DATARADIO COR Ltd.
Corporate Headquarters and Manufacturing Operations
299 Johnson Avenue, PO Box 1733
Waseca, MN 56093-0833 USA
Phone: 507-835-8819 Fax: 507-835-6648

FCC Part 15.247 Certification Application
for FCC ID: NP42424099-002

Industry Canada RSS 210 Application

Test Report
And Technical Documentation
For Dataradio COR Ltd.
Frequency Hopping Wireless Modem

Prepared by
Dataradio COR Ltd. Engineering
299 Johnson Ave
Waseca, MN 56093-0833

AFFIDAVIT

The technical data included in this report has been accumulated through tests that were performed by me or by engineers under my direction. To the best of my knowledge, all of the data is true and correct.

Mark Christensen
Director of Engineering, Dataradio COR Ltd.

Table of Contents

Dataradio COR Ltd.
Waseca, Minnesota

Engineering Statement of Allen Frederick:

The application consisting of the attached engineering exhibit and associated FCC form 731 has been prepared in support of a request for Certification. Certification is requested for the Dataradio COR Ltd (DRL) Integra-H Wireless Modem. DRL located in (Waseca, MN) will build the transceiver part number 023-4099-050 and buy the Integra-H modem from Dataradio Inc (Quebec, Canada) with part number 685-4099-001. DRL will install the modem and perform final assembly. The assembled unit will be marketed under the model name Integra-H and identified by the FCC number **NP42424099-002** and DRL part# 242-4099-430. The Integra-H wireless modem operates pursuant to FCC Part(s) 15.247 of the Rules and Regulations.

EXISTING CONDITIONS

The units utilized for these Certification measurements were obtained from prototypes. The transceiver is designed to operate on frequencies ranging from 902 MHz to 928 MHz. The frequency tolerance of the transceiver is .00015% or 1.5 parts per million. The frequency stability of the transceiver is controlled by a temperature compensated crystal oscillator (TCXO) operating at 14.4 MHz.

PROPOSED CONDITIONS

It is proposed to certify the Integra-H, 902-928 MHz wireless modem for operation in the band of frequencies previously outlined. The applicant anticipates marketing the device for use in wireless transmission of data.

PERFORMANCE MEASUREMENTS

All Certification measurements were conducted in accordance with the Rules and Regulations Section 15.247 of Pike & Fischer Inc., CD ROM revision 4/1/00. FCC Public Notice docket DA 00-705 titled Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems dated March 30, 2000 was also used as a reference guide.

Industry Canada measurements were conducted in accordance with the Rules and Regulations of RSS-210, Issue 3 dated February 5, 2000.

Equipment performance measurements were made in the engineering laboratory and on the FCC certified Open Area Test Site at Transcrypt International / E.F. Johnson Radio Products located at 299 Johnson Avenue in Waseca, Minnesota. All measurements were made and recorded by myself or under my direction. The performance measurements were made between July 5, 2000 and July 28, 2000.

CONCLUSION

Given the results of the measurements contained herein, the applicant requests that Certification be granted for the Integra-H, 902-928 MHz wireless modem as tested for data communications.

____ November 13, 2000
Allen Frederick
Electrical Engineer II, Dataradio COR Ltd.

1 Qualifications of Engineering Personnel

NAME:	Charles M. Pollock III
TITLE:	Principal Engineer (Dataradio COR Ltd.)
TECHNICAL EDUCATION:	BSEE University of Arizona 1984
TECHNICAL EXPERIENCE:	16 years experience in analog and radio frequency communications.

NAME:	**Allen Frederick**
TITLE:	Electrical Engineer II (Dataradio COR Ltd.)
TECHNICAL EDUCATION:	Bachelor of Science Degree in Electronic Engineering Technology (1998) from Minnesota State University, Mankato.
TECHNICAL EXPERIENCE:	4 years experience in analog and radio frequency communications.

NAME:	**Constantin Pintilei**
TITLE:	R&D Test Engineer (DATARADIO Inc.)
TECHNICAL EDUCATION:	Bachelor of Science Degree in Radiotechnique Electronic Engineering (1993) Technical University of Iasi, Romania.
TECHNICAL EXPERIENCE:	7 Years experience in radio frequency measurements.

2 GENERAL INFORMATION

The following report has been generated for FCC Certification of the Dataradio 902-928 MHz wireless modem, part number 242-4099-430. Unless otherwise noted, all of the measurements were conducted following the procedures set forth in the TIA/EIA-603 standards.

MODEL NUMBER:	Integra-H
PART NUMBER:	242-4099-430
MANUFACTURER:	Dataradio COR Ltd., Waseca, MN 56093 (Transceiver - final assembly) DATARADIO Inc., Town of Mount Royal, Quebec, Canada, H4P 1H7 (Modem)
FCC ID NUMBER:	NP42424099-002
RULES AND REGS:	FCC Part (s) 15.247 Industry Canada RSS-210
FREQUENCY RANGE:	902.000 MHz – 928.000 MHz
SERIAL NUMBER (S):	EP4 Unit #6
MAXIMUM POWER RATING:	1.00 Watts (.1 to 1 watt variable)
MODULATION TYPE:	DRCMSK
NUMBER OF CHANNELS:	1024 Channel Modem
INPUT IMPEDANCE:	50 ohms, Nominal
VOLTAGE REQUIREMENTS:	13.6 VDC, Nominal

EQUIPMENT IDENTIFICATION:

TRADE NAME	DESCRIPTION	DRI PART NUMBER
Transceiver	902-928 MHz RF Transceiver	023-4099-050
Integra-H	Modem	685-4099-001
Hopper/Integra	Transceiver/Modem	242-4099-430

3 Test Facilities

The following tests:

15.247(c)	Spurious Radiation Emissions
15.205	Restricted Bands of Operation

were performed at:

FCC certified Open Area Test Site
Transcrypt International / E.F. Johnson Radio Products
299 Johnson Avenue
Waseca, MN 56093

All other testing was performed:

Engineering laboratory
Dataradio COR Ltd.
299 Johnson Avenue
Waseca, MN 56093

4 Antenna Compliance

4.1 Antenna Requirement

FCC Rule: 15.203
IC Rule: 5.5

FCC Docket DA 00-705 description:

Describe how the EUT complies with the requirement that either its antenna is permanently attached, or that it employs a unique antenna connector, for every antenna proposed for use with the EUT. The exception is in those cases where the EUT must be professionally installed. In order to demonstrate that professional installation is required, the following three points must be addressed: (a) the application (or intended use) of the EUT, (b) the installation requirements of the EUT, and (c) the method by which the EUT will be marketed.

Description of compliance:

This product must be professionally installed so compliance with the unique antenna connector or a permanently attached antenna is not valid.

To demonstrate that professional installation is required, the following three points have been addressed:

(a) the application (or intended use) of the EUT
The Integra-H is intended to be used in the SCADA & Data Acquisition market. The Integra-H will be professionally installed within a Remote Terminal Unit (RTU).

(b) the installation requirements of the EUT
The professional installer is responsible for ensuring Radiation Exposure Limits and EIRP (36 dBm) limits are not exceeded.

(c) the method by which the EUT will be marketed.
The method in which the unit will be sold is direct sales to system installers.

4.2 External Radio Frequency Power Amplifiers and Antenna Modifications

FCC Rule: 15.204
IC Rule: 5.8

Docket DA 00-705 description:

External power amplifiers are prohibited. The following information for the highest gain of each type of antenna proposed for use with the EUT is provide below:

(a) type (e.g., Yagi, patch, grid, dish, etc.)
(b) manufacturer and model number
(c) gain with reference to an isotropic radiator.

Type	Manufacturer	Part Number	Gain (dBi)
Yagi	Maxrad	MYG 9159	10 dBi
Omni Directional	Maxrad	MFB 9157	7 dBi
Unity Gain	Maxrad	MFB 9150	0 dBi
Whip	Maxrad	EXE-902-SM Or EXR-902-BN	0 dBi

5 Test Results

5.1 Carrier Frequency Separation

FCC Rule: 15.247(a)(1)
IC Rule: 6.2.2(o)(a1)

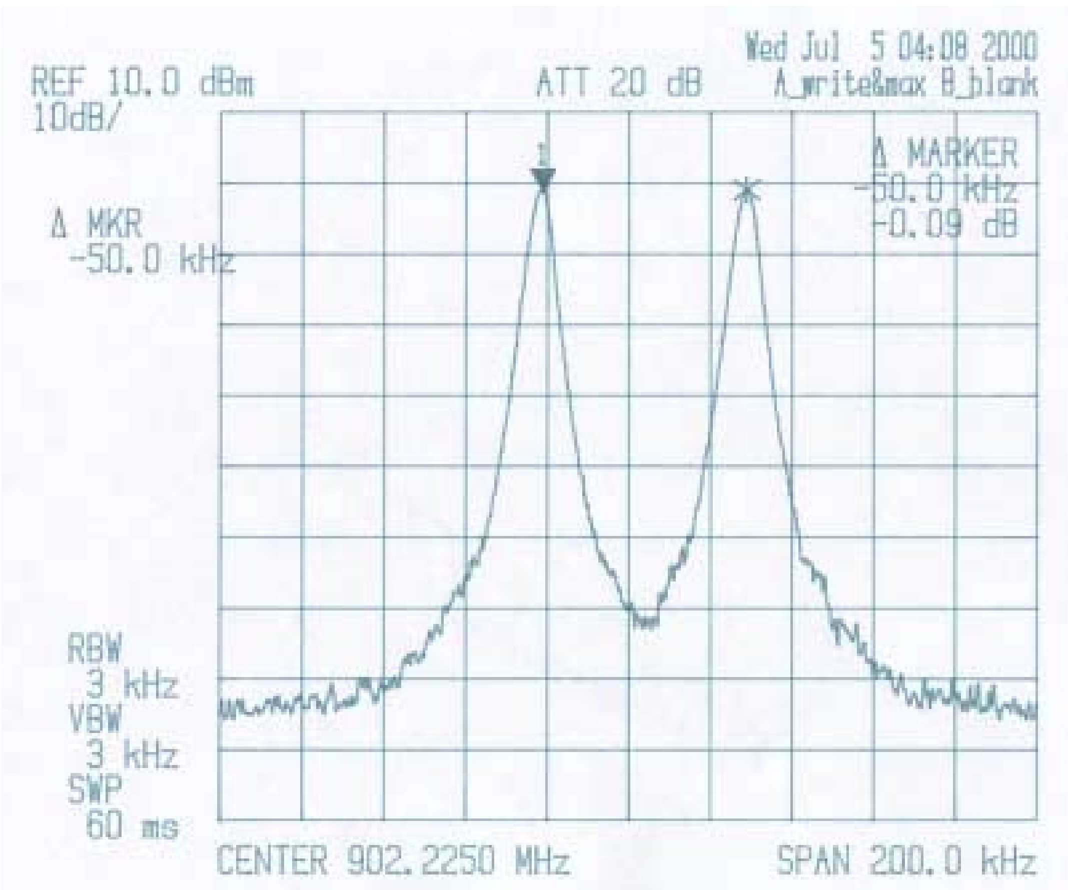
Specification: Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

Test Equipment: Advantest 3365A Spectrum Analyzer

Procedure:
Span = 200 kHz
RBW = 3 kHz
VBW = RBW
Sweep = auto (60 mS)
Detector function = peak
Trace = max hold

Trace was allowed to stabilize. Using the marker-delta function the separation between the peaks of the adjacent channels was determined.

Results: Carrier Frequency Separation **=** 50 kHz (Maximum 20dB BW = 30 kHz)



5.2 20 dB Bandwidth

FCC Rule: 15.247(a)(1)
IC Rule: 6.2.2(o)(a1)

Specification: The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

Test Equipment: Advantest 3365A Spectrum Analyzer

Procedure:

Span = 100 kHz
RBW = 1 kHz
VBW = RBW
Sweep = auto
Detector function = peak
Trace = max hold

The Integra-H was transmitting random data at its maximum data rate with 8 kHz deviation. Deviation is factory set using a tone ¼ the bit rate. Measurements were performed at the high end of the band, 928 MHz. The deviation will be maximum at the high end of the band due to the greater multiplication factor of the TCXO. The trace was allowed to stabilize. Using the “Peak Search” function of the Advantest 3365A spectrum analyzer a reference was set at the peak emission. Using the “xxdB Down” function of the 3365A spectrum analyzer the 20 dB bandwidth was found. See following plots.

