FCC PART 15 SUBPART C

EMI MEASUREMENT AND TEST REPORT

For

AeroComm, Inc.

10981 Eicher Drive
Lenexa, KS 66219

FCC ID: KQLAC4490-100

2003-05-22

This Report Concerns:	**Equipment Type:**
☒ Original Report	900MHz Transceiver

Test Engineer:	Benjamin Jing /
Report No.:	R0305053
Test Date:	2003-05-19
Reviewed By:	Ling Zhang /
Prepared By:	Bay Area Compliance Laboratory Corporation (BACL) 230 Commercial Street Sunnyvale, CA 94085 Tel: (408) 732-9162 Fax: (408) 732 9164

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1 - GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

The *AeroComm, Inc.'s* product, model no.:AC4490 or the "EUT" as referred to this report is a 900 MHz Transceiver which is measured approximately 4.8"L x 1.7"W x 0.8"H. The EUT provides an asynchronous TTL level serial interface for OEM Host communications. Communications include both system and configuration data. The Host supplies system data for transmission to other Host(s). Configuration data is stored in an on0board EEPROM. All frequency hopping, synchronization, and RF system data transmission/reception is performed by the transceiver.

** The test data gathered is from typical production samples provided by the manufacturer.*

1.2 Objective

This type approval report is prepared on behalf of *AeroComm, Inc.* in accordance with Part 2, Subpart J, Part 15, Subparts A and C of the Federal Communication Commissions rules.

The objective of the manufacturer is to demonstrate compliance with C108.8 & RSS-210 rules for the bluetooth transmitter:

- Maximum Peak Output Power
- Hopping Channel Separation
- Number of Hopping Frequency Used
- 20 dB Bandwidth
- Dwell Time on Each Channel
- 100 kHz