Technologies Corporation
EMC Test Laboratory
Cedar Rapids, IA

MEASUREMENT/TECHNICAL REPORT

Intermec Technologies Corporation
Intellitag ITRM24501 Radio Module
2450 MHz Spread Spectrum Transmitter

REPORT NO: 011214-1

DATE: December 14, 2001

This report concerns: Original Grant ___X___ Class II change _____
Equipment Type: 2400- 2483.5 MHz Frequency Hopping Spread Spectrum Transceiver, FCC 15.247 Industry Canada RSS-210 Issue 4, RSS-102 Issue 1
Request issue of the grant immediately upon completion of review.
Measurement procedure used: ANSI C63.4-1992 and as described within this test report.

Report Prepared by:	Report Prepared For:
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This report contains data that is outside the NVLAP scope of accreditation.

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SECTION NUMBER

APPENDIXES (may be file attachments for electronic applications of approval)

xxx = file extension .doc or .pdf

1.0 COMPLIANCE CERTIFICATION

The electromagnetic compatibility test and data evaluations findings of this report have been prepared by the EMC Test Lab, Intermec Technologies Corporation, in accordance with applicable specifications instructions required per-

FCC SECTION	CANADA RSS-210	TEST NAME
15.33, 15.35	4.0	Range of Meas., Meas. Detectors
15.15, 15.31	5.3, 5.8, 9.0, 11.0	General Requirements, Meas. Methods
15.203, 15.204	5.5	Antenna Description(s)
2.925, 15.19	5.10	Labeling
15.21	5.11, 14.0	Information to the User
15.247 (a, b, c, d, e), 15.209	5.7-5.9.2	Transmitter Characteristics
15.215	6.4	Freq. & Power Stability, Volts
15.109	7.3	Receiver Radiated Emissions
15.207, 15.107	6.6, 7.4	AC Line Conducted Emissions
1.1307 (b)(1)	14.0 & RSS-102	RF Safety, Exposure Limits

The data, data evaluation and equipment configuration represented herein are a true and accurate representation of the measurements of the test sample's electromagnetic compatibility characteristics as of the dates and at the times of the test under the conditions herein specified. The data presented herein is traceable to the National Institute of Standards and Technology.

This report is not an endorsement of the tested product by NVLAP or any agency of the U.S. Government.

NVLAP®

Accredited by the National Institute of Standards and Technology, National Voluntary Laboratory Accreditation Program for the specific scope of accreditation under Lab Code 100269-0.

Intermec Technologies Corporation
EMC Test Laboratory
550 Second Street S.E.
Cedar Rapids, Iowa 52401

The scope of accreditation at the EMC Test Laboratory is limited to NVLAP codes:

12/CIS22 IEC/CISPR 22:1993: Limits and methods of measurement of radio disturbance characteristics of information technology equipment. **12/CIS22a** IEC/CISPR 22:1993: Limits and methods of measurement of radio disturbance characteristics of information technology equipment, Amendment 1:1995, and Amendment 2:1996. **12/CIS22b** CNS 13438:1997: Limits and methods of measurement of radio disturbance characteristics of information technology equipment.
12/F01 FCC Method - 47 CFR Part 15 - Digital Devices. **12/F01a** Conducted Emissions, Power Lines, 450 kHz to 30 MHz. **12/F01b** Radiated Emissions.
12/T51 AS/NZS 3548: Electromagnetic Interference - Limits and Methods of Measurement of Information Technology Equipment.

EMC 017

Interference Technology International

Dave Fry — Date 01/04/02 mm/dd/yy
Dave Fry
Regulatory Engineer II

John Jorgenson — Date 01/08/02 mm/dd/yy
John Jorgenson
Staff RF Engineer

CERTIFIED NARTE ENGINEER

National Association of Radio and Telecommunications Engineers

1.1 Measurement Uncertainties:

Radiated Emissions On 3 Meter Open Area Test Site

30-90 MHz has an Expanded Measurement Uncertainty of +/- 3.42 dB.
90-200 MHz has an Expanded Measurement Uncertainty of +/- 3.33 dB.
200-1000 MHz has an Expanded Measurement Uncertainty of +/- 4.76 dB.
1-2 GHz has an Expanded Measurement Uncertainty of +/- 2.54 dB.
2-12.5 GHz has an Expanded Measurement Uncertainty of +/- 3.62 dB.

Radiated Emissions On 1 Meter Open Area Test Site, HP8566B Spectrum Analyzer

1-2 GHz has an Expanded Measurement Uncertainty of +/- 4.28 dB.
2-12.5 GHz has an Expanded Measurement Uncertainty of +/- 4.88 dB.
12.5-18 GHz has an Expanded Measurement Uncertainty of +/- 5.18 dB.

Radiated Emissions On 1 Meter Open Area Test Site, ESI 40 Receiver/Spectrum Analyzer

18-26.5 GHz has an Expanded Measurement Uncertainty of +/- 4.32 dB.

Receiver and Transmitter Conducted Generator Substitution Measurements with HP83630A RF Generator, ESI 40 Receiver / Spectrum Analyzer

50-7000 MHz has an Expanded Measurement Uncertainty of +/- 0.88 dB.
7-20 GHz has an Expanded Measurement Uncertainty of +/- 1.02 dB.
20-26.5 GHz has an Expanded Measurement Uncertainty of +/- 1.27 dB.

Receiver and Transmitter Direct Conducted Measurements Using ESI 40 Receiver/Spectrum Analyzer

9 kHz-4.5 GHz has an Expanded Measurement Uncertainty of +/- 0.56 dB.
4.5-7 GHz has an Expanded Measurement Uncertainty of +/- 0.75 dB.
7-20 GHz has an Expanded Measurement Uncertainty of +/- 1.18 dB.
20-26.5 GHz has an Expanded Measurement Uncertainty of +/- 1.46 dB.
26.5-40 GHz has an Expanded Measurement Uncertainty of +/- 1.88 dB.

AC Line Conducted

0.15-30 MHz has an Expanded Measurement Uncertainty of +/- 1.34 dB.

Confidence Statement

The measurement uncertainty statements above use a Coverage Factor K = 2.
The Coverage Factor K = 2 equates to an approximate confidence level of 95%.

2.0 GENERAL INFORMATION

2.1 Product Description

This report addresses certification for a spread spectrum radio module operating in the 2400 – 2483.5 MHz radio band. The ITRM24501 is a radio used for reading and writing to RF Identification (RFID) tags operating in the same frequency band. It uses up to four patch antennas alternatively. Detailed pictures of the product and the circuit boards are in the attached exhibits. Power levels, frequency ranges and channel characteristics are not user adjustable.

The ITRM24501 radio module is used within stationary tag readers that interface to mainframe computers other terminal devices for inventory control, pricing and process control.

Two versions of this radio will be sold, one with four antenna connectors and one with only two antenna connectors. The same printed circuit board will be used for both, only the unnecessary connectors will be terminated on the PC board with 50-ohms. The change to the shield will only accommodate the two antenna connectors. The four-connector radio will be offered with either two or four antennas, the unused connectors will be terminated using reverse sex SMA 50-ohm loads. The customer will be able to add the two remaining antennas to accommodate future expansion if desired.

The ITRM24501 radio module is manufactured by Intermec Technologies Corporation and will be marketed as an OEM radio module to other companies with the possibility of re-labeling. The conditions of re-labeling will address modification restrictions and antennas restrictions to inform the end user of their regulatory requirements and responsibilities.

This report shows the radio as a stand-alone module to show the radio is designed to comply with the FCC and Canadian requirements without any additional shielding or filtering. The test data within shows radio characteristics when used with a high gain antenna. Two antenna types will be offered for sale, both are high gain patch antennas, the one tested herein is an Intermec Intellitag 5.9 dBi, and the alternate Huber Suhner antenna is rated at 3.1 dBi. All antennas marketed by Intermec for the ITRM24501 radio satisfies the unique connection requirements outlined in the FCC and Canada rules.

The module is intended for global marketing therefore must comply to the CISPR 22 (EN55022) Class A digital emissions. Intermec Technologies Corporation will perform testing for compliance for digital emissions to the CISPR 22 Class A limits and issue separate reports addressing the integration in Intermec products. Based on these tests and reports the Class A self-declaration can be used for United States marketing. Canada will accept a self-declaration for compliance to ICES-003.

The radio module shown herein is an engineering prototype. The antennas listed herein are production versions.

Transmitter modular approval, conditional requirements.

1) The transmitter has its own shielding and is tested herein using off the shelf power supply and interconnecting cables. The shield is soldered to the printed circuit board during manufacturing. Instructions to end-users and resellers will warn of possible regulatory consequences for modifying the radio in any manner.

2) Only serial data and power is presented to the radio, all modulation and control of the transmitter is contained within the module.