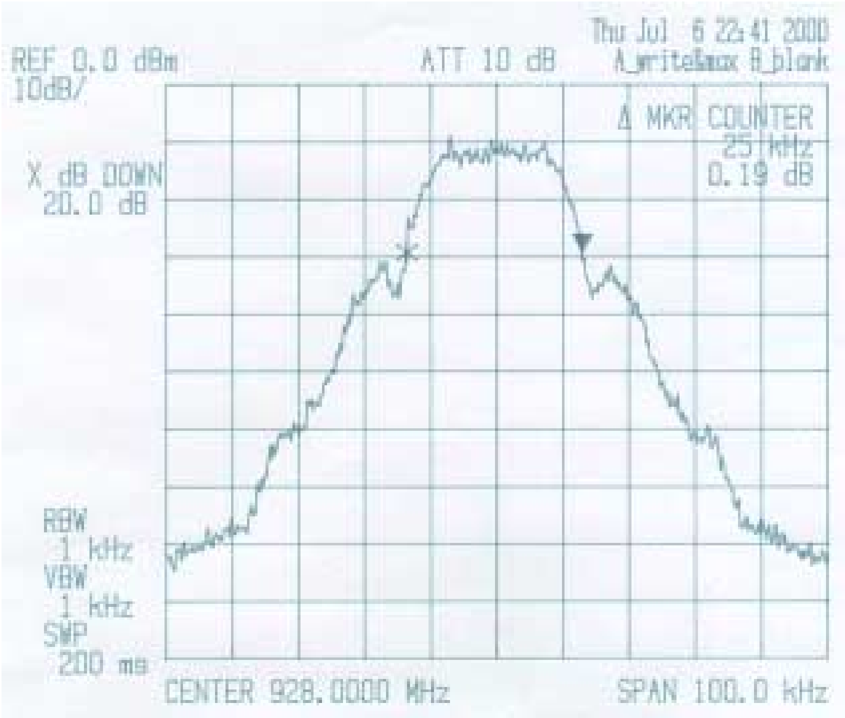
Results (See following plots):

Plot	Bit Rate	20 dB BW
1	9600	22 kHz
2	19200	22 kHz
3	21400	25 kHz
4	25600	30 kHz

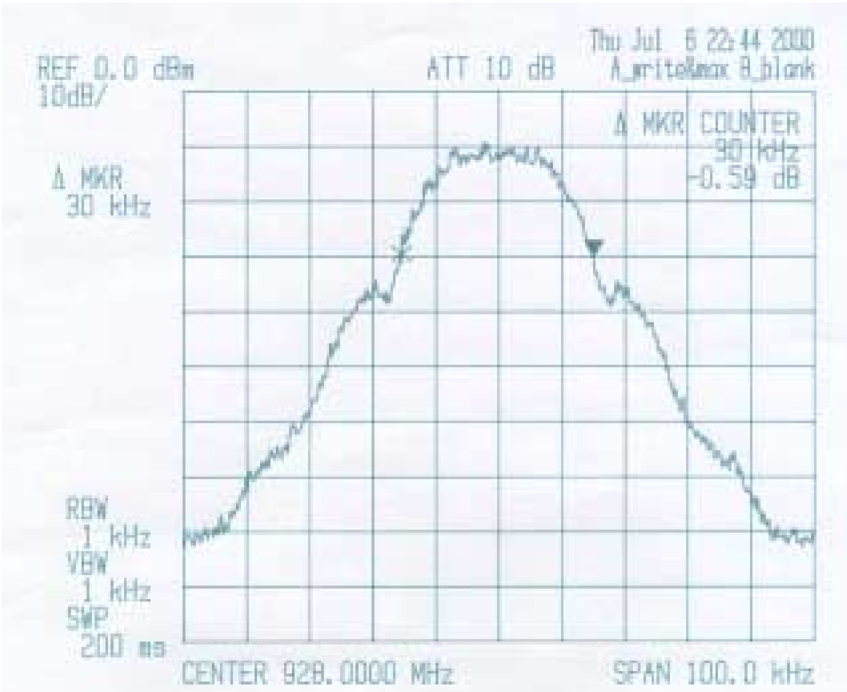
Plot 1
Bit Rate: 9600 bits/sec
Deviation: 8 kHz
20 dB BW: 22 kHz

Plot 2
Bit Rate: 19200 bits/sec
Deviation: 8 kHz
20 dB BW: 22 kHz

Plot 3
Bit Rate: 21400 bits/sec
Deviation: 8 kHz
20 dB BW: 25 kHz



Plot 4
Bit Rate: 25600 bits/sec
Deviation: 8 kHz
20 dB BW: 30 kHz



5.3 System Receiver Input Bandwidth

FCC Rule: 15.247(a)(1)
IC Rule: 6.2.2(o)(a1)

Specification: 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.

Results: The maximum 20 dB Bandwidth is 30 kHz, the receiver IF section is also 30 kHz which complies with section 15.247(a)(1) of the FCC rules and section 6.2.2(o)(a1) of the IC rules.

5.4 Number of Hopping Frequencies

FCC Rule: 15.247(a)(1)(i)
IC Rule: 6.2.2(o)(a2)

Test Equipment: Advantest 3365A Spectrum Analyzer

Number of Hopping Frequencies: 64 to 512

Specification: If the 20 dB BW of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies

Procedure:
The RF band from 902 – 928 MHz has a 400kHz guard band and the remaining spectrum (902.2-927.775MHz) is used for hopping. These frequencies are divided into 1024 (25kHz) channels grouped into 16 equally spaced sub-bands. An odd/even channel selection selects 512 (512 odd, 512 even) from the 1024 channels . All sub-bands contain 32 channels separated by 50 kHz. The Integra-H uses all 512 channels (16 bands x 32 chan = 512 chan) unless a sub-band is blocked out in accordance with section 15.247(h) which states:

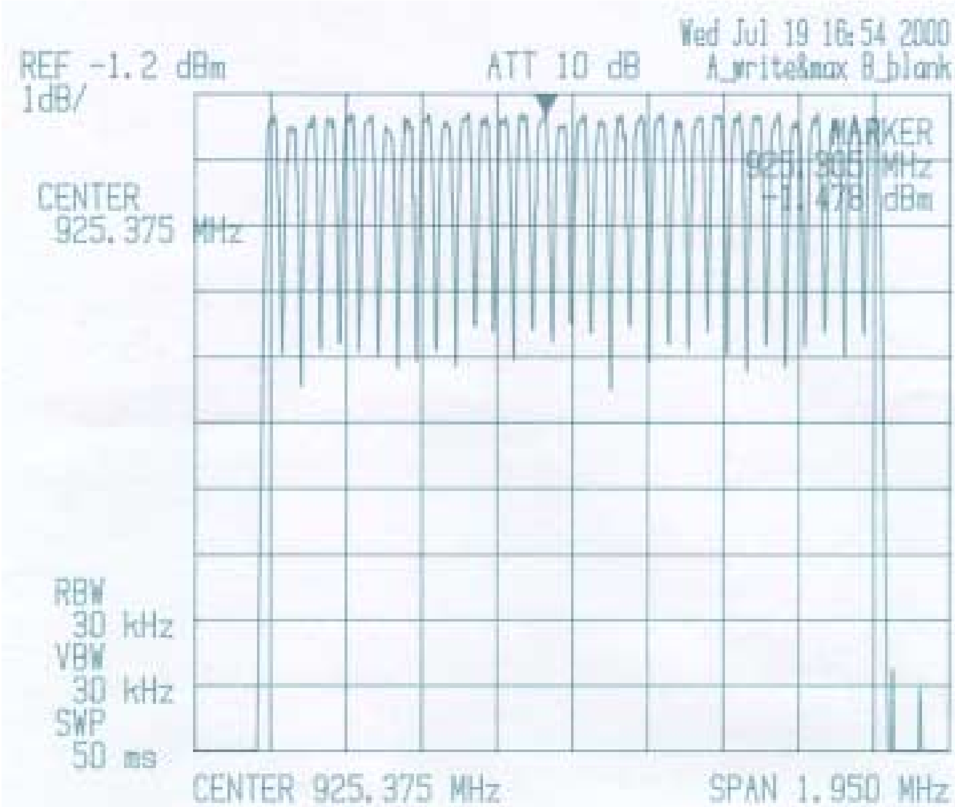
"The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted."

The user has the ability to block all but a minimum of two sub-bands. The minimum number of hopping channels possible will be when two of the 16 sub-bands (32 channels each) are enabled. This would be a minimum of 64 channels. Nothing will prevent two or more remotes, with the same System ID, from transmitting on the same frequency if they transmit at the same time. The units have no internal algorithms that can or will allow for coordination with other transmitters. The user has the option of selecting from 2 to 16 sub-bands within the 512 channel frequency range so as to adapt the hop sets to avoid hopping on occupied channels. Multiple transmitters can have different System ID codes, which differentiates the pseudo random sequence but does not guarantee avoidance of simultaneous occupancy of individual hopping frequencies. A single system with one master and multiple remotes will have the same System ID for all units, hence all units will be synced to the same channel at any given time. Below is a list of the sub band channelization.

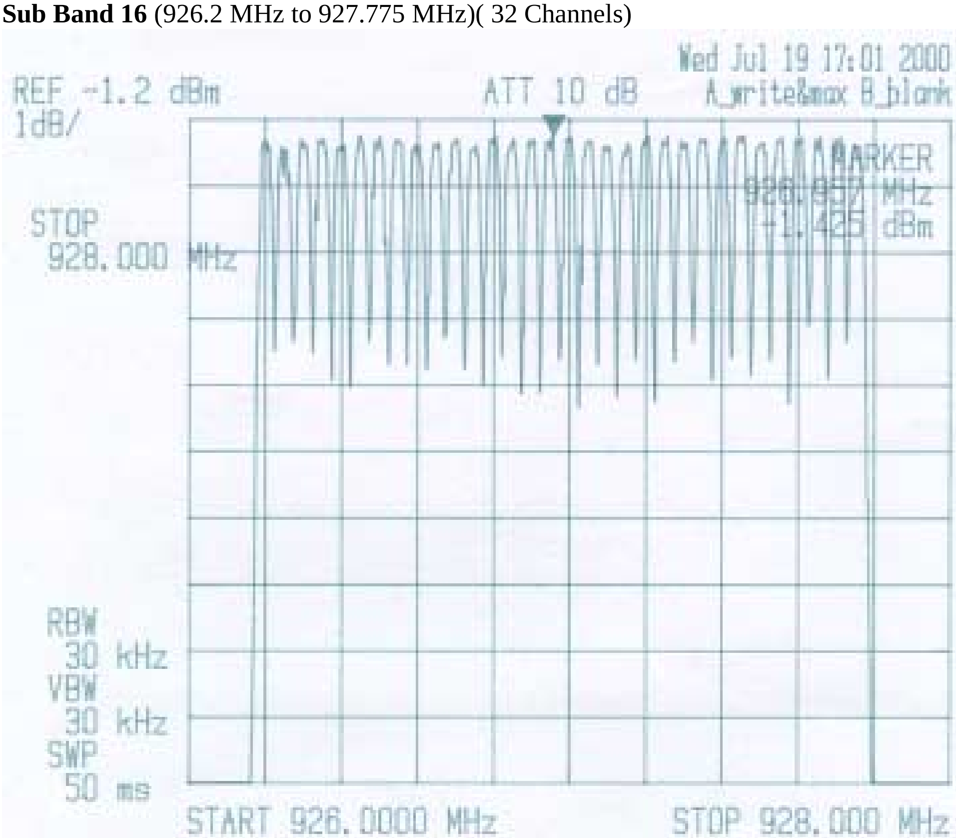
Sub Band	Frequency Range	Channels
1	902.200 – 903.775 MHz	000 - 031
2	903.800 – 905.375 MHz	032 - 063
3	905.400 – 906.975 MHz	064 - 095
4	907.000 – 908.575 MHz	096 - 127
5	908.600 – 910.175 MHz	128 - 159
6	910.200 – 911.775 MHz	160 - 191
7	911.800 – 917.375 MHz	192 - 223
8	913.400 – 914.975 MHz	224 - 255
9	915.000 – 916.575 MHz	256 - 287
10	916.600 – 918.175 MHz	288 - 319
11	918.200 – 919.775 MHz	320 - 351
12	919.800 – 921.375 MHz	352 - 383
13	921.400 – 922.975 MHz	384 - 415
14	923.000 – 924.575 MHz	416 - 447
15	924.600 – 926.175 MHz	448 - 479
16	926.200 – 927.775 MHz	480 - 511

See following plots of last two sub bands.

