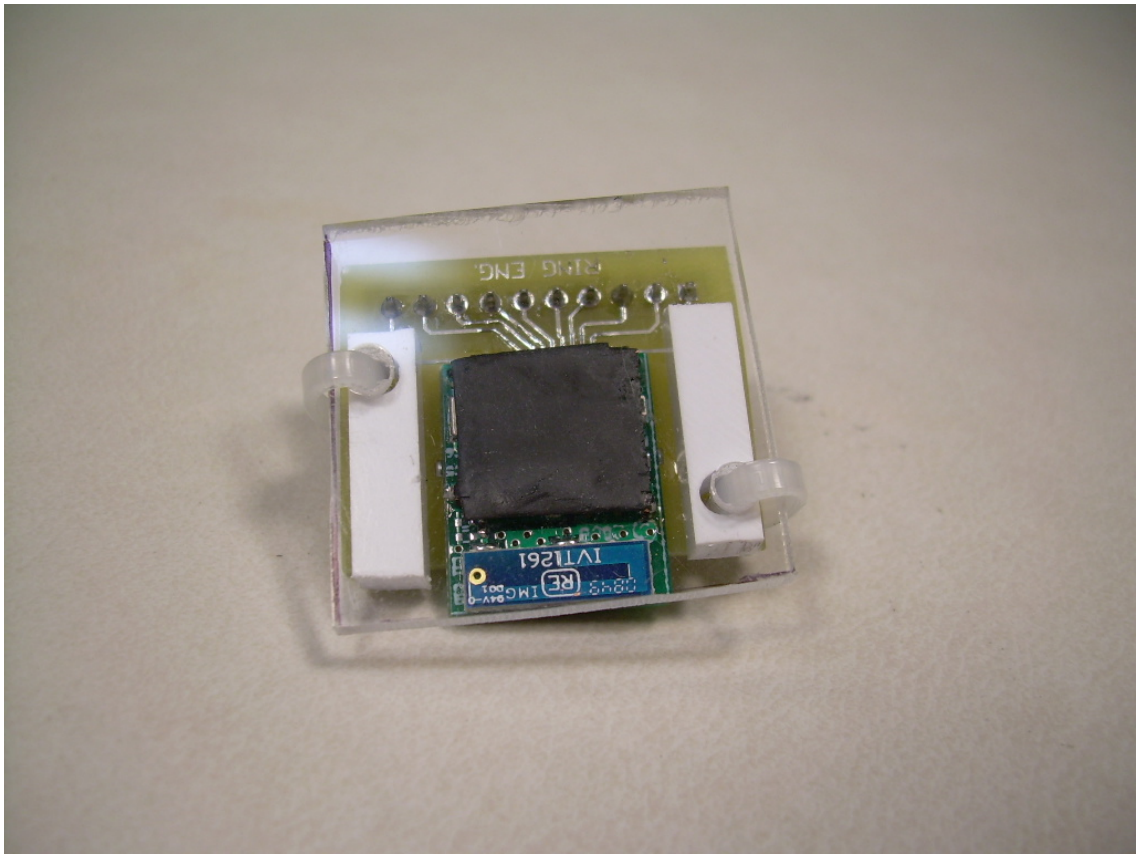


Photograph 3 – Front View Conducted Disturbance Worst Case Configuration

Photograph 4 – Back View Conducted Disturbance Worst Case Configuration



Photograph 5 – Front View of the EUT as Configured to Interface Host for Testing



Photograph 6 – Back View of the EUT as Configured to Interface Host for Testing

Photograph 7 – View of the EUT Installed in Typical Host

Photograph 8 – View of the Component Side of the EUT with RF Shield in Place

Photograph 9 - View of the Component Side of the EUT with RF Shield Removed

Photograph 10 – View of the Trace Side of the EUT