3) The transmitter operates across a voltage range of +7.5 to 10.0 VDC. An onboard regulator provides stable power to the radio. Internal power output and transmitter frequency controls maintain operation within the parameters defined in the regulations. Test data within shows the transmitter characteristics across the specified voltage range.

4) The module uses an antenna connector that meets the unique coupler requirements. The antennas offered for sale with the transmitter DO NOT require professional installation.

5) The radio offers a 9 pin standard RS 232/422 port and a general purpose interface with 4 inputs and 4 outputs. During testing a commercially available serial cable connected to a remote personal computer, acting as an interface to enable the test modes on the transmitter. The radio is tested in the horizontal and vertical planes. Data presented shows a complete evaluation of the radiated characteristics of the shielding on the radio. The off the shelf AC-DC power adapter was modified to remove 1 meter of the shield from the end of DC power cable to the radio. AC line conducted emissions are presented herein.

6) In Intermec products that restrict access to the radio, the exterior of those units will contain an external label that states; “Contains TX FCC ID: EHAITRM25401”. Resellers will also be instructed to label the exterior of products where access to the module is restricted.

7) The module as manufactured is completely controlled by the onboard processor. There are no influences to the operation of the transmitter the end user can induce that will operate the radio outside of scope of the regulations. Intermec service and manufacturing are the only persons with the equipment to alter the internal radio software that controls transmitter power, operating frequencies, hop sequences and duty cycle. All internal software is placed under revision control within Intermec with restrictions under the supervision of Intermec Safety and Compliance manager. Resellers and integrators will be informed of the operating voltage requirements for the module.

8) The transmitter herein was tested with the antennas listed. Compliance to RF exposure requirements for all the antennas offered for sale by Intermec is included within this application for approval. Sales information regarding OEM resellers will inform those entities of their regulatory obligations to use the Intermec antennas as presented herein or to seek approval through the appropriate regulatory agency. Instructions to resellers will also define the requirements to show the integrated radio meets the unintentional emissions requirements where appropriate.

2.2 Related Submittal(s)/Grants(s) None.

2.3 Tested Systems Details

Items tested:			
Model Number (Serial Number)	FCC ID:	Description	Cable Description
ITRM24501 radio module, 4 antenna ports PCB PN:144-916-XXX SN: A	EHAITRM24501	Self-contained assembly, frequency hopping spread spectrum, 4 antenna ports	Module testing shown as stand-alone. Antenna cables represent the shortest versions used.
ELPAC Power Supply PN: MI2009 SN: 000264 and 000364	-	universal power supply	detachable unshielded AC cord, shielded DC cable to mobile computer *
Dell Expression Lap-top PN: 04949 SN: 2RVX-5180	AK8PD475SC	Host computer	Standard shielded cables attached. Remote mounted when possible to show maximum radio emissions.
Dell Charger PN: 73463 SN: T4037851	-	universal charger	detachable shielded AC cord, unshielded DC cable to mobile computer
Antennas tested for this report that will be used with the ITRM24501 radio module:			
Intermec Intellitag "Amtech" 9" RHC antenna PN:805-605-001	-	Intermec 5.9 dBi panel antenna	2.44 m (8 feet) RG303 with reverse sex SMA connectors minimum length**
Radio module variant of assembly tested.			
ITRM24501 radio module, 2 antenna ports PCB PN:144-916-XXX SN: A	EHAITRM24501	Self-contained assembly, frequency hopping spread spectrum, 2 antenna ports	Same as 4 port version
Antennas not tested that will be used with the ITRM24501 radio module:			
High Gain Panel Antenna PN: 805-576-101 Mfg PN: SPA 2400/70/9/0/CP	-	Huber Suhner 3.1 dBi panel antenna	2.44 m (8 feet) of RG58 with reverse sex SMA connectors minimum length**

* During radiated emissions testing 1 meter of shielding is removed to satisfy the conditions for listed for FCC "Modular Approval".

** The 2.44m length is the minimum length cable offered, longer cable/antenna assemblies are offered for improved installation flexibility without field terminated cables.

2.4 Test Methodology

This section addresses the following:
FCC Sections 15.15 General Requirements, 15.31 Measurement Standards, 15.33 Range of Measurement, and 15.35 Measurement Detectors

Industry Canada RSS-210 sections; 4.0 Instrumentation, 5.3 Test Method, 5.8 Measurement Bandwidths, 5.17, Digital Circuits Emissions, 6.3 Restricted Bands and Unwanted Emissions Frequencies, 9.0 AC Wireline Conducted Measurement Method, 11.0 Radiation Measurement Method

Per FCC rules 15.31 (k) the measurements on an intentional radiator operating over a range greater than 10 MHz requires testing on channels at the bottom, middle and top of the range of operation.

The test software of the ITRM24501 radio module is capable of operating the radio continuously in transmit modes locked on channel or hop using a pre-programmed pseudo-random hop sequence. The test software is set to operate on channel 02, 41 or 80. The transmitter test sends pseudo-random data continuously or CW on the selected channel.

Channel 02 transmit = 2402 MHz
Channel 41 transmit = 2441 MHz
Channel 80 transmit = 2480 MHz

These channels represent the low, middle and highest channels of operation within the band of 2400 – 2483.5 MHz.

Per FCC regulations the transmitter emissions are measured to the 10^{th} harmonic, or 24.8 GHz. Canadian regulations for transmitters require testing to the 5^{th} harmonic. Receiver emissions are not presented here because the receiver is enabled with the transmitter during operation. All testing of the transmitter includes any spurious emissions the receiver may generate.

Where possible ANSI C63.4, 1992 is referenced during radiated and AC wireline conducted emissions testing. Details on measurement equipment, set-up, test details and calculations are presented within each specific test section.

Radiated emissions below 1000 MHz are tested at a three-meter distance using a Quasi-Peak detector with a 120 kHz measurement bandwidth (BW).

Emissions above 1000 MHz are tested at one-meter measurement distance with a preamplifier to improve the measurement sensitivity. Above 18 GHz measurements are made within the instrumentation room because the excessive cable losses for the open area test site cable will not show emissions measurements below the specified limit. Manual product positioning at a half-meter distance is used to locate any potential emissions above 18 GHz. The antenna and product heights are then positioned to maximize any emissions discovered with the final measurement made at a one-meter distance.

Average measurements above 1000 MHz are made with a spectrum analyzer on a 100 MHz span with Resolution BW 1 MHz and Video BW of 3 kHz. Peak measurements are made using the spectrum analyzer on a 100 MHz span with Resolution BW and Video BW of 1 MHz, these settings are detailed on the spreadsheet test results.

Measurements or limits are corrected for distance by using the inverse linear distance extrapolation, 20 dB/decade.

Refer to the photographs in appendix B and test setup figures in section 6 for details.

2.5 TEST FACILITY:

The location of the open area test site and conducted measurement facility used to collect the radiated data is 90 West Cemetery Road, Fairfax, Iowa 52228. This site has been fully described in report number 577-500-971, dated November 6, 2000, and submitted to the Federal Communication Commission USA, and accepted in a letter dated December 8, 2000 for ANSI C63.4: 1992 testing. The test site was also submitted to Industry Canada for the performance of radiated measurements and is reference by the file number IC 3909. Test site complies to CISPR Publication 22: 1993, Clauses 10 and 11 for methods of measurements for radiated and conducted emissions testing.

3.0 PRODUCT LABELING AND INFORMATION TO THE USER

3.1 PRODUCT LABELING

See Appendix A (011214A1.xxx)

3.2 INFORMATION TO THE USER

The appendixes L show the compliance insert for the ITRM24501 module (011214L1.xxx). This document is shipped with each product.

4.0 THEORIES OF OPERATION

Proprietary Intermec Technologies document. Confidentiality requested for this document. See appendix I. 011214I1.xxx

5.0 SCHEMATICS

Proprietary Intermec Technologies document. Confidentiality requested for this document. See appendix K. 011214K1.xxx

6.0 CONDUCTED AND RADIATED EMISSIONS TEST DATA

The following tests and results are recorded within this section.

Antenna Description

Frequency Hopping Spread Spectrum (FHSS) 20 dB Bandwidth

FHSS Transmitter Duty Cycle

FHSS Channel Occupancy and Dwell Time

Peak Output Power

Out of Band Emissions, Transmitter Conducted and Radiated

Frequency and Power Stability Across Voltage

Receiver Radiated Emissions

AC Wireline Conducted Emissions

RF Safety, Exposure Limits

EQUIPMENT: ITRM24501 Radio Module

NAME OF TEST: Antenna Description

FCC RULE NUMBER: 15.203, 15.204
CANADA RSS-210 Par.: 5.5

MINIMUM STANDARD:
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited.

Antenna Gain in excess of 6 dBi shall be added to the measured RF power before using the specified power limits.