Sub Band 15 (924.6 MHz to 926.175 MHz)(32 Channels)



Sub Band 16 (926.2 MHz to 927.775 MHz)(32 Channels)



5.5 Time of Occupancy (Dwell Time)

FCC Rule: 15.247(a)(1)(i)
IC Rule: 6.2.2(o)(a2)

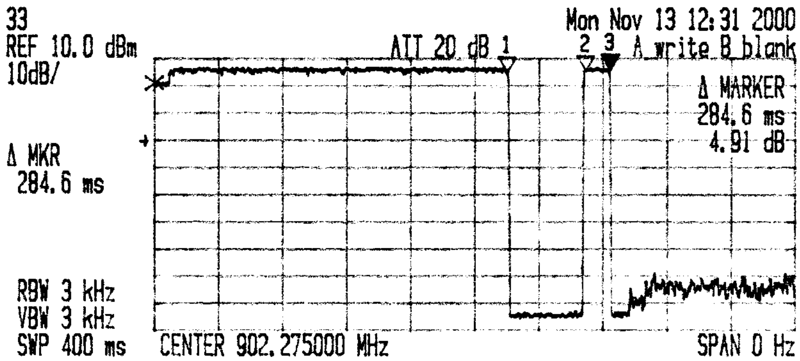
Specification: For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period

Test Equipment: Advantest 3365A Spectrum Analyzer

Procedure:
Continuous data was sent to the modem and the dwell time was captured on the Spectrum Analyzer. (see plot 1)
No data was sent to the modem and the dwell time was captured on the Spectrum Analyzer. (see plot 2)
See attachment entitled "Hopping Description" for description of hopping.

Measured Results:	Plot 1:	Continuous Data:	Data first 220 mS, last 15.5 mS Sync information
	Plot 2:	No Data (Sync Dwell):	15.86 mS

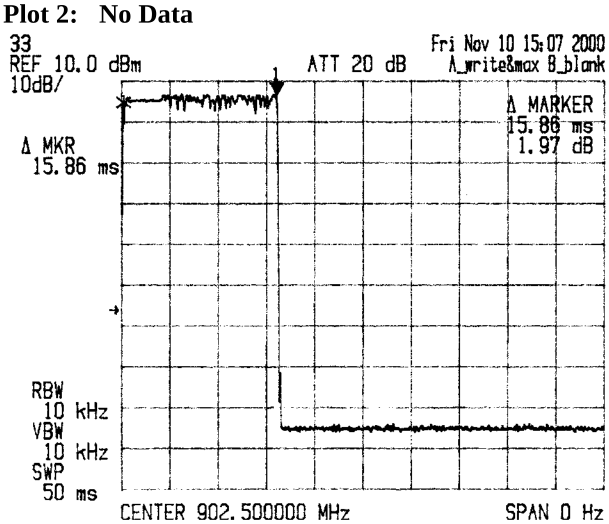
Plot 1: Continuous Data



*** Multi Marker List ***

No. 1:	220.0 ms	3.70 dB	A
No. 2:	269.1 ms	4.52 dB	A
No. 3:	284.6 ms	4.91 dB	A

Plot 2: No Data



5.6 Peak Output Power

FCC Rule: 15.247(b)(2)
IC Rule: 6.2.2(o)(a2)

Specification: For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels

Test Equipment: HP437B Power Meter

Procedure: The Integra-H was set to transmit an unmodulated carrier at each frequency listed below. An HP437B power meter was used to measure the peak power. After correcting for cable loss the following results were obtained.

Circuit Description: A directional coupler senses the forward power and feeds a DC signal to the non-inverting terminal of opamp U501(comparator). Digipot U103C sets the reference voltage for the comparator (U501), power out can be adjusted in approximately .05 dB increments. U501 regulates the control line voltage of the PA (U500, RF2131) maintaining a stable output power over temperature, load and supply voltage. Zener diode CR504 protects the control line input of the PA.

Results:

Peak Power Out Vs. Frequency

902.2 MHz	**911.2 MHz**	**919.2 MHz**	**927.775 MHz**
29.94 dBm (986 mW)	29.95 dBm (989 mW)	29.93 dBm (984 mW)	29.94 dBm (986 mW)

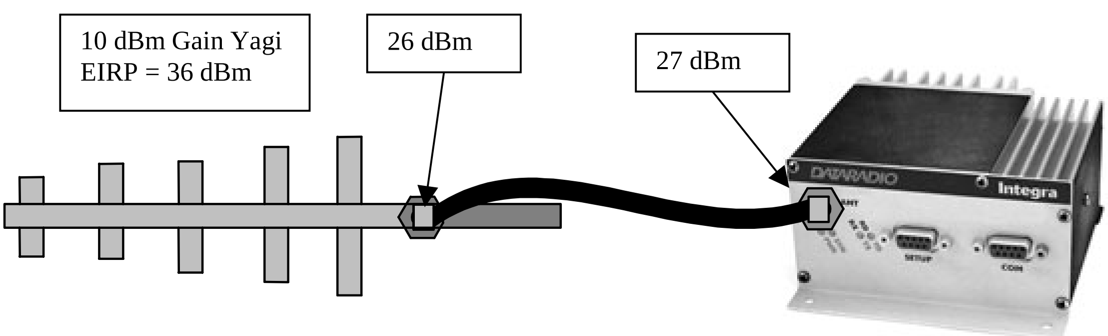
5.7 *De Facto* EIRP Limit

FCC Rule [15.247(b)(3)]: If transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator is reduced below 30 dBm by the amount in dB that the directional gain of the antenna exceeds 6 dBi. Cable loss is taken into account so that the power seen at the antenna input is the lesser of 30 dBm or 36 dBm minus directional gain of antenna in dB. The minimum cable length used would be zero in the instance where the antenna is attached directly to the antenna port without an interconnecting cable. It is the responsibility of the professional system installer to make sure the Integra-H is operated in compliance with the FCC rules. The Integra-H was tested with a 10 dB Yagi, 7 dB Omni, unity gain, and a ½ wave whip antenna. These would be the maximum gain antenna's of each type used by the professional installer.

IC Rule [6.2.2(o)(a2)]: The output power is not to exceed 1.0 watt and the EIRP not to exceed 6 dBW if the hopset uses 50 or more frequencies.

Example Calculation:
Yagi Antenna = 10 dB Exceeds 6dBi by 4 dB (10 dB – 6 dB) so antenna power must be reduced by **4 dB**
Cable Loss = 1 dB

Integra-H is reduced by 4dB plus 1 dB to account for cable loss so:
30 dBm – 4 dB + 1 dB = **27 dBm** at antenna port of hopper
after 1 dB loss through cable: 27 dBm – 1 dB = **26 dBm** input to Antenna which is a reduction of **4 dB**



5.8 RF Exposure Compliance Requirements

FCC Rule: 1.1307, 1.1310, 2.1091(b)(d), 2.1093
IC Rule: RSS-210 (14), Exemption Clause RSS-102(4.3)

Description of Compliance: The Integra-H is intended to be used in the SCADA (Supervisory Control And Data Acquisition) market and will be mounted in a fixed RTU (Remote Terminal Unit). The Integra-H will be professionally installed in such a way that a minimum separation distance of more than 20 cm will be maintained between the radiating structure and any person so it is classified as a mobile. A typical installation would be with the antenna mounted on a tower, in rare instances a ½ wave whip antenna would be used. In either installation the antenna would be mounted greater than the minimum distance calculated below.

The calculation for the more stringent specification, a General Population/Uncontrolled Mobile device according to section 2.1091(b) and section 1.1310 Note 2 is shown below:

Limits for General Population/Uncontrolled Exposure:

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density mW/cm^2	Averaging Time (minutes)
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f2)	30
30-300	27.5	0.073	0.2	30
300-1500	---	---	f/1500	30
1500-100,000	---	---	1.0	30

Environmental Specification: f (MHz) / 1500 mW/cm^2
f (902 MHz) / 1500 mW/cm^2 = **.6 mW/cm^2** (worse case)

$S = (PG) / (4\pi R^2)$ (OET Bulletin 65)

where: S = power density (in appropriate units, e.g. mW/cm^2)
P = power input to the antenna (in appropriate units, e.g., mW)
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

Distance Calculation:
Maximum Antenna Gain: 10 dB Yagi $10^{(10dB / 10)} =$ 10
$.6\ mW/cm^2 = (1000\ mW * 10) / (4\pi R^2)$ ➔ **Minimum Distance = 36.42 cm**

5.9 Band-edge Compliance of RF Conducted Emissions

FCC Rule: 15.247(c)
IC Rule 6.2.2(o)(e1):

Specification: 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.

Test Equipment: Advantest 3365A Spectrum Analyzer

Procedure:

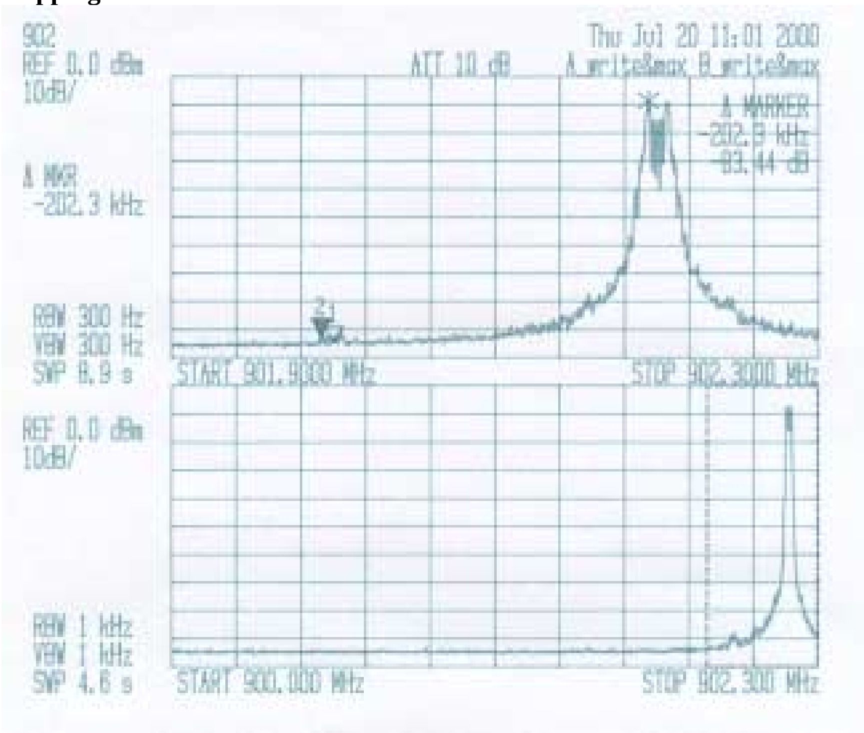
The modem was set to transmit at 9600, 19200, 21400 and 25600 bps. The trace was allowed to stabilize. The marker was set on the emission at the highest modulation product outside of the band. The marker-delta function was enabled and the marker-to-peak function was used to move the marker to the peak of the in-band emission. Using the 3365A spectrum analyzer's multi-screen feature a 1 MHz span is shown on the bottom of the screen and a zoomed in picture of the out of band emission is shown on the top. The first four plots show the out of band emissions with the hopping function disabled.

The above procedure was followed with the hopping feature enabled. The next four plots show the out of band emissions with the hopping function enabled.

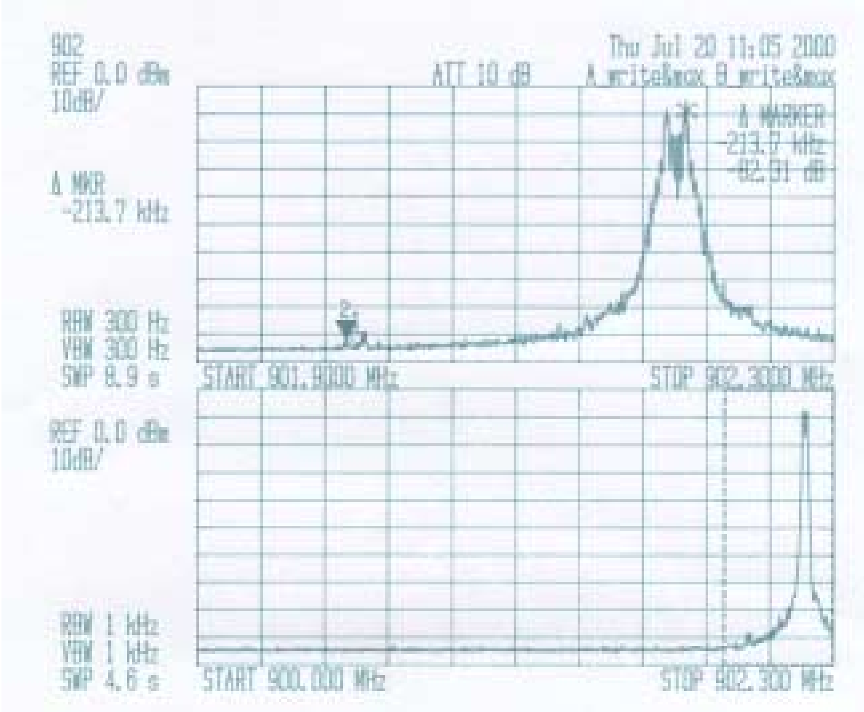
Results:

(see following pages)