TEST PROCEDURE: Inspection

TEST EQUIPMENT: Not applicable

PERFORMED BY: Dave Fry Date: December 27, 2001

SET UP: Not applicable

TEST RESULTS:
The antennas for the ITRM24501 radio interface using a reverse sex SMA connector. The antennas are provided from their suppliers with these miniature coaxial connectors. Antennas sold for the ITRM24501 will only be offered through Intermec Technologies.

In the event the radio is marketed as an OEM device to another system integrator, antenna types and connector restrictions will be communicated to re-seller. Their regulatory obligations will be made clear as a condition for re-selling and or re-labeling of the ITRM24501.

The highest antenna gain Intermec Technologies is offering for sale is + 5.9 dBi. The transmitter peak power is +30.0 dBm. Adding the antenna gain to the transmitter power totals +35.9 dBm EIRP. This total is 0.1 dB below the maximum EIRP of +36 dBm allowed under FCC or Industry Canada rules.

Antenna Descriptions: Antennas for the ITRM24501 reader

Measuring the complex plane-wave field along the real axis of vertical or horizontal, we realize a polarization isolation of p=|1/2^1/2(x+jy)*y|^2=0.5 or -3 dB where x and y are orthogonal components in the complex plane-wave field. In addition, the attenuation of RG303 has losses of 0.8 dB/meter at 2.5 GHz. RG58 at 2.5 GHz is .95 dB/meter. Both cables are terminated with a reverse sex SMA connector with 0.1-dB loss at 2.5 GHz. Thus, the effective antenna gains are:

The Intermec Intellitag 9-inch RHC antenna, Intermec part number (805-605-001), is a 2 x 2-element circularly polarized microstrip array. It comes attached to 2.44 meters of RG303 coax cable terminated into a reverse sex SMA connector. The circular gain of the element is +10.9 dBic (decibels isotropic circular). 50 Ohms, VSWR 2.0: 1. 230 x 35 mm. Cable loss –2.0 dB, polarization isolation –3.0 dB equals and effective linear gain of +5.9 dBi.

The Huber Suhner antenna, Intermec part number 805-576-101, for remote use is a SPA 2400/70/9/0/CP right-hand circular polarized element. It comes attached to 2.44 meters (8 ft) of RG58 coax cable terminated into a reverse sex SMA connector. The circular gain of the element is +8.5 dBic. 50 Ohms, VSWR 1.5: 1. 101 x 95 x 32 mm. Cable loss –2.4 dB, polarization isolation –3.0 dB equals and effective linear gain of +3.1 dBi.

EQUIPMENT: ITRM24501 Radio Module

NAME OF TEST: Bandwidth, Number of Channels, Duty Cycle and Occupancy

FCC RULE NUMBER: 15.247 (a)(1)(ii)
CANADA RSS-210 Par.: 6.2.2 (o)

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

(ii) Frequency hopping systems operating in the 2400-2483.5 MHz and 5725-5850 MHz bands shall use at least 75 hopping frequencies. The maximum 20-dB bandwidth of the hopping channel is 1 MHz. The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30-second period.

TEST PROCEDURE:

Note: The radio module utilizes internal test software to generate a transmitter pattern of random ones and zeros in either selected channel or hopping mode.

1. Using the test setup of figure 1, adjust the spectrum analyzer to sweep from 2.4 -2.4835 GHz with a resolution bandwidth of 1 MHz. Set the transmitter for hopping mode channels 2-80. Peak hold and plot showing channel utilization.

2. Using the test setup of figure 1, adjust the spectrum analyzer to 2 MHz span centered at 2.402 GHz with a resolution and video bandwidth of 30 kHz. Enable the transmitter to selected channel 01 and peak hold the analyzer. Indicate the 20-dB bandwidth using Δ markers. Plot and identify the marker positions. Repeat for channels 41 and 80.

3. Adjust the analyzer to span 0 Hz at 2.441 GHz with resolution bandwidth of 30 kHz and video bandwidth of 30 kHz. Activate the transmitter in hopping mode. Using single 4 second sweep select a display showing channel 41 keyed up on the transmitter. Utilizing the Δ function, indicate the time between transmissions on channel 41 and plot.

4. Adjust the analyzer for a 100 milli-second sweep time and use video trigger. Place the marker on the end of the transmitter on time. Plot the transmit time to show the transmitter duty cycle.

MEASUREMENT DATA:
79 channels are utilized within the allowed spectrum. The worst case 20 dB channel bandwidth was 221.4 kHz for channel 80 of the transmitter. The time between hops on a selected channel is 3.562 seconds. The average number of hops in a 30-second period will be 8.422. The time spent on each channel is 44.48 milli-seconds (msec). The average time in an average 30-second window will be 374.62 msec. See the plots from the spectrum analyzer on appendix C.

TEST EQUIPMENT: Spectrum Analyzer R&S ESI 40
Attenuator HP 8491- 20 dB

PERFORMED BY: Dave Fry Date: December 20-31, 2001

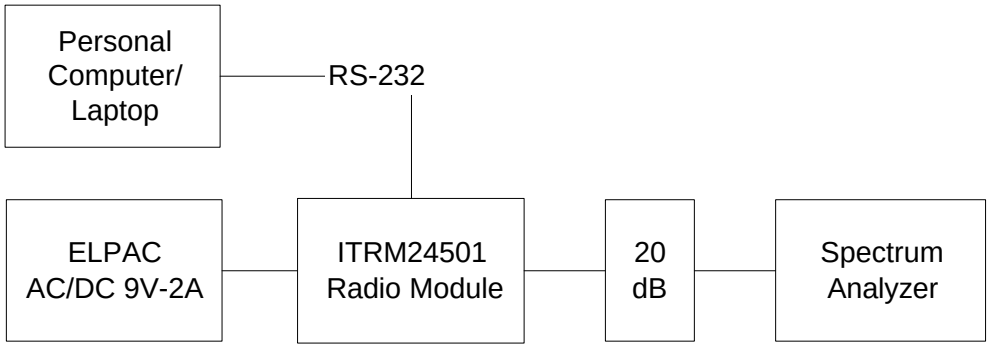


Figure 1.

TEST RESULTS: Conforms. The transmitter has an operating bandwidth less than 1.0 MHz. The transmitter is on frequency less than 0.4-seconds in an average 30-second period. See appendix E (010312E1.xxx) for plots.

See Appendix I (010312I1.xxx) for details on radio hopping sequences and conditions for transmission interruption and restarting to address the equal usage of each channel on average.

Frequency, Channel Number	2402 MHz, low Ch. 02	2441 MHz, mid Ch. 41	2480 MHz, high Ch. 80
B.W. kHz	213.4	207.4	221.4

EQUIPMENT: ITRM24501 Radio Module

NAME OF TEST: Peak Power Output

FCC RULE NUMBER: 15.247 (b)(1)(3)
MINIMUM STANDARD:
(b) The maximum peak output power of the intentional radiator shall not exceed the following:

I. For frequency hopping systems operating in the 2400–2483.5 MHz or 5725–5850 MHz band and for all direct sequence systems: 1 watt.

(3) Except as shown in paragraphs (b)(3) (i), (ii) and (iii) of this section, if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1) or (b)(2) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

CANADA RSS-210 Par.: 6.2.2(o)
MINIMUM STANDARD:

(a3) For the band 2400-2483.5 MHz, the transmitter output power shall not exceed 1.0 watt. See (d) below for special conditions.

(d) **Special Conditions (Applicable to the Bands 2400-2450 and 2450-2483.5 MHz)**

(d1) The 2400 - 2450 MHz band is used in Canada by the radio relay fixed and other services on a licensed basis. Spread spectrum systems (DS or FH) operating in this band (i.e. the 20 dB bandwidth falling fully or partly into this sub-band) may be subject to licensing and so the standard RSS-139 will apply for the purpose of equipment certification except as provided below.

When **ALL** the following conditions are met, RSS-210 can be used for equipment certification:
- it is designed for indoor use only (e.g. in non-waterproof casings), and

- the spectral density shall not exceeding 50 milliwatts per MHz. **(Note:** Spectral density = transmitter output power in milliwatts at antenna terminals divided by the spread spectrum (SS) bandwidth in MHz for direct sequence systems. For Frequency Hopping: SS bandwidth = Channel Bandwidth multiplied by Number of Distinct Frequencies in the hopset).

- the device's **label** or the **user manual** contains this statement (or equivalent): *"To prevent radio interference to the licensed service, this device is intended to be operated indoors and away from windows to provide maximum shielding. Equipment (or its transmit antenna) that is installed outdoors is subject to licensing."*

TEST PROCEDURE:

Note: The ITRM24501 radio utilizes internal test software to generate a transmitter pattern of random ones and zeros. The transmitter channels represent the low, mid and high for operation in North American.

(1) Verify the calibration on the power meter and attenuator then setup the test as in figure 2.

(2) Set DC supply to +7.5 volts. Activate the transmitter on the low channel, 2402 MHz, and record the peak output power observed on the power meter. Repeat for 8.75 and 10.0 volts

(3) Repeat 1 and 2 using the middle and high channels, 2441 and 2480 MHz.

TEST EQUIPMENT:	Spectrum Analyzer	R&S ESI 40
	Attenuator	HP 8491-20 dB
	DC Supply	Tek PS282
	Voltmeter	Fluke 77

PERFORMED BY: Dave Fry Date: December 31, 2001

SET UP:

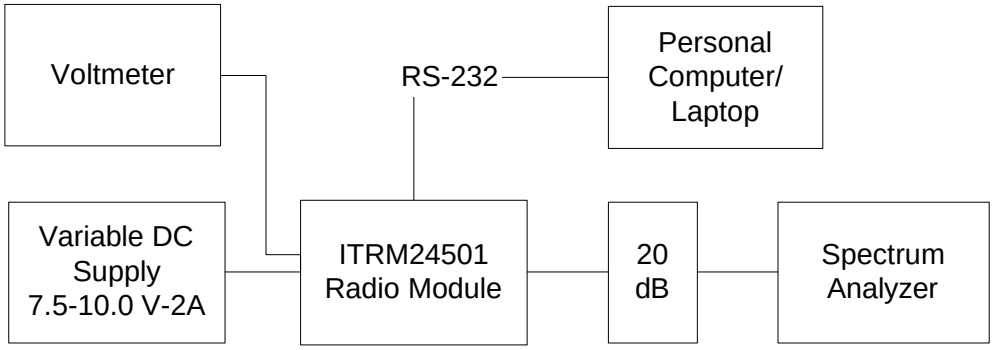


Figure 2.

TEST RESULTS:
Conforms. The transmitter has transmitter peak power of 30 dBm or 1.0watts. This is 0 milliwatts below the 1-watt limit.

Antennas to be used with the transmitter have a highest gain of +5.9 dBi. The total system Effective Radiated Power is calculated as:

Tp + Ag = EIRP

30 + 5.9 = 35.9 dBm or 3.89 watts EIRP

Transmitter Power = Tp (dBm)
Antenna Gain = Ag (dBi)
Effective Radiated Power = EIRP (dBm and watts)

Specified limit is calculated as:

30 Tp + 6 Ag = +36 dBm or 4 watts EIRP

MEASUREMENT DATA: See Appendix E for plots of spectrum analyzer settings.

Conducted measurement at the antenna connector. Module voltage +7.5

Spectrum analyzer compensates for cable/attenuator loss. Limit: +30 dBm				
Freq. / Channel	Port (dBm)	Port 2 (dBm)	Port 3 (dBm)	Port 4 (dBm)
2402 MHz / Ch. 02	29.79	29.79	29.79	29.79
2441 MHz / Ch. 41	29.90	29.90	29.79	29.79
2480 MHz / Ch. 80	30.00	29.90	29.90	29.90

Conducted measurement at the antenna connector. Module voltage +8.75

Spectrum analyzer compensates for cable/attenuator loss. Limit: +30 dBm				
Freq. / Channel	Port (dBm)	Port 2 (dBm)	Port 3 (dBm)	Port 4 (dBm)
2402 MHz / Ch. 02	29.79	29.79	29.79	29.79
2441 MHz / Ch. 41	29.90	29.90	29.79	29.79
2480 MHz / Ch. 80	30.00	29.90	29.90	29.90

Conducted measurement at the antenna connector. Module voltage +10.0

Spectrum analyzer compensates for cable/attenuator loss. Limit: +30 dBm				
Freq. / Channel	Port (dBm)	Port 2 (dBm)	Port 3 (dBm)	Port 4 (dBm)
2402 MHz / Ch. 02	29.79	29.79	29.79	29.79
2441 MHz / Ch. 41	29.90	29.90	29.79	29.79
2480 MHz / Ch. 80	30.00	29.90	29.90	29.90

EQUIPMENT: ITRM24501 Radio Module

NAME OF TEST: Out of Band Emissions

FCC RULE NUMBER: 15.247 (c)
MINIMUM STANDARD:
(c) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

CANADA RSS-210 Par.: 6.2.2, (o)(e1)
MINIMUM STANDARD:
(e1) **Out of Band Emissions:** In any 100 kHz bandwidth outside the operating frequency bands, between 30 MHz and 5 times the carrier frequency, the unwanted emission spectral density shall be either at least 20 dB below the inband spectral density, or shall not exceed the levels specified in Table 3, whichever is less stringent. **Note:** For frequency hopping systems, the inband density S_i shall be measured with the hopping sequence stopped at the lowest channel and the highest channel in turn, as well as with the hopping running normally. The 20 dB shall be with reference to the lowest of the three S_i values.

TEST PROCEDURE:
1. Determine the cable loss and actual attenuator values for the measurement system at 2441 MHz. Use this value to calculate the in-band peak power and the limit. The limit calculated will be used to identify the limit on the conducted spurious emissions plots.

Attenuator and cable loss	20.9 dB
In-band peak measured	+29.9 dBm (100 kHz Res. &Vid. BW)
Limit	-20.0 dB
Limit (Generator Sub.)	+9.9 dBm

2. Using the setup diagramed in figure 3, record the conducted emissions of the transmitter. Plot the near band emissions on a 139.16667 MHz span centered on 2441.75 MHz using 100 kHz video and resolution bandwidths. Enable the end channels and recording the delta from the peak of each channel to the highest emission outside the allowable band. Plot the low channel in black and the highest channel in red. Placing the highest inband peak on the top graticule of the spectrum analyzer best shows the limit for the near-band plots, the limit is 20 dB down from the inband peak.

3. Detail the near band-edge emissions by centering each specified band edge and plot on a 10 MHz span. Show the end channels as a steady state CW then overlay the modulated end channel on the same plot. Repeat the modulated plot with the transmitter in hop mode. Record the delta from the transmitter peak to the highest out of band emission.

4. Complete plotting the transmitter emissions by showing the following spans. 0-5, 5-10, 10-25 GHz. Use the setup diagramed in figure 4 for the plots above 4 GHz. Identify any emissions observed above the measurement noise floor. Indicate the limit on each plot by calculating the limit based on the transmitter inband peak power and correcting for the losses in the cable and attenuation used. The generator substitution of the limit swept across the plot.

5. Record the radiated emissions using the testing methodology described in section 2.4 to measure the spurious emissions. Using the three-meter measurement distance and test receiver, scan and measure transmitter related spurious emissions from 30 to 1000 MHz. A measurement distance of one meter and an amplifier between the horn antenna and spectrum analyzer, measure emissions above 1000 MHz. Refer to section 2.4, Test Methodology, for more details on testing above 1000 MHz.

TEST EQUIPMENT:	Antenna, bi-conical	EMCO 3110
	Antenna, log periodic	EMCO 3146
	Antenna, DRG horn	EMCO 3115
	Antenna, DRG horn	EMCO 3116
	Receiver	Rohde & Schwarz ESVP
	Receiver/ Spectrum Analyzer	Rohde & Schwarz ESI 40
	High Pass Filter	Cir-Q-Tel R9H-1G5/10G-28A
	High Pass Filter	K&L 13SH10-3000/T24000-0/0
	Microwave amplifier	HP 8449B
	Spectrum Analyzer	HP 8566B
PERFORMED BY:	Dave Fry	Date: December 14-29, 2001

TEST SETUP: Transmitter Conducted Emission

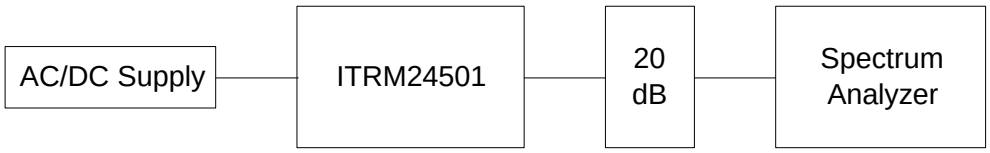


Figure 3.