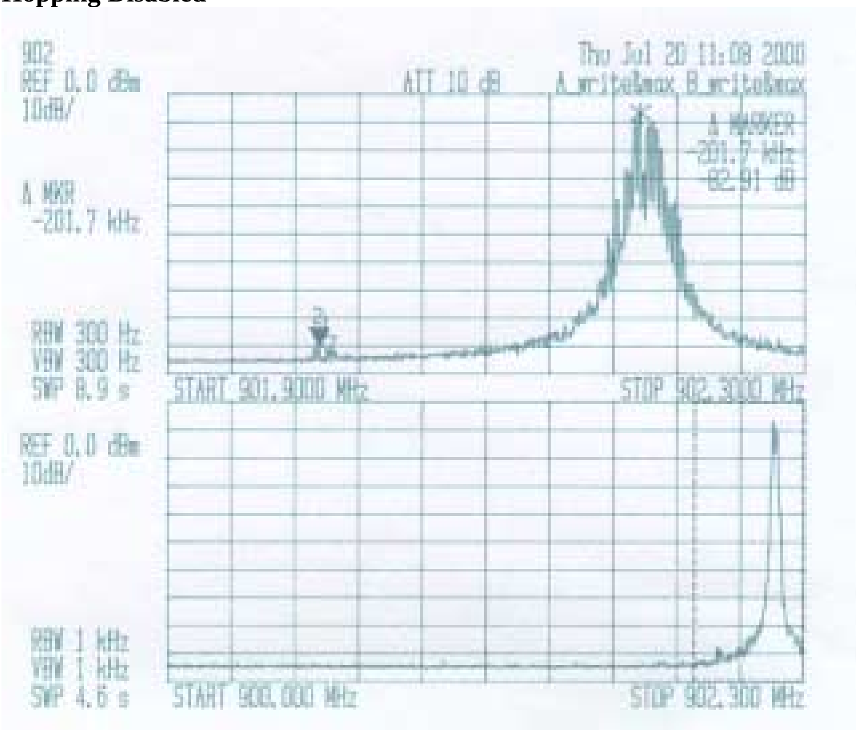
902.2 MHz
9600 bps
Hopping Disabled



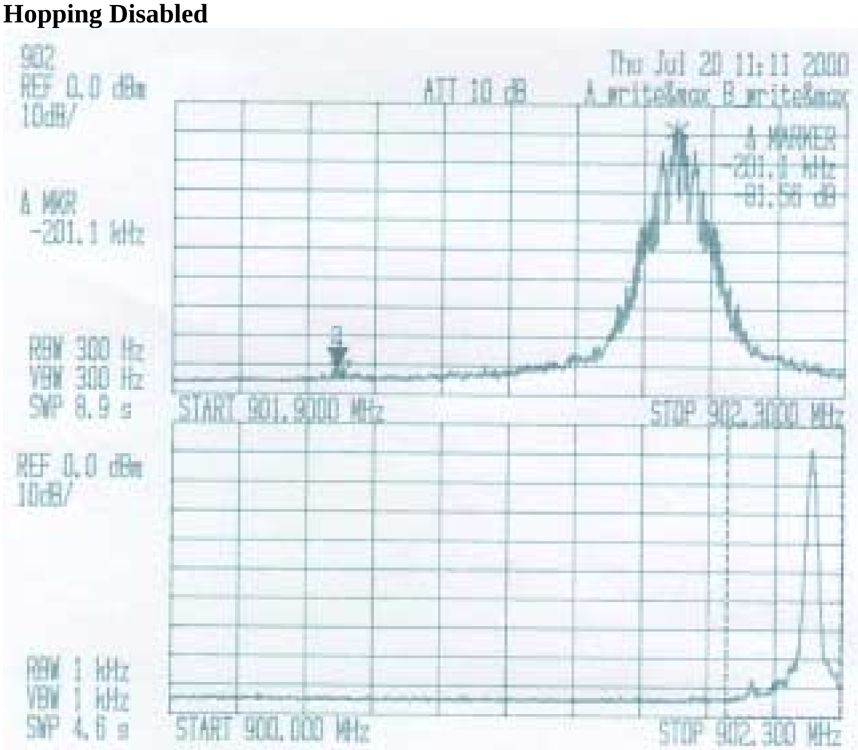
902.2 MHz
19200 bps
Hopping Disabled



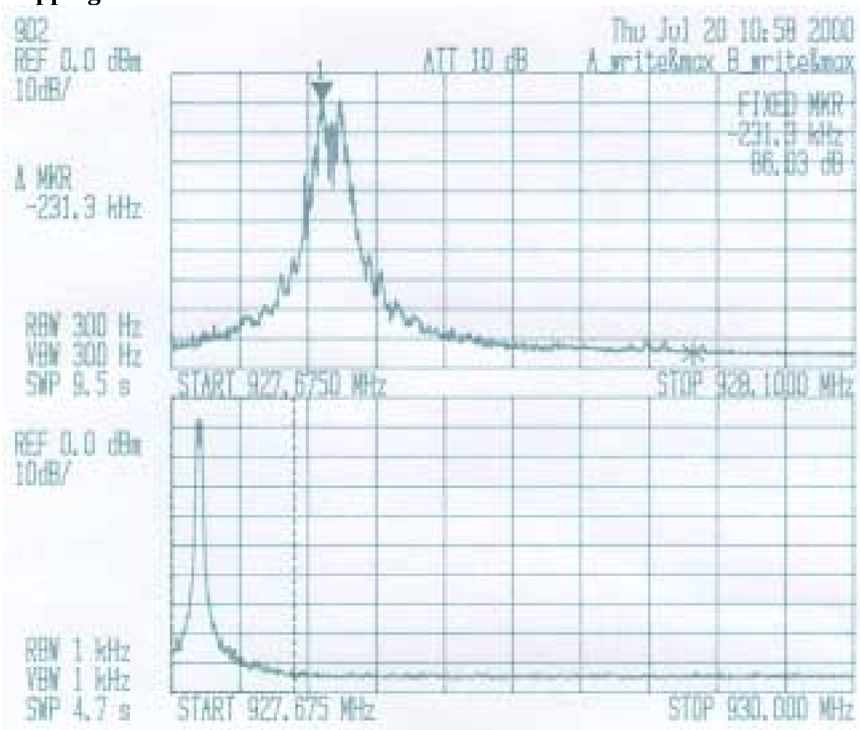
902.2 MHz
21400 bps
Hopping Disabled



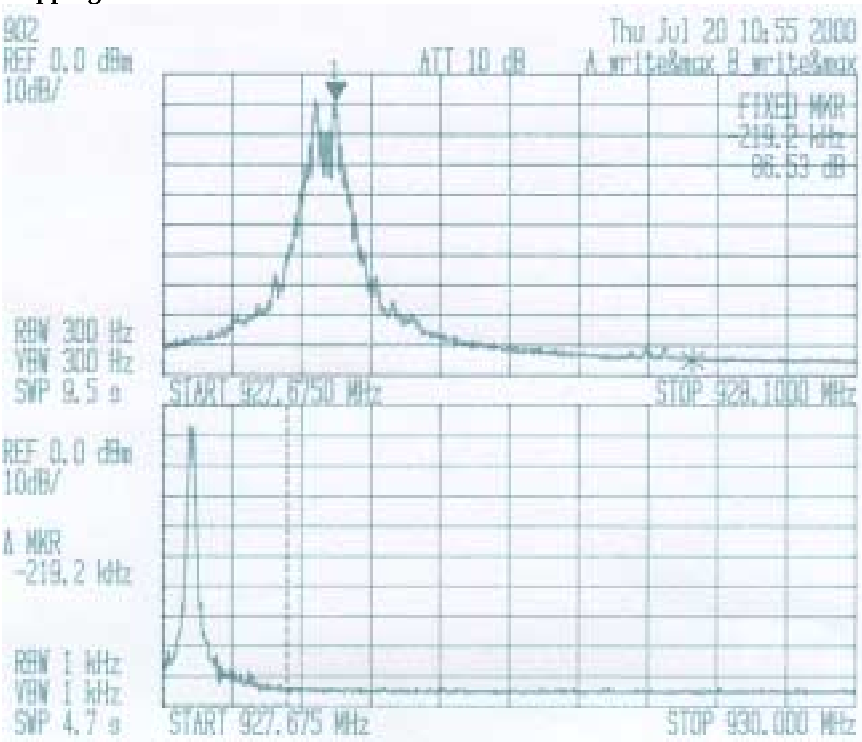
902.2 MHz
25600 bps
Hopping Disabled



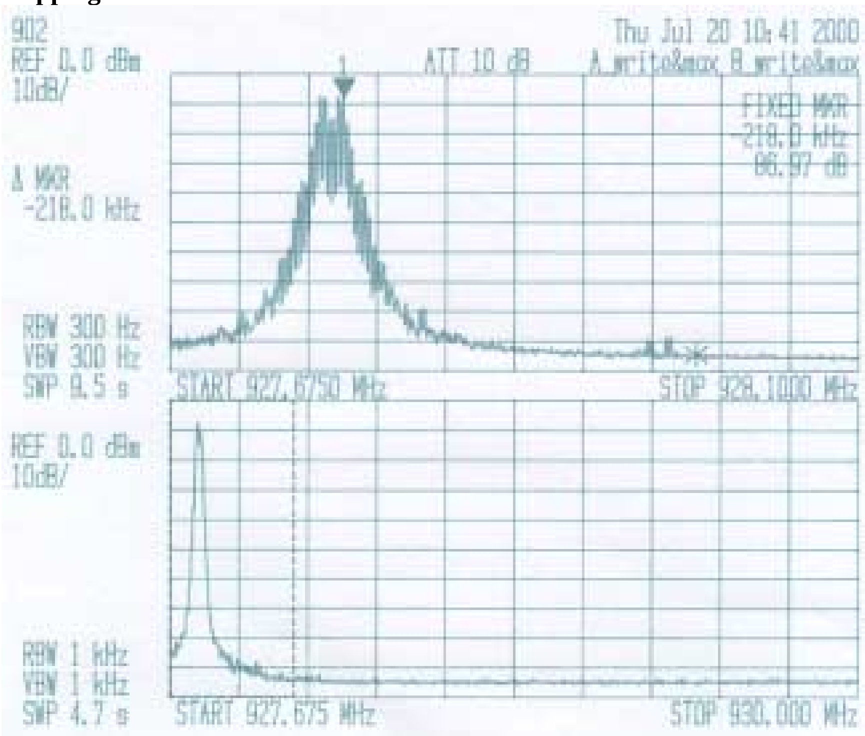
927.775 MHz
9600 bps
Hopping Disabled



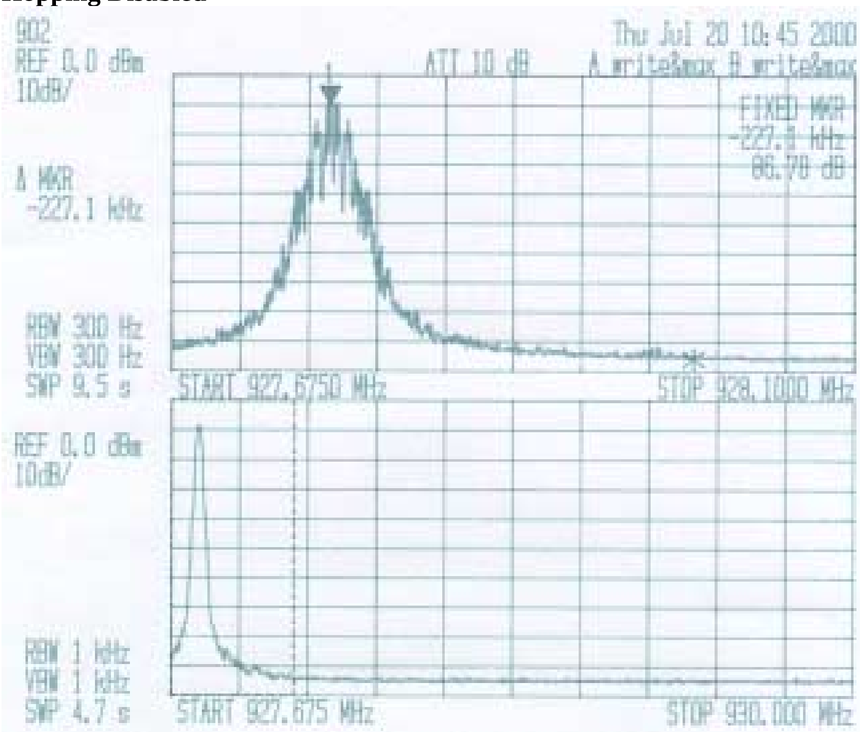
927.775 MHz
19200 bps
Hopping Disabled



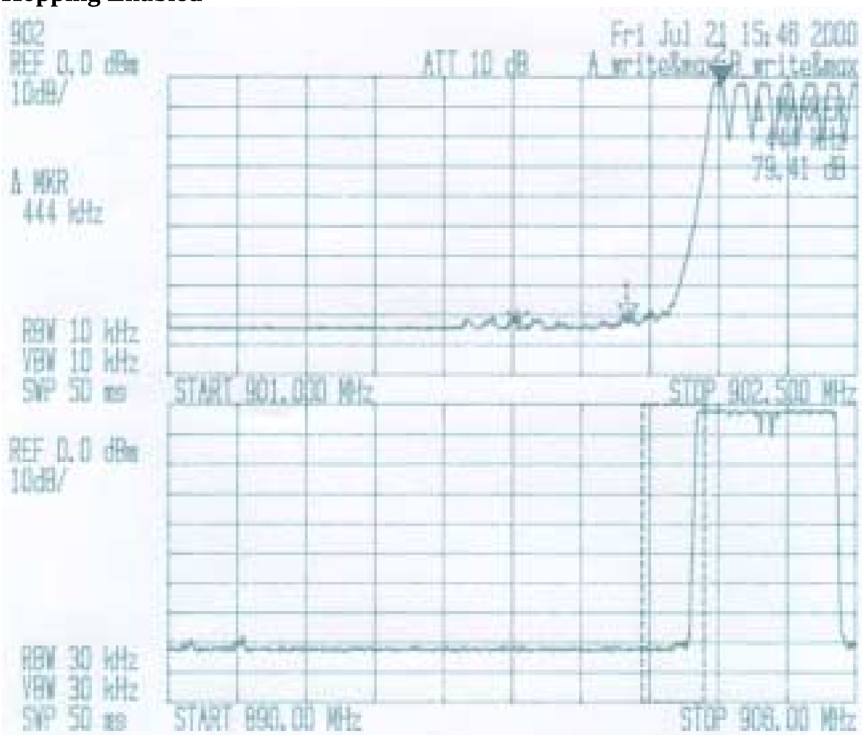
927.775 MHz
21400 bps
Hopping Disabled



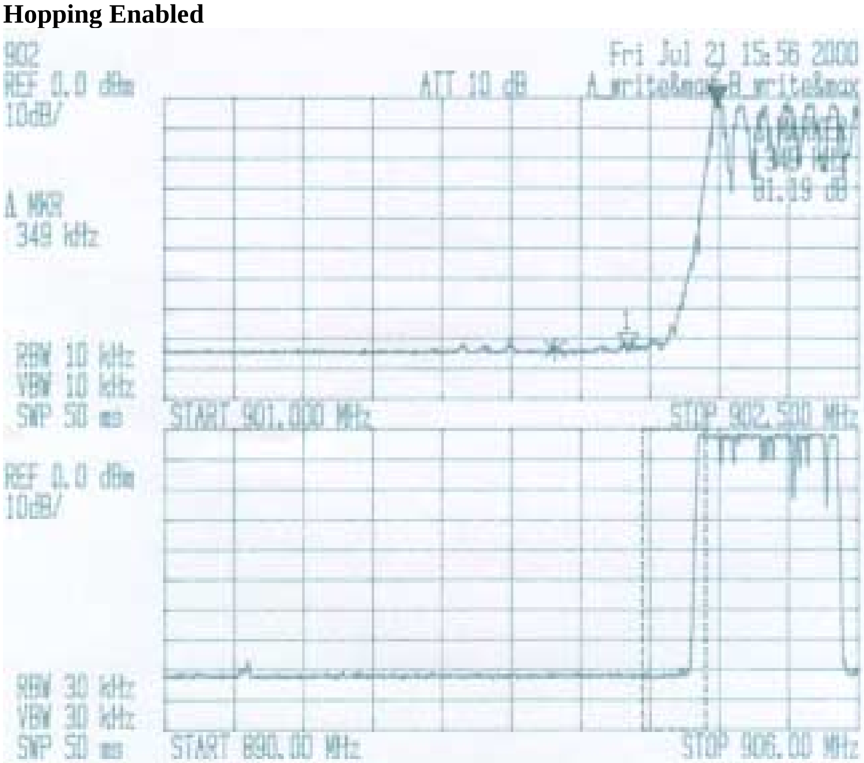
927.775 MHz
25600 bps
Hopping Disabled



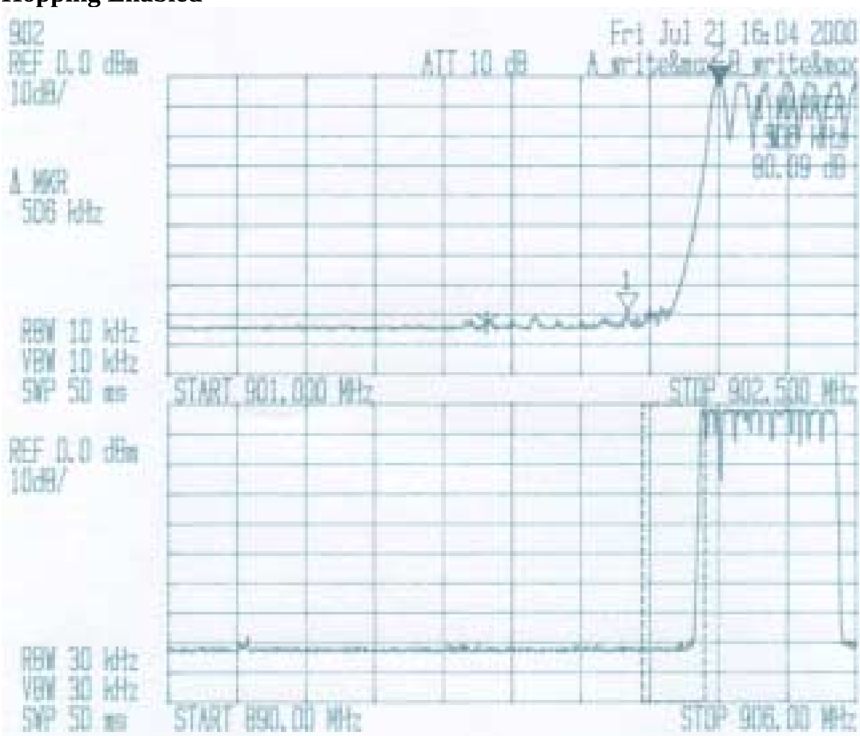
902.2 MHz
9600 bps
Hopping Enabled



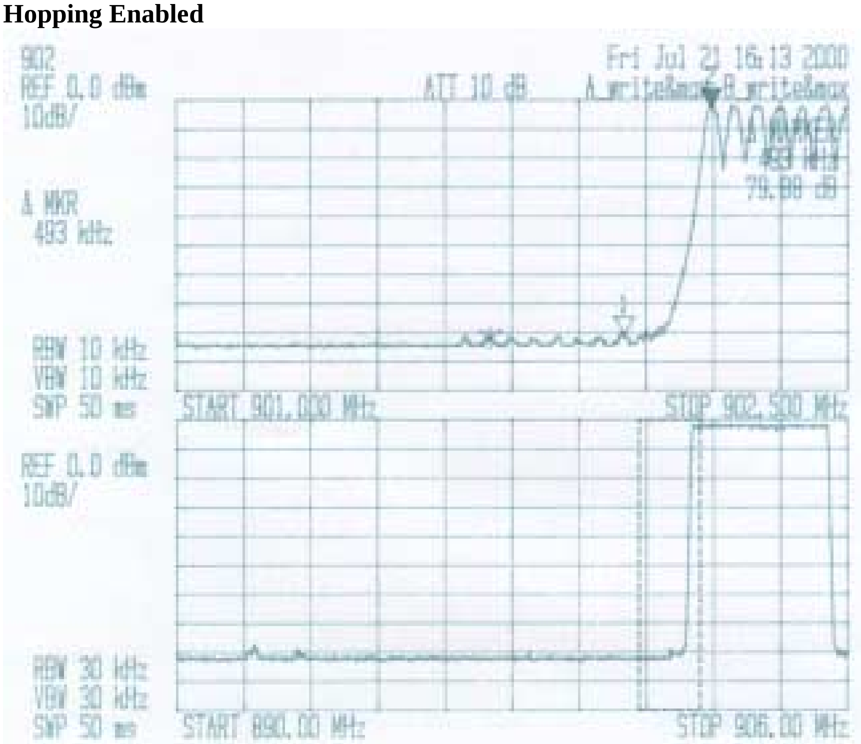
902.2 MHz
19200 bps
Hopping Enabled



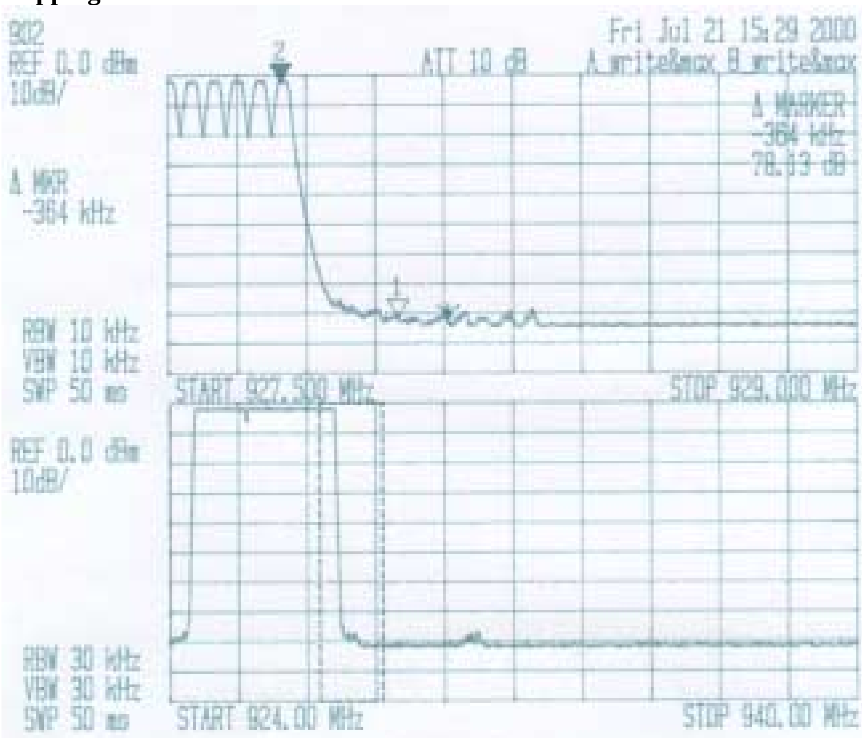
902.2 MHz
21400 bps
Hopping Enabled



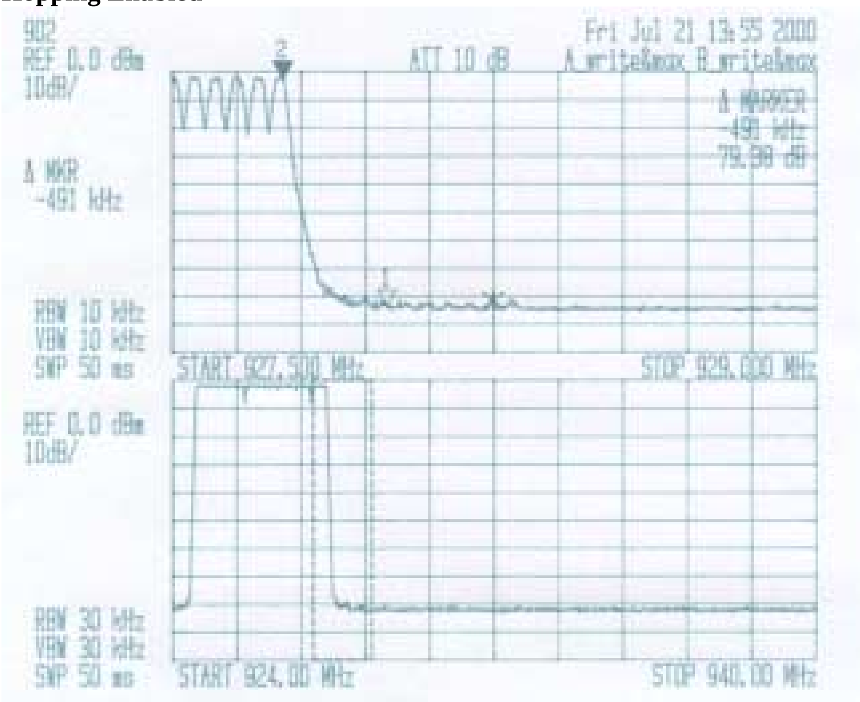
902.2 MHz
25600 bps
Hopping Enabled



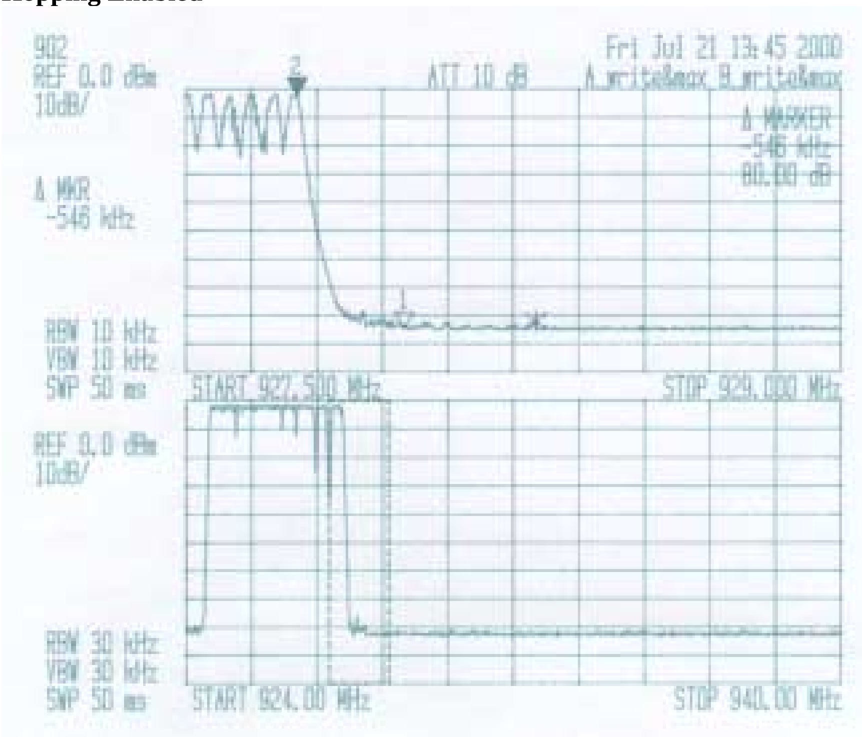
927.775 MHz
9600 bps
Hopping Enabled



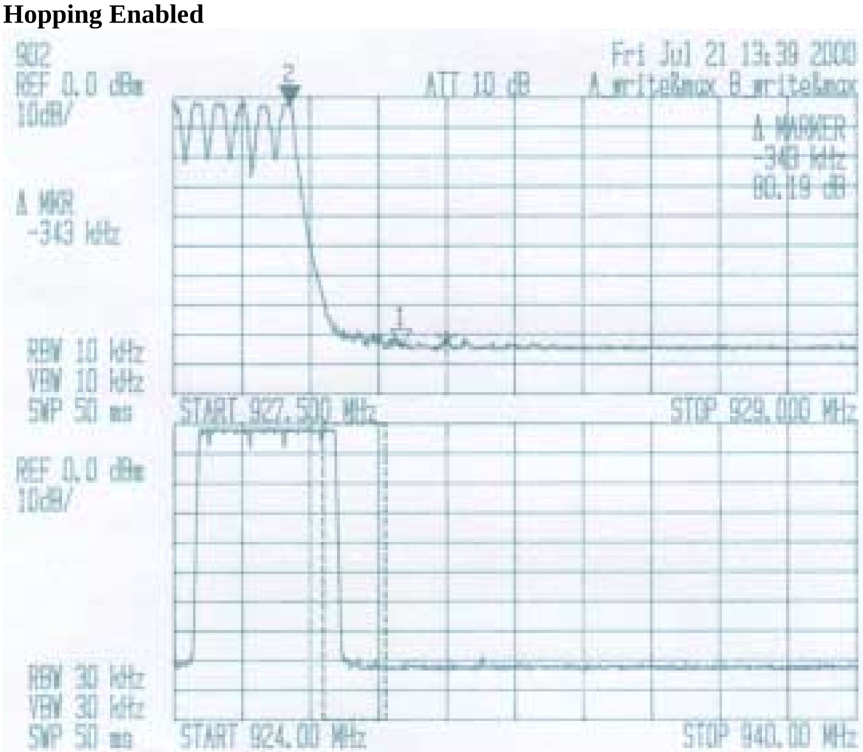
927.775 MHz
19200 bps
Hopping Enabled



927.775 MHz
21400 bps
Hopping Enabled



927.775 MHz
25600 bps
Hopping Enabled



5.10 Spurious RF Conducted Emissions

FCC Rule: 15.247(c)
IC Rule 6.2.2(o)(e1), 6.3:

Specification: 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.

Test Equipment: HP 8563E Spectrum Analyzer
HP 83732B Signal Generator (Reference Generator)

Procedure:
The EUT was tested from the lowest frequency generated up through the 10th harmonic. A substitution generator was used to find the loss (cables, attenuator) between the EUT and the spectrum analyzer. See Table below for summary.

Sample Calculation (2nd Harmonic of 902.2 MHz):

Measured on Spectrum Analyzer: -55 dBm

Correct for cable loss: -55 dBm - -21.67 dB = -33.33 dBm

Reference to Carrier: -33.33 dBm + 30 dB = -63.33 dBc

Results:

902.2 MHz

Freq, GHz	EUT	Loss	dBm	dBc
1.8044	-55.00	-21.67	-33.33	-63.33
2.7066	-64.83	-22.00	-42.83	-72.83
3.6088	-67.33	-23.67	-43.66	-73.66
4.5110	-90.50	-12.83	-77.67	-107.67
5.4132	-72.00	-11.67	-60.33	-90.33
6.3154	-89.50	-14.17	-75.33	-105.33
7.2176	-64.50	-11.83	-52.67	-82.67
8.1198	-76.00	-12.00	-64.00	-94.00
9.0220	-83.17	-18.00	-65.17	-95.17

915.0 MHz

Freq, GHz	EUT	Loss	dBm	dBc
1.8300	-60.67	-21.67	-39.00	-69.00
2.7450	-65.67	-21.83	-43.84	-73.84
3.6600	-70.00	-23.33	-46.67	-76.67