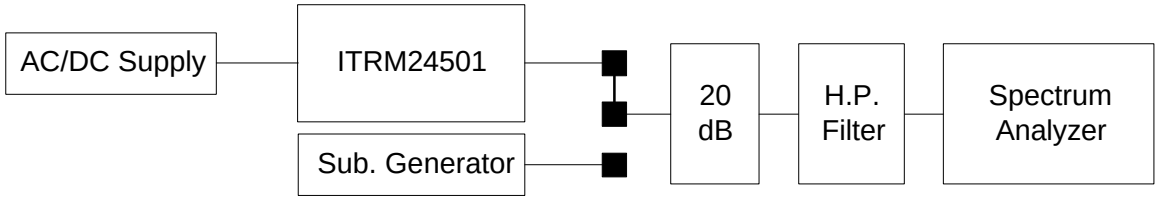


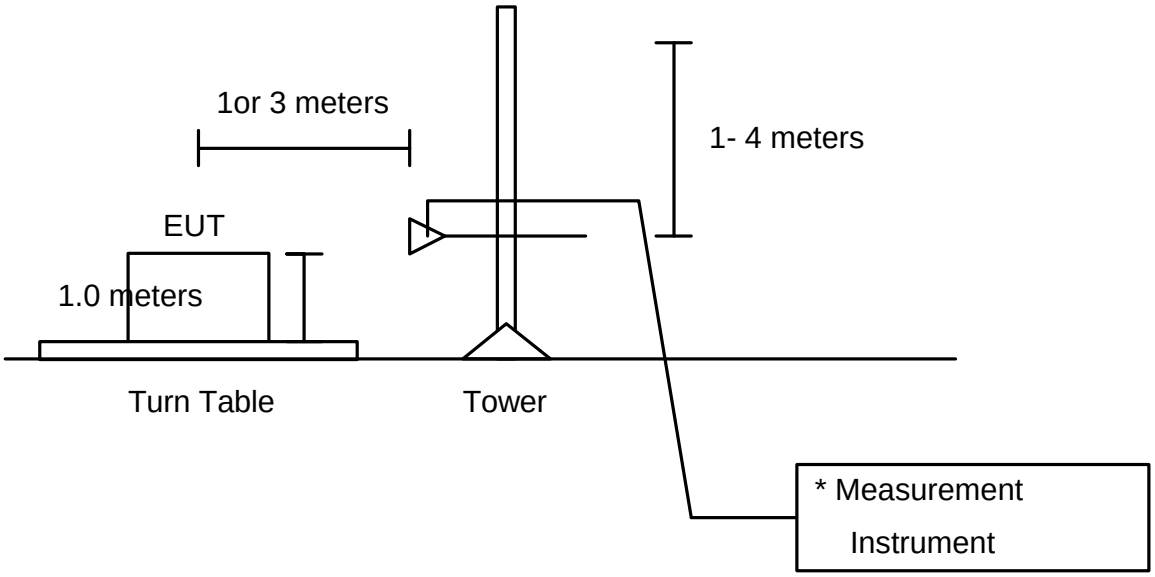
Figure 4.

Note: The high pass filter in figure 4 eliminates the creation of a falsely high amplitude on the harmonics of the transmitter. This occurs when the power of the transmitter over drives the input stage of the spectrum analyzer. A generator substitution determines the actual level of any spurious emissions observed.

TEST SETUP: Transmitter Radiated Spurious Emissions

Open area test site at the Intermec EMC Test Facility
Three-meter test range below 1000 MHz.
One-meter test range above 1000 MHz.

Review the following diagrams for setup details. Refer to the photographs in appendix B (011214B1.xxx) for placement ITRM24501 radio module and antennas.



* 30-1000 MHz, Rohde & Schwarz receiver or
1-18 GHz, HP8566B Spectrum Analyzer with preamplifier and high-pass filter
or 18-25 GHz, ESI 40, high-pass filter with preamplifier

TEST RESULTS: Transmitter conducted emissions conforms.
The ITRM24501 radio module complies with the FCC and Industry Canada requirements. Transmitter conducted emissions plots show the transmitter emissions, other than harmonics, outside of the band are 40 dB below the level of the fundamental and greater than 20 dB below the limit. The band from 30 to 24835 MHz was examined, the only significant emissions were above 1000 MHz. See Appendix D (010312D1.xxx) for plots showing compliance.

Below is listed the Average and Peak radiated measurements for each antenna specified for use with the radio module. The data presented below calculates the AVERAGE emissions by recording the 100% duty cycle emissions. The attached calculation spreadsheets show the de-rating the measurement limit for 50% duty cycle, or -6 dB. The 50% de-rating is a conservative figure, duty cycles for operation is nearer the 45% on time for duty cycle.

Duty cycle determination of the worst case average emissions shown with the duty cycle emissions reduction. As outlined in the FCC Public Notice: Guidance on Measurements for FHSS Systems the average data is to be de-rated by a duty cycle calculation. The radio presented herein has transmitter duty cycle of less than 45%. (See the following plot, showing the transmitter duty cycle plotted on an the spectrum analyzer.) The calculated emissions reduction for this radio is 6 dB based on the calculation for a 50% duty cycle.

the Tx time within 0.1 second period = 0.045, or 45 %

the calculation for de-rating for a 45% is shown below:

(1dB@100% x .45 log) 20 = -6.9 dB de-rating for 45% in dB

Applying the same formula for a 50% duty cycle results in a -6.0 dB de-rating for the AVERAGE emissions when measured at 100% duty cycle and measurement taken in dB(µV) (microvolts).

The spreadsheet data appendix G shows the measured emissions for a 100% transmit duty cycle. The de-rating is added to the average limit to show the margins of compliance for the duty cycle calculated above. The data shows all emissions compared to the limits outlined in 15.209 for restricted bands. The data summary below highlights the highest emissions in those restricted bands.

Plots showing the transmitter duty cycle on the spectrum analyzer are included in appendix E.

To show modular compliance the first antenna data presented shows the radio placed horizontally, then data is collected with the radio placed vertically.(See setup photographs in appendix B.)

The system configurations show two antennas on the radiated emissions site and two antennas remote mounted or just two antenna with two terminated radio ports. This represents the typical installation for a system. The radio is designed to support two, tag-reading portals. Using antennas mounting of two angles toward a single point, reading tags of unknown orientation is possible by alternately transmitting the between two antennas. A tag reading portal is represented by a pair of antennas mounted at a product conveyor belt, or at a shipping dock entry. To insure the worst case emissions are measured, antennas are pointed toward the measurement antenna to maximize any potential emissions.

If two tag portals were adjacent to each other, the worst case antenna spacing would be represented by the configuration tested. The radio only transmits to one antenna at a given time, therefore testing with a single antenna enabled again is representative of normal operation. Preliminary testing using various radio antenna connector combinations nets the following worst case combinations.

Two other four-antenna configurations were tested these configurations were not considered typical installations. The emissions results for configurations 2 and 3 were slightly lower that those measured for configuration 1. Therefore the results presented for the two and four antenna systems in this report section represent the worst case emissions for typical installations.

ITRM24501 radio module horizontal, 2 antennas

with Intellitag 9" RHC antennas (see appendix G, 011214G1.xxx, for the data spreadsheets)

The highest AVERAGE field strength of the out of band transmitter radiated emissions is 66.6 dB(µV)/m measured at a distance of one-meter for 7440 MHz. The emissions was observed during testing of the unit placed horizontally and the measurement antenna vertically polarized. Applying the 6 dB duty cycle correction the emissions are 60.6 dB(µV)/m. That is –3.4 dB relative to the limit of 64 dB(µV)/m at one-meter.

AVERAGE EMISSIONS

Highest emissions observed above the measurement noise floor.
Complete data is contained in the Spreadsheet Appendix or file attachments

Ch. /MHz	Meas. Polarity	100% dB(uV)/M	duty cycle conversion dB	50% dB(uV)/M	limit dB(uV)/M @1M	margin dB
02 / 4804	H	64.8	-6.0	58.8	64.0	-5.2
02 / 7206	V	66.2	-6.0	60.2	64.0	-3.8
41 / 4882	H	64.2	-6.0	58.2	64.0	-5.8
41 / 7323	V	65.9	-6.0	59.9	64.0	-4.1
80 / 4960	H	65.8	-6.0	59.8	64.0	-4.2
80 / 7440	V	66.6	-6.0	60.6	64.0	-3.4

The highest Quasi-Peak or PEAK field strength of the out of band transmitter radiated emissions relative to the limit is 67.4 dB(µV)/m measured at a distance of one-meter for 7440 MHz. The emissions was observed during testing of the unit placed horizontally and the measurement antenna vertically polarized. That is –16.6 dB relative to the limit of 84 dB(µV)/m at one-meter. (no duty cycle correction can be applied to QP or Pk data).

QUASI-PEAK AND PEAK EMISSIONS

Highest emissions observed above the measurement noise floor.
Complete data is contained in the Spreadsheet Appendix or file attachments
d* indicates distance of 1 meters for emissions >1GHz or 3 meters for <1 GHz

Ch. / MHz	Detector QP or Pk	Meas. Polarity	dB(uV)/M	limit dB(uV)/M@ d*	margin dB
02 / 4804	Pk	H	65.0	84.0	-19.0
02 / 7206	Pk	V	66.5	84.0	-17.5
41 / 4882	Pk	H	64.2	84.0	-19.8
41 / 7323	Pk	V	67.2	84.0	-16.8
80 / 4960	Pk	H	66.1	84.0	-17.9
80 / 7440	Pk	V	67.4	84.0	-16.6

ITRM24501 radio module vertical, 2 antennas

with Intellitag 9" RHC antennas (see appendix G, 011214G1.xxx, for the data spreadsheets)

The highest AVERAGE field strength of the out of band transmitter radiated emissions is 68.3 dB(µV)/m measured at a distance of one-meter for 4960 MHz. The emissions was observed during testing of the unit placed vertically and the measurement antenna horizontally polarized. Applying the 6 dB duty cycle correction the emissions are 62.3 dB(µV)/m. That is –1.7 dB relative to the limit of 64 dB(µV)/m at one-meter.

AVERAGE EMISSIONS

Highest emissions observed above the measurement noise floor.
Complete data is contained in the Spreadsheet Appendix or file attachments

Ch. /MHz	Meas. Polarity	100% dB(uV)/M	duty cycle conversion dB	50% dB(uV)/M	limit dB(uV)/M @1M	margin dB
02 / 7206	V	64.1	-6.0	58.1	64.0	-5.9
02 / 7206	H	66.6	-6.0	60.6	64.0	-3.4
41 / 4882	V	66.4	-6.0	60.4	64.0	-3.6
41 / 4882	H	67.7	-6.0	61.7	64.0	-2.3
80 / 4960	V	66.0	-6.0	60.0	64.0	-4.0
80 / 4960	H	68.3	-6.0	62.3	64.0	-1.7

The highest Quasi-Peak or PEAK field strength of the out of band transmitter radiated emissions relative to the limit is 68.5 dB(µV)/m measured at a distance of one-meter for 4960 MHz. The emissions was observed during testing of the unit placed vertically and the measurement antenna horizontally polarized. That is –15.5 dB relative to the limit of 84 dB(µV)/m at one-meter. (no duty cycle correction can be applied to QP or Pk data)

QUASI-PEAK AND PEAK EMISSIONS

Highest emissions observed above the measurement noise floor.
Complete data is contained in the Spreadsheet Appendix or file attachments

d* indicates distance of 1 meters for emissions >1GHz or 3 meters for <1 GHz

Ch. / MHz	Detector QP or Pk	Meas. Polarity	dB(uV)/M	limit dB(uV)/M@ d*	margin dB
02 / 7206	Pk	V	64.9	84.0	-19.1
02 / 7206	Pk	H	67.4	84.0	-16.6
41 / 4882	Pk	V	66.8	84.0	-17.2
41 / 4882	Pk	H	68.1	84.0	-15.9
80 / 4960	Pk	H	68.5	84.0	-15.5
80 / 7440	Pk	H	67.0	84.0	-17.0

ITRM24501 radio module horizontal, 4 antennas

with Intellitag 9" RHC antennas (see appendix G, 011214G1.xxx, for the data spreadsheets)

The highest AVERAGE field strength of the out of band transmitter radiated emissions is 67.6 dB(µV)/m measured at a distance of one-meter for 7440 MHz. The emissions was observed during testing of the unit placed horizontally and the measurement antenna vertically polarized. Applying the 6 dB duty cycle correction the emissions are 61.6 dB(µV)/m. That is –2.4 dB relative to the limit of 64 dB(µV)/m at one-meter.

AVERAGE EMISSIONS

Highest emissions observed above the measurement noise floor.
Complete data is contained in the Spreadsheet Appendix or file attachments

Ch. /MHz	Meas. Polarity	100% dB(uV)/M	duty cycle conversion dB	50% dB(uV)/M	limit dB(uV)/M @1M	margin dB
02 / 4804	H	64.9	-6.0	58.9	64.0	-5.1
02 / 7206	H	63.8	-6.0	57.8	64.0	-6.2
41 / 4882	V	66.7	-6.0	60.7	64.0	-3.3
41 / 4882	H	66.1	-6.0	60.1	64.0	-3.9
80 / 4960	H	66.4	-6.0	60.4	64.0	-3.6
80 / 7440	V	67.6	-6.0	61.6	64.0	-2.4

The highest Quasi-Peak or PEAK field strength of the out of band transmitter radiated emissions relative to the limit is 68.2 dB(µV)/m measured at a distance of one-meter for 7440 MHz. The emissions was observed during testing of the unit placed horizontally and the measurement antenna vertically polarized. That is –15.8 dB relative to the limit of 84 dB(µV)/m at one-meter. (no duty cycle correction can be applied to QP or Pk data)

QUASI-PEAK AND PEAK EMISSIONS

Highest emissions observed above the measurement noise floor.
Complete data is contained in the Spreadsheet Appendix or file attachments
d* indicates distance of 1 meters for emissions >1GHz or 3 meters for <1 GHz

Ch. / MHz	Detector QP or Pk	Meas. Polarity	dB(uV)/M	limit dB(uV)/M@ d*	margin dB
02 / 4804	Pk	H	65.3	84.0	-18.7
02 / 7206	Pk	H	65.0	84.0	-19.0
41 / 4882	Pk	V	67.2	84.0	-16.8
41 / 4882	Pk	H	66.2	84.0	-17.8
80 / 4960	Pk	H	66.6	84.0	-17.4
80 / 7440	Pk	V	68.2	84.0	-15.8

ITRM24501 radio module vertical, 4 antennas

with Intellitag 9" RHC antennas (see appendix G, 011214G1.xxx, for the data spreadsheets)

The highest AVERAGE field strength of the out of band transmitter radiated emissions is 68.4 dB(µV)/m measured at a distance of one-meter for 7206 MHz. The emissions was observed during testing of the unit placed vertically and the measurement antenna horizontally polarized. Applying the 6 dB duty cycle correction the emissions are 62.4 dB(µV)/m. That is –1.6 dB relative to the limit of 64 dB(µV)/m at one-meter.

AVERAGE EMISSIONS

Highest emissions observed above the measurement noise floor.
Complete data is contained in the Spreadsheet Appendix or file attachments

Ch. /MHz	Meas. Polarity	100% dB(uV)/M	duty cycle conversion dB	50% dB(uV)/M	limit dB(uV)/M @1M	margin dB
02 / 4804	H	64.7	-6.0	58.7	64.0	-5.3
02 / 7206	H	68.4	-6.0	62.4	64.0	-1.6
41 / 4882	H	66.3	-6.0	60.3	64.0	-3.7
41 / 7323	H	68.4	-6.0	62.4	64.0	-1.6
80 / 4960	H	67.7	-6.0	61.7	64.0	-2.3
80 / 7440	H	67.8	-6.0	61.8	64.0	-2.2

The highest Quasi-Peak or PEAK field strength of the out of band transmitter radiated emissions relative to the limit is 68.9 dB(µV)/m measured at a distance of one-meter for 7206 MHz. The emissions was observed during testing of the unit placed vertically and the measurement antenna horizontally polarized. That is –15.1 dB relative to the limit of 84 dB(µV)/m at one-meter. (no duty cycle correction can be applied to QP or Pk data)

QUASI-PEAK AND PEAK EMISSIONS

Highest emissions observed above the measurement noise floor.
Complete data is contained in the Spreadsheet Appendix or file attachments

d* indicates distance of 1 meters for emissions >1GHz or 3 meters for <1 GHz

Ch. / MHz	Detector QP or Pk	Meas. Polarity	dB(uV)/M	limit dB(uV)/M@ d*	margin dB
02 / 4804	Pk	V	65.1	84.0	-18.9
02 / 7206	Pk	H	68.9	84.0	-15.1
41 / 4882	Pk	H	66.6	84.0	-17.4
41 / 7323	Pk	H	68.8	84.0	-15.2
80 / 4960	Pk	H	67.9	84.0	-16.1
80 / 7440	Pk	H	68.4	84.0	-15.6

MEASUREMENT DATA: Observe the appendix E and F (011214E1.xxx, 011214F1.xxx) that shows the transmitter conducted measurements. The appendix G (010312G1.xxx) file attachment spreadsheets show the radiated emissions data tabulated and graphically in dB(µV)/m. The conversion for calculating dB(µV)/m to µV/m follows.

[(dB (µV)/m)/ 20] anti log = µV/m
[(54 dB (µV)/m @ 1 mtr) / 20] anti log = 501.2 µV/m @ 1 mtr

or µV/m to dB(µV)/m

20 (log µV/m) = dB (µV)/m
20 (log 500 µV/m) = 54 dB (µV)/m

Limit conversion, three-meter to one-meter (mtr)

54 dB (µV)/m @ 3 mtrs + 10 dB = 64 dB (µV)/m @ 1 mtr

These spreadsheets include the calculation for duty cycle de-rating by adding 6 dB to the average limits. De-rating correction is not allowed for the peak and quasi-peak emissions.

64 dB (µV)/m @ 1 mtr + 6 dB (correction) = 70 dB (µV)/m @ 1 mtr

EQUIPMENT: ITRM24501 Radio Module

NAME OF TEST: Frequency and Power Stability Across Voltage

FCC RULE NUMBER: None
CANADA RSS-210 Par.: 6.4

MINIMUM STANDARD:
This test is not required be either the FCC or Industry Canada. It is presented to show the stability of the ITRM24501 radio module. The voltage range specified for the 2450 module is 7.5 to10.0 VDC. The transmitter power as well as frequency stability are presented across the above voltage range. The power shall remain below the limits specified for maximum transmitter power. The operating frequency shall demonstrate stability to remain in-band at all channels of the transmitter.