4.5750	-91.50	-13.00	-78.50	-108.50
5.4900	-75.67	-11.67	-64.00	-94.00
6.4050	-89.83	-14.67	-75.16	-105.16
7.3200	-67.83	-11.33	-56.50	-86.50
8.2350	-70.00	-11.17	-58.83	-88.83
9.1500	-90.33	-22.00	-68.33	-98.33

927.8 MHz

Freq, GHz	EUT	Loss	dBm	dBc
1.8556	-61.67	-21.67	-40.00	-70.00
2.7834	-66.17	-22.00	-44.17	-74.17
3.7112	-72.00	-23.83	-48.17	-78.17
4.6390	-91.17	-13.17	-78.00	-108.00
5.5668	-72.17	-11.83	-60.34	-90.34
6.4946	-89.67	-14.83	-74.84	-104.84
7.4224	-76.50	-10.00	-66.50	-96.50
8.3502	-75.33	-12.33	-63.00	-93.00
9.2780	-90.00	-24.33	-65.67	-95.67

5.11 Spurious RF Radiated Emissions

FCC Rule: 15.247(c), 15.209, 15.35(b)
IC Rule 6.2.2(o)(e1), 6.3:

Specification: Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a). Table 15.209 lists limits for measurements employing a average detector for radiated emissions. Section 15.35(b) states the limit for measurements employing peak detectors is 20 dB greater than average detectors. For frequencies above 960 MHz, 20 dB above 500 µV/m is 5000 µV/m.

15.209 Radiated emission limits, general requirements (For Average Detectors):

Frequency (MHz)	Field Strength (µV/m)	Measurement Distance (meters)
0.009-0.490	2400/F (kHz)	300
0.490-1.705	24000/F (kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Sample Calculation:

1) Signal measured on spectrum analyzer:	-71.02 dBm	
2) Add cable loss to spectrum analyzer measurement:	-71.02 dBm + 7 dB =	-64.02 dBm
3) Convert signal to dBµV by adding 107 dB:	-64 dBm + 107 dB =	42.98 dBµV
4) Add Antenna Correction Factor (ACF):	42.98 dBµV + 31 dB =	73.98 dBµV/m
5) Convert to µV/m = $10^{((\text{dB}\mu\text{V/m})/20)}$	$10^{((73.98\ \text{dB}\mu\text{V/m})/20)}$ =	5000 µV/m

Using 5000 µV/m as the spec the limit needed to be read on the spectrum analyzer was determined for each frequency. See Table 2 on next page.

Test Equipment:

HP 8563E	Spectrum Analyzer
EMCO 3115	Horn Antenna (Receiving Antenna)
MYG 9159	Maxrad 10 dBi Yagi
MFB 9157	Maxrad 7 dBi Omni Directional
MFB 9150	Maxrad 0 dBi Omni
EXR-902-BN	Maxrad 0 dBi ½ Wave Whip

Procedure: TIA/EIA 603, 2.2.12
Span = 100 kHz
RBW = 1kHz
VBW =RBW
Sweep = auto
Detector function = peak
Trace = max hold

Radiated emissions that fall in the restricted bands were tested up to the 10^{th} harmonic. The point at which the transmitter harmonics and restricted bands overlapped were measured at the high and low end.