TEST PROCEDURE:
(1) Using the set-up in figure 5, record the transmitter frequency and power at nominal voltage. Vary the operating voltage across the expected range in 0.25 increments and record the transmitter power and frequency. Perform this test for DC operation across the voltage range of 7.5 to 10.0 VDC.

TEST EQUIPMENT:

Receiver/	
Spectrum Analyzer	R&S ESI 40
20 dB Attenuator	HP8491-20
Variable DC Supply	Tektronix PS282
Volt Meter	Fluke

PERFORMED BY: Dave Fry Date: December 29, 2001

TEST SET UP: Voltage Stability Set Up

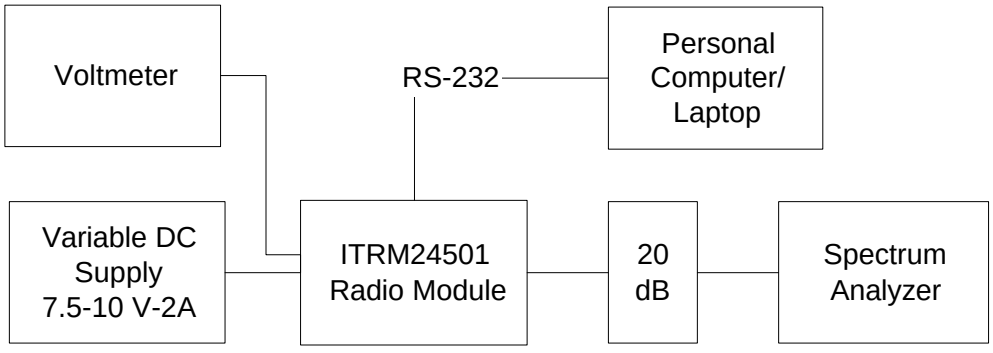


Figure 5.

TEST RESULTS: The ITRM24501 radio module shows the transmitter maintains power and remains on frequency across the normal voltage range expected when operated as specified.

While operated across voltage range of +7.5 to 10.0 VDC, the transmitter frequency and power is unaffected. No measurable change was observed in transmitter power. A change of +/- 400 Hz was observed in transmitter frequency.

MEASUREMENT DATA: Power Output and Frequency versus Voltage

Nominal test voltage is 8.75V.
The specified range of the radio is 7.5 to 10.0 VDC.

Voltage verus Frequency and Power

				Ref Delta	
DCV		MHz	dBm	MHz	dBm
10.00		2441.0359	29.79	0.0004	0
9.75		2441.0359	29.79	0.0004	0
9.50		2441.0359	29.79	0.0004	0
9.25		2441.0358	29.79	0.0003	0
9.00		2441.0357	29.79	0.0002	0
ref. 8.75		2441.0355	29.79	-	-
8.50		2441.0354	29.79	-0.0001	0
8.25		2441.0354	29.79	-0.0001	0
8.00		2441.0353	29.79	-0.0002	0
7.75		2441.0352	29.79	-0.0003	0
7.50		2441.0352	29.79	-0.0003	0
7.25		2441.0351	29.79	-0.0004	0
7.00		2441.0351	29.79	-0.0004	0

EQUIPMENT:	ITRM24501 Radio Module
NAME OF TEST:	Receiver Spurious Emissions (radiated)
FCC RULE: CANADA RSS-210 Par.:	15.109 (a) 7.3
MINIMUM STANDARD:	Not Applicable for this radio. The receiver operates simultaneously with the transmitter to read the RFID tag. Any reciever spurious emissions emanating from the radio receiver are measured during transmitter operation. In normal use it is impossible to have only receiver emissions.
TEST PROCEDURE:	Not applicable
TEST EQUIPMENT:	Not applicable
PERFORMED BY:	Dave Fry Date: December 27, 2001
TEST SETUP:	Not applicable
TEST RESULTS:	Not applicable

EQUIPMENT: ITRM24501 Radio Module

NAME OF TEST: TX, RX AC Wireline Conducted Emissions

FCC RULE NUMBER: 15.209 (a)
CANADA RSS-210 Par: 6.6-7.4

MINIMUM STANDARD:

FCC Rules

Section 15.207 Conducted limits.

(a) For an intentional radiator which 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 450 kHz to 30 MHz shall not exceed 250 microvolts. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals.

Canada RSS-210 6.6, 7.4

Transmitter AC wireline conducted emissions: This is a measurement of the extent of unwanted emissions conducted back into the AC electrical network by LPDs. Note that this test is only for unwanted emissions and not the wanted conducted emissions of AC Carrier Current devices described in section 8.3. This test applies when the device has any one or more of the following characteristics:

(i) The carrier frequency is within 0.45-30 MHz;
(ii) The equipment power supply contains switching circuitry (any frequency);
(iii) Internal clock or local oscillator frequency is within 0.45-30 MHz.

To claim test exemption, the engineering brief or test report shall contain a statement that the conditions of test exemption are met. More information on this is in section 9. The test on the transmitter may be combined with the test of section 7.4 on the receiver.

Minimum standard:

(a) On any frequency or frequencies within the band of 0.45-30 MHz, the measured RF voltage (CISPR meter) shall not exceed 250 microvolts (across 50 ohms).
This test is applicable to battery operated devices that permit operation while connected to AC line powered battery chargers.

TEST PROCEDURE:

As referenced in ANSI C63.4, 1992 place the EUT on a wooden table inside a shield room. Connect the AC power supply to the LISN mounted on the floor behind the table. Measure from .15 to 30 MHz the conducted emissions while the radio is transmitting, then repeat with the radio in receive mode. Preliminary testing was made using a spectrum analyzer to determine the maximum emissions placement of the EUT. Final measurements were made and plots of the conducted emissions were produced. The spectrum analyzer was used in a prescan and swept the frequency range from .15 to 30 MHz using the peak detector as compared to the FCC Class B limit.

Quasi-peak measurements of the highest emissions were made with the test receiver. The tabulated data is contained with the measurement data section.

Refer to appendix A for photographs of the maximum emissions placement of the EUT during AC wireline conducted testing.

General And Environmental Conditions

For FCC and Industry Canada, testing was performed within a shield room, setup as described in ANSI C63.4-1992 section 5.2. The EUT was powered by single phase 120 Volts ~ 60 Hz AC power.

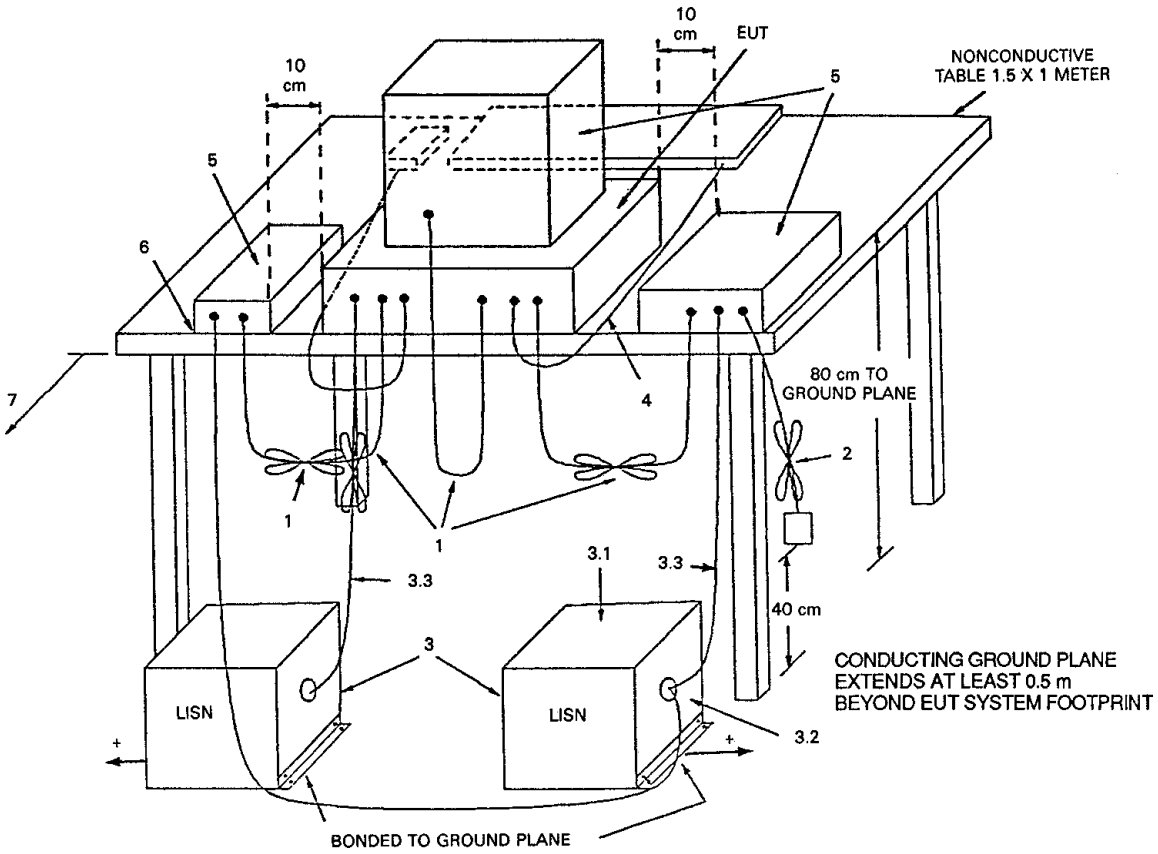
Environmental conditions at the time of testing were a temperature +20 C and relative humidity of 25 %.

TEST EQUIPMENT:

LISN	EMCO 3825/2R
LISN	Rohde & Schwarz, ESH3.Z5
Receiver	Rohde & Schwarz, ESH3
Spectrum Analyzer	HP 8591A

PERFORMED BY: Dave Fry Date: December 20, 2001

NAME OF TEST: AC Wireline Conducted Emissions, TX and RX



+LISNs may have to be moved to the side to meet 3.3 below.

LEGEND:

1. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth forming a bundle 30 to 40 cm long, hanging approximately in the middle between ground plane and table.
2. I/O cables that are connected to a peripheral shall be bundled in center. The end of the cable may be terminated if required using correct terminating impedance. The total length shall not exceed 1 m.
3. EUT connected to one LISN. Unused LISN connectors shall be terminated in 50 Ω LISN can be placed on top of, or immediately beneath, ground plane.

3.1 All other equipment powered from second LISN.
3.2 Multiple outlet strip can be used for multiple power cords of non-EUT equipment.
3.3 LISN at least 80 cm from nearest part of EUT chassis.

Cables of hand-operated devices, such as keyboards, mouses, etc., have to be placed as close as possible to the host.

4. Non-EUT components being tested.
5. Rear of EUT, including peripherals, shall be all aligned and flush with rear of tabletop.
6. Rear of tabletop shall be 40 cm removed from a vertical conducting plane that is bonded to the floor ground plane.

Test Configuration
Tabletop Equipment Conducted Emissions

NAME OF TEST: AC Wireline Conducted Emissions, TX and RX

TEST RESULTS: Complies with FCC and Industry Canada (IC) requirements while operated at 120 VAC. Listed below are the operation configuration and AC voltage.

System	Frequency (MHz)	120 VAC 60 Hz Line Side	Spec Limit	Max. TX Emission dB (uV)	TX Em. Margin to Limit dB
ELPAC MI2009 / ITRM24501 radio	6.130	L1	FCC-IC	44.7	-3.3
ELPAC MI2009 / ITRM24501 radio	6.242	N	FCC-IC	44.9	-3.1

Measured Data:

FCC-Industry Canada
120 VAC 60 Hz

For FCC and Industry Canada (IC) testing begins with a swept plot showing the maximum conducted emissions measured with a peak detector. This plot was referenced to make the following final measurements using a quasi-peak detector.

The frequency range used for testing was 450 kHz to 30 MHz. Unless otherwise noted, all final measurements are made using a Quasi-Peak (QP) detector with a 9 kHz measurement bandwidth . The QP data being compared to the QP limit for FCC-IC requirements.

AC Wireline Conducted Emissions, ITRM24501 radio module when powered by ELPAC MI2009. See appendix E (011214H1.xxx) showing the spectrum plot of the peak emissions. These plots show 120 VAC operation compared to the FCC Class B limits. The data presented in the above chart show the 120 VAC QP data compared to the 250 µV microvolts, 48 dB(µV), limit.

Conversion Factors: The conversion for calculating dB (µV) to microvolts (µV) follows.

dB (µV) to µV (dB (µV) / 20) anti log = µV

µV to dB (µV) 20 (log µV) = dB (µV)

EQUIPMENT: ITRM24501 Radio Module

NAME OF TEST: RF Exposure Safety

FCC RULE NUMBER: 1.1307 (b)(1) references 1.1310 Radiofrequency radiation exposure limits.
The criteria listed in table 1 shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in § 1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of § 2.1093 of this chapter. Further information on evaluating compliance with these limits can be found in the FCC's OST/OET Bulletin Number 65, ''Evaluating Compliance with FCC-Specified Guidelines for Human Exposure to Radiofrequency Radiation.''

Portion of Table 1, FCC 1.1310		
MHz	(mW/cm^2)	Averaging Time (Sec.)
1500-100,000	1.0	30

CANADA RSS-210 Par.: 14.0 (see RSS-102)
CANADA RSS-102 2.2 Mobile Radios
Mobile radios that are not bodyworn (e.g. mounted on vehicles or placed on desks, shelves, etc.) and operated such that humans are normally separated from their radiating element by **at least 20 cm** are not subject to SAR tests, but must have an RF evaluation by the certification applicant, based on the calculated or measured field strength value. SAR evaluation can be used if so desired in lieu of a RF evaluation of field strength limits.

Exposures produced by such radios shall not exceed the exposure limits (see section 3 below) specified in Health Canada's Safety Code 6.

MINIMUM STANDARD: Summarized within the rules sections above.

PERFORMED BY: Dave Fry Date: January 4, 2002

RESULTS:

See Appendix M (011214M1.xxx) for MPE calculations for each antenna.

The ITRM24501 spread spectrum transmitter when combined with the high gain antennas presented in this report creates a RF exposure greater than outlined by the limits when the operator or nearby persons allow their body less than 20-cm from the antenna during operation. Installation instructions will highlight antenna placements that will limit the user and nearby persons to RF exposure. The following warning statements are included on compliance documents shipped with each product. See Appendix L (011214L1.xxx) for all compliance statements regarding this product.

WARNING: per the FCC and Canadian RF (radio frequency) exposure requirements,

(1) Antennas must be supplied and installed as recommended by Intermec Technologies to ensure compliance to RF exposure requirements. The antennas approved for use are Intermec part numbers 805-605-001 and 805-576-101. Correct antenna mounting is fully described within the Intermec ITRM24501 Users Guide.

(2) When installing and using Intermec approved remote antennas associated the RFID tag reader, a 20-cm (8-inch) passing distance must be maintained from any body part of the user or near by persons and the remote antenna. The antenna must not be touched during transmitter operation.

(3) Cables attached to the remote antennas must have a minimum length as provided from Intermec to insure the proper losses to control RF exposure.

(4) RF safety requirements mandate this device cannot be co-located with other transmitters.

7.0 EQUIPMENT LIST

EQUIPMENT	MFG/MODEL	SERIAL NO.	CAL. DATE	CYCLE
Antenna, bi-conical	EMCO 3110	1185	9/01	12 Mo.
Antenna, log periodic	EMCO 3146	1262	9/01	12 Mo.
Antenna, DRG horn	EMCO 3115	2246	7/01	12 Mo.
Antenna, DRG horn	EMCO 3116	9311-2215	7/01	16 Mo.
Attenuator	HP 8491-10 dB	43380	9/01	12 Mo.
Attenuator	HP 8491-20 dB	36824	9/01	12 Mo.
High Pass Filter	Cir-Q-Tel R9H-1G5/10G-28A	01	9/01	12 Mo.
High Pass Filter	K&L 13SH01-3000/T24000	01	9/01	12 Mo.
LISN	Rhode & Schwarz ESH3-Z5	832479/018	8/01	12 Mo.
LISN	EMCO 3825/2R	1026	10/01	12 Mo.
Mixer	HP 11970K	3003A05374	12/00	24 Mo.
Plotter	HP 7470A	2308A27380	On Req.	
Power Meter	Giga-Tronics 8541	010618569	4/01	12 Mo.
Power Supply	Tektronix PS282	PS282 TW10045	On Req.	
Preamplifier	HP 8449B	3008A00439	4/01	24 Mo.
Preamplifier	HP 11975A	2738A01994	2/01	12 Mo.
Pulse Limiter	Rhode & Schwarz ESH3-Z2	007-6977	9/01	12 Mo.
Receiver	Rohde & Schwarz ESH3	872318/050	3/01	12 Mo.
Receiver	Rohde & Schwarz ESVP	879674/046	1/01	12 Mo.
Receiver/SA	Rohde & Schwarz ESI 40	100047/040	6/01	24 Mo.
RF Preselector	HP 85685A	3221A01427	8/01	12 Mo.
Signal Generator	HP 83630A	3250A00322	3/00	24 Mo.
Spectrum Analyzer	HP 8566B	2637A03549	8/01	12 Mo.
Spectrum Analyzer	HP 8591A	3144A02470	1/01	24 Mo.
Voltmeter	Fluke 77	35300152	8/00	18 Mo.

On Req. = On Request