Example 1: 2^{nd} Harmonic of neither 902 (1804) nor 928 (1856) landed in a restricted band
Tested: 2^{nd} Harmonic Not Tested

Example 2: 3^{rd} Harmonic of 902 (2706) and 928 (2784) fall within the restricted band 2655-2900 MHz
Tested: 2706 and 2784 MHz

Example 3: 8^{th} Harmonic of 906.25 (7250) falls into the low end of the restricted band 7250 MHz
8^{th} Harmonic of 928 (7424) falls within restricted band 7250-7750 MHz
Tested: 7250 and 7424 MHz Summary shown in Table 1 on next page

Table 1: Summary of Overlap Between Transmitter Harmonics and Restricted Bands

	902	928	Restricted Bands		High Low Freq of Interference			
Harmonic	Frequency of Harmonics				Low edge of band		High edge of band	
					Tuned	Freq	Tuned	Freq
2	1804.00	1856.00			NA	NA	NA	NA
3	2706.00	2784.00	2655	2900	902	2706	928	2784
4	3608.00	3712.00	3600	4400	902	3608	928	3712
5	4510.00	4640.00	4500	5150	902	4510	928	4640
6	5412.00	5568.00	5350	5460	902	5412	910	5460
7	6314.00	6496.00			NA	NA	NA	NA
8	7216.00	7424.00	7250	7750	906.25	7250	928	7424
9	8118.00	8352.00	8025	8500	902	8118	928	8352
10	9020.00	9280.00	9000	9200	902	9020	920	9200

Table 2: Limit Read on Spectrum Analyzer to Meet Minimum Specification:

Freq (MHz)	Harmonic	Freq (MHz)		ACP (dB)	**Spectrum Anaylyzer (dBm)**	Conversion To (dBuV)	Cable Loss (dB)	Extrapolate Distance To (Meters)	Field Intensity (uV/m)
902	3	2706	H	31.0	**-71.02**	35.98	7.00	3	5000
			V	31.0	**-71.02**	35.98	7.00	3	5000
928	3	2784	H	31.2	**-71.52**	35.48	7.30	3	5000
			V	31.2	**-71.52**	35.48	7.30	3	5000
902	4	3608	H	33.3	**-76.02**	30.98	9.70	3	5000
			V	33.3	**-76.02**	30.98	9.70	3	5000
928	4	3712	H	33.5	**-75.82**	31.18	9.30	3	5000
			V	33.5	**-75.82**	31.18	9.30	3	5000
902	5	4510	H	34.1	**-77.12**	29.88	10.00	3	5000
			V	34.1	**-77.12**	29.88	10.00	3	5000
928	5	4640	H	34.4	**-77.62**	29.38	10.20	3	5000
			V	34.4	**-77.62**	29.38	10.20	3	5000
902	6	5412	H	35.9	**-79.92**	27.08	11.00	3	5000
			V	35.9	**-79.92**	27.08	11.00	3	5000
910	6	5460	H	35.9	**-79.92**	27.08	11.00	3	5000
			V	35.9	**-79.92**	27.08	11.00	3	5000
906.25	8	7250	H	37.7	**-84.02**	22.98	13.30	3	5000
			V	37.7	**-84.02**	22.98	13.30	3	5000
928	8	7424	H	38.0	**-84.32**	22.68	13.30	3	5000
			V	38.0	**-84.32**	22.68	13.30	3	5000
902	9	8118	H	38.7	**-86.52**	20.48	14.80	3	5000
			V	38.7	**-86.52**	20.48	14.80	3	5000
928	9	8352	H	38.8	**-87.02**	19.98	15.20	3	5000
			V	38.8	**-87.02**	19.98	15.20	3	5000
902	10	9020	H	39.1	**-88.12**	18.88	16.00	3	5000
			V	39.1	**-88.12**	18.88	16.00	3	5000
920	10	9200	H	39.3	**-88.32**	18.68	16.00	3	5000
			V	39.3	**-88.32**	18.68	16.00	3	5000

Table 3: Measured RF Radiated Emissions Summary

Freq (MHz)			Harmonic	Freq (MHz)	Antenna Orientation	Spec	10 dB Yagi Measured	10 dB Yagi Margin	7 dB Omni Measured	7 dB Omni Margin	Unity Measured	Unity Margin	Whip Measured	Whip Margin
902			3	2706	H	-71.0	-80.0	9.0	-81.0	10.0	-88.0	17.0	-84.0	13.0
				2706	V	-71.0	-78.0	7.0	-78.0	7.0	-81.0	10.0	-75.5	4.5
	928		3	2784	H	-71.5	-78.0	6.5	-75.5	4.0	-75.0	3.5	-77.0	5.5
				2784	V	-71.5	-75.0	3.5	-74.0	2.5	-74.0	2.5	-73.5	2.0
902			4	3608	H	-76.0	-94.0	18.0	-93.0	17.0	-91.0	15.0	-84.0	8.0
				3608	V	-76.0	-95.0	19.0	-89.0	13.0	-91.0	15.0	-87.0	11.0
	928		4	3712	H	-75.8	-97.0	21.2	-98.0	22.2	-94.0	18.2	-98.0	22.2
				3712	V	-75.8	-98.0	22.2	-93.0	17.2	-90.0	14.2	-91.0	15.2
902			5	4510	H	-77.1	-95.0	17.9	-100.0	22.9	-97.0	19.9	-104.0	26.9
				4510	V	-77.1	-99.0	21.9	-100.0	22.9	-97.0	19.9	-106.0	28.9
	928		5	4640	H	-77.6	-93.0	15.4	-103.0	25.4	-92.0	14.4	-99.0	21.4
				4640	V	-77.6	-95.0	17.4	-102.0	24.4	-88.0	10.4	-97.0	19.4
902			6	5412	H	-79.9	-89.0	9.1	-92.0	12.1	-85.0	5.1	-90.0	10.1
				5412	V	-79.9	-86.0	6.1	-90.0	10.1	-84.0	4.1	-85.0	5.1
		910	6	5460	H	-79.9	-86.5	6.6	-90.0	10.1	-91.0	11.1	-94.0	14.1
				5460	V	-79.9	-88.0	8.1	-86.0	6.1	-89.0	9.1	-90.0	10.1
		906.25	8	7250	H	-84.0	-100.0	16.0	-100.0	16.0	-96.0	12.0	-101.0	17.0
				7250	V	-84.0	-97.0	13.0	-94.0	10.0	-90.0	6.0	-96.0	12.0
	928		8	7424	H	-84.3	-105.0	20.7	-102.0	17.7	-95.0	10.7	-98.0	13.7
				7424	V	-84.3	-98.0	13.7	-98.5	14.2	-93.0	8.7	-96.0	11.7
902			9	8118	H	-86.5	-102.0	15.5	-101.0	14.5	-103.0	16.5	-104.0	17.5
				8118	V	-86.5	-100.0	13.5	-101.0	14.5	-103.0	16.5	-104.0	17.5
	928		9	8352	H	-87.0	-105.0	18.0	-103.0	16.0	-100.0	13.0	-103.0	16.0
				8352	V	-87.0	-102.0	15.0	-104.0	17.0	-94.0	7.0	-101.0	14.0
902			10	9020	H	-88.1	-105.0	16.9	-97.0	8.9	-100.0	11.9	-106.0	17.9
				9020	V	-88.1	-102.0	13.9	-97.0	8.9	-103.0	14.9	-106.0	17.9
		920	10	9200	H	-88.3	-102.0	13.7	-103.0	14.7	-103.0	14.7	-104.0	15.7
				9200	V	-88.3	-102.0	13.7	-102.0	13.7	-101.0	12.7	-100.0	11.7
Worse Case Margin								**3.5**		**2.5**		**2.5**		**2.0**
Best Case Margin								**22.2**		**25.4**		**19.9**		**28.9**

5.12 Antenna Power Conduction Limits for Receivers

FCC Rule: 15.111
IC Rule 7.2

Specification: In addition to the radiated emission limits, receivers that operate (tune) in the frequency range 30 to 960 MHz and CB receivers that provide terminals for the connection of an external receiving antenna may be tested to demonstrate compliance with the provisions of §15.109 with the antenna terminals shielded and terminated with a resistive termination equal to the impedance specified for the antenna, provided these receivers also comply with the following: with the receiver antenna terminal connected to a resistive termination equal to the impedance specified or employed for the antenna, the power at the antenna terminal at any frequency within the range of measurements specified in §15.33 shall not exceed 2.0 nanowatts (-57 dBm).

Test Equipment: HP 8563E Spectrum Analyzer

Procedure: The receiver was tuned to 902.2, 915 and 927.8 MHz. A spectrum analyzer was used to measure the conducted level of the LO. See results below.

Receiver Conducted Spurious

Tuned: 1st IF:	902.2 MHz -86.85 MHz		915 MHz -86.85 MHz		927.8 MHz -86.85 MHz	
Harmonic	Freq (MHz)	Spur Level (dBm)	Freq (MHz)	Spur Level (dBm)	Freq (MHz)	Spur Level (dBm)
1	815.35	-84	828.15	-84	840.95	-82
2	1630.70	-85	1656.30	-86	1681.90	-85
3	2446.05	-76	2484.45	-86	2522.85	-85
4	3261.40	-95	3312.60	-101	3363.80	-97
5	4076.75	-80	4140.75	-85	4204.75	-83
6	4892.10	-101	4968.90	-105	5045.70	-107
7	5707.45	-86	5797.05	-92	5886.65	-87
8	6522.80	-80	6625.20	-96	6727.60	-100
9	7338.15	-90	7453.35	-111	7568.55	-91
10	8153.50	-95	8281.50	-98	8409.50	-95

5.13 Spurious RF Radiated Receiver Emissions (FCC: Non-radiating Load)

FCC Rule: 15.109
IC Rule: 7.3

Specification: The field strength of radiated emissions from a Class A digital device, as determined at a distance of 10 meters, shall not exceed the following:

FCC 15.109 Radiated emission limits, general requirements (For Average Detectors):

Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (meters)
30 - 88	90	10
88 - 216	150	10
216 - 960	210	10
Above 960	300	10

Sample Calculation:

1) Signal measured on spectrum analyzer: -74.8 dBm
2) Add cable loss to spectrum analyzer measurement: -74.8 dBm + 2.7 dB = -72.1 dBm
3) Convert signal to dBμV by adding 107 dB: -72.1 dBm + 107 dB = 34.9 dBμV
4) Add Antenna Correction Factor (ACF): 34.9 dBμV + 22 dB = 56.9 dBμV/m
5) Convert to μV/m = $10^{((dB\mu V/m)/20)}$ $10^{((56.9\ dB\mu V/m)/20)}$ = 700 μV/m
6) Measurements were taken at 3 meters so they need to be extrapolated to 10 meters as specified in section 15.109(b).
   a) Scaling factor from 3 meters to 10 meters => 10/3 => 3 1/3)
   b) Power density is proportional to $1/r^2$ where r is the radius or distance.
      P_{10} = Power at 10 meters
      P_3 = Power at 3 meters
      V_{10} = rms Voltage at 10 meters
      V_3 = rms Voltage at 3 meters
      R = terminating load (50 Ω)
      $P_{10} = P_3 / r^2$ => $V_{10}^2/R = V_3^2 / Rr^2$ => $V_{10} = V_3/r$
   c) V_{10} = (μV/m) / (Scaling Factor) => V_{10} = 298.54 / (3 1/3) = **210 μV/m**
   NOTE: Using the above calculations, the level needed to be read on the spectrum analyzer was determined. See Table 1 on next page.

Test Equipment:

	HP 8563E	Spectrum Analyzer
	HP83732A	Reference Generator
	HP-6024A	Power Supply
	EMCO 3115	Horn Antenna (Receiving Antenna)

Procedure: TIA/EIA 603, 2.2.12

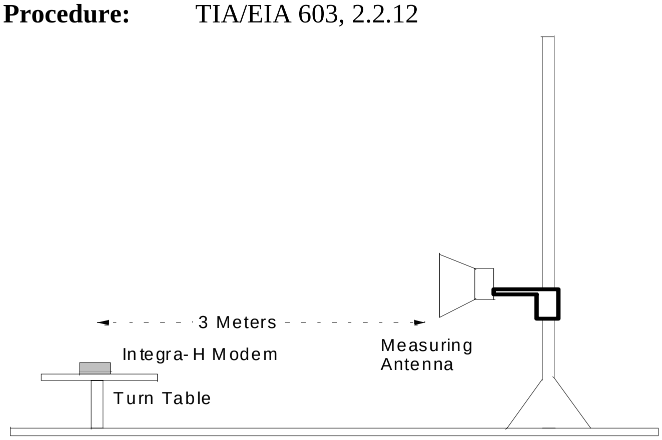


Table 1: Spectrum Analyzer Measurement needed to Meet Specification

Tuned 915
IF -86.85

Freq (MHz)		ACP (dB)	**Spectrum Anaylyzer (dBm)**	Conversion To (dBuV)	Cable Loss (dB)	Extrapolate Distance To (Meters)	Field Intensity (uV/m)
828.15	H	22.0	**-74.8**	32.20	2.70	10	210
	V	22.0	**-74.8**	32.20	2.70	10	210
1656.3	H	27.5	**-78.5**	28.50	4.00	10	300
	V	27.5	**-78.5**	28.50	4.00	10	300
2484.45	H	30.5	**-82.7**	24.29	5.21	10	300
	V	30.5	**-82.7**	24.29	5.21	10	300
3312.6	H	32.5	**-87.5**	19.50	8.00	10	300
	V	32.5	**-87.5**	19.50	8.00	10	300
4140.75	H	34.2	**-88.4**	18.60	7.20	10	300
	V	34.2	**-88.4**	18.60	7.20	10	300
4968.9	H	35.1	**-90.4**	16.60	8.30	10	300
	V	35.1	**-90.4**	16.60	8.30	10	300
5797.05	H	36.2	**-92.5**	14.50	9.30	10	300
	V	36.2	**-92.5**	14.50	9.30	10	300
6625.2	H	36.6	**-93.9**	13.10	10.30	10	300
	V	36.6	**-93.9**	13.10	10.30	10	300
7453.35	H	38.0	**-97.2**	9.80	12.20	10	300
	V	38.0	**-97.2**	9.80	12.20	10	300
8281.5	H	38.8	**-99.1**	7.90	13.30	10	300
	V	38.8	**-99.1**	7.90	13.30	10	300

Table 2: Measured Spurious RF Radiated Receiver Emissions (Field Strength)

Tuned 915
IF -86.85

Freq (MHz)		ACP (dB)	**Spectrum Anaylyzer (dBm)**	Conversion To (dBuV)	Cable Loss (dB)	Extrapolate Distance To (Meters)	Field Intensity (uV/m)
828.15	H	22.0	**-90.0**	17.00	2.70	10	36
	V	22.0	**-91.0**	16.00	2.70	10	33
1656.3	H	27.5	**-115.0**	-8.00	4.00	10	4
	V	27.5	**-110.0**	-3.00	4.00	10	8
2484.45	H	30.5	**-106.0**	1.00	5.21	10	21
	V	30.5	**-98.0**	9.00	5.21	10	52
3312.6	H	32.5	**-114.0**	-7.00	8.00	10	14
	V	32.5	**-113.0**	-6.00	8.00	10	16
4140.75	H	34.2	**-104.0**	3.00	7.20	10	50
	V	34.2	**-102.0**	5.00	7.20	10	63
4968.9	H	35.1	**-116.0**	-9.00	8.30	10	16
	V	35.1	**-114.0**	-7.00	8.30	10	20
5797.05	H	36.2	**-115.0**	-8.00	9.30	10	22
	V	36.2	**-111.0**	-4.00	9.30	10	36
6625.2	H	36.6	**-116.0**	-9.00	10.30	10	24
	V	36.6	**-112.0**	-5.00	10.30	10	37
7453.35	H	38.0	**-116.0**	-9.00	12.20	10	34
	V	38.0	**-116.0**	-9.00	12.20	10	34
8281.5	H	38.8	**-116.0**	-9.00	13.30	10	43
	V	38.8	**-116.0**	-9.00	13.30	10	43

Table 3: Spurious RF Radiated Receiver Emissions Margin

		Specification	Measured	Margin
828.15	H	-74.80	-90.00	15.20
	V	-74.80	-91.00	16.20
1656.3	H	-78.50	-115.00	36.50
	V	-78.50	-110.00	31.50
2484.45	H	-82.71	-106.00	23.29
	V	-82.71	-98.00	15.29
3312.6	H	-87.50	-114.00	26.50
	V	-87.50	-113.00	25.50
4140.75	H	-88.40	-104.00	15.60
	V	-88.40	-102.00	13.60
4968.9	H	-90.40	-116.00	25.60
	V	-90.40	-114.00	23.60
5797.05	H	-92.50	-115.00	22.50
	V	-92.50	-111.00	18.50
6625.2	H	-93.90	-116.00	22.10
	V	-93.90	-112.00	18.10
7453.35	H	-97.20	-116.00	18.80
	V	-97.20	-116.00	18.80
8281.5	H	-99.10	-116.00	16.90
	V	-99.10	-116.00	16.90

Worse Case Margin 13.6 dB
Best Case Margin 36.5 dB

5.14 Spurious RF Radiated Receiver Emissions (IC: Highest Gain Antenna, 10 dB Yagi)

IC Rule: 7.3

Specification: This measurement is to be performed, with the device's antenna connected in its place at a calibrated Open Area Test Site (see section 11).

IC Table 3: Radiated emission limits, general requirements:

Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (meters)
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
960 - 1610	500	3
Above 1610	1000	3

Sample Calculation (828.15 MHz, Horizontal, Table 4):

1) Signal measured on spectrum analyzer: -85.68 dBm
2) Add cable loss to spectrum analyzer measurement: -85.68 dBm + 2.7 dB = -82.98 dBm
3) Convert signal to dBμV by adding 107 dB: -82.98 dBm + 107 dB = 24.02 dBμV
4) Add Antenna Correction Factor (ACF): 24.02 dBμV + 22 dB = 46.02 dBμV/m
5) Convert to μV/m = $10^{((\text{dB}\mu\text{V/m})/20)}$ $10^{((46.02\ \text{dB}\mu\text{V/m})/20)}$ = 200 μV/m

NOTE: Using the above calculations, the level needed to be read on the spectrum analyzer was determined. See Table 4 on next page.

Test Equipment:

HP 8563E	Spectrum Analyzer
HP83732A	Reference Generator
HP-6024A	Power Supply
EMCO 3115	Horn Antenna (Receiving Antenna)

Procedure: Maxrad 10 dB Yagi, Model MYG 9159 was attached to antenna port.
TIA/EIA 603, 2.2.12 method followed

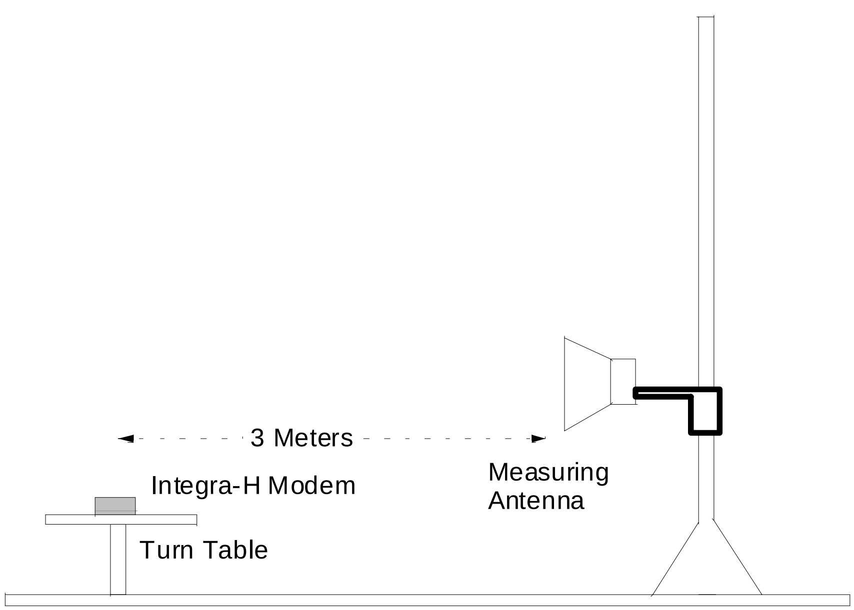


Table 4: Spectrum Analyzer Measurement needed to Meet Specification

Tuned 915 MHz
IF -86.85 MHz

Freq (MHz)		ACP (dB)	**Spectrum Anaylyzer (dBm)**	Conversion To (dBuV)	Cable Loss (dB)	Extrapolate Distance To (Meters)	Field Intensity (uV/m)
828.15	H	22.0	**-85.7**	21.32	2.70	3	200
	V	22.0	**-85.7**	21.32	2.70	3	200
1656.3	H	27.5	**-78.5**	28.50	4.00	3	1000
	V	27.5	**-78.5**	28.50	4.00	3	1000
2484.45	H	30.5	**-82.7**	24.29	5.21	3	1000
	V	30.5	**-82.7**	24.29	5.21	3	1000

Table 5: Spurious RF Radiated Receiver Emissions Margin

		Specification	Measured	Margin
828.15	H	-85.7	-89.5	**3.8**
	V	-85.7	-97.0	**11.3**
1656.3	H	-78.5	-111.0	**32.5**
	V	-78.5	-97.0	**18.5**
2484.45	H	-82.7	-97.0	**14.3**
	V	-82.7	-98.0	**15.3**

Worse Case Margin 3.8 dB
Best Case Margin 32.5 dB

Table 6: Spurious RF Radiated Receiver Emissions (Field Strength)

Tuned 915 MHz
IF -86.85 MHz

Freq (MHz)		ACP (dB)	**Spectrum Anaylyzer (dBm)**	Conversion To (dBuV)	Cable Loss (dB)	Extrapolate Distance To (Meters)	Field Intensity (uV/m)
828.15	H	22.0	**-89.5**	17.50	2.70	3	129
	V	22.0	**-97.0**	10.00	2.70	3	54
1656.3	H	27.5	**-111.0**	-4.00	4.00	3	24
	V	27.5	**-97.0**	10.00	4.00	3	119
2484.45	H	30.5	**-97.0**	10.00	5.21	3	193
	V	30.5	**-98.0**	9.00	5.21	3	172

5.15 Conducted Limits (ac Power Line Conducted)

FCC Rule: 15.207, 15.35(b)

Specification:

(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.

(b) The following option may be employed if the conducted emissions exceed the limits in paragraph (a) of this section when measured using instrumentation employing a quasi-peak detector function: if the level of the emission measured using the quasi-peak instrumentation is 6 dB, or more, higher than the level of the same emission measured with instrumentation having an average detector and a 9 kHz minimum bandwidth, that emission is considered broadband and the level obtained with the quasi-peak detector may be reduced by 13 dB for comparison to the limits. When employing this option, the following conditions shall be observed:

Equipment:

Spectrum Analyzer HP8561B
Radio Shack 100W, DC supply 22-504

Procedure:

The procedure outlined in ANSI C63.4-1992 was followed. Unused terminations of the LISN were terminated into 50 ohms. An HP8561B spectrum analyzer was used to make the measurements. The EUT was tested as a table top device, placed 80 cm from the conducting ground plane and 40 cm from the wall of the screen room (vertical ground plane). A PC was used to send data to the EUT to simulate the transmitter in a real world application. A radio shack 100 Watt 13.8 VDC, 3 Amp supply was used, catalog part number 22-504.

Results:

Quasi peak detector's usually measure about 2 dB less than peak detectors. The actual levels using a quasi peak detector would be approximately 2 dB less than shown below or 2dB more margin. The margin shown below measured with a peak detector is sufficient to verify compliance with the levels set forth in 15.207.

The spurs at 750kHz and 700kHz were greater than the –59 dBm limit when using the peak detector. The delta between measurements made with a peak and average detector was greater than 40 dB so according to 15.207(b) the spurious is considered broad band and the limit can be lowered by 13dB. With this correction the margin is approximately 10dB.

Table of Results:

Hot

Using Peak Detector				Using Average Detector				Limits	
Freq (MHz)	Spur (Peak dBm)	Cable Loss (dB)	Correction (dBm)	Spur (Avg dBm)	Cable Loss (dB)	Correction (dBm)	Peak Avg Delta (dB)	Spec (dBm)	Margin (dB)
0.75	-56.00	0.03	-55.97	-97.50	0.03	-97.47	41.50	-46	9.97
10.35	-65.00	0.06	-64.94					-59	5.94
10.15	-65.50	0.06	-65.44					-59	6.44
10.69	-65.50	0.06	-65.44					-59	6.44
10.89	-66.17	0.06	-66.11					-59	7.11

Neutral

Using Peak Detector				Using Average Detector				Limits	
Freq (MHz)	Spur (Peak dBm)	Cable Loss (dB)	Correction (dBm)	Spur (Avg dBm)	Cable Loss (dB)	Correction (dBm)	Peak Avg Delta (dB)	Spec (dBm)	Margin (dB)
0.7	-57.00	0.03	-56.97	-98.00	0.03	-97.97	41.00	-46	10.97
10.35	-65.50	0.06	-65.44					-59	6.44
10.55	-65.67	0.06	-65.61					-59	6.61
10.2	-66.17	0.06	-66.11					-59	7.11
10.69	-66.67	0.06	-66.61					-59	7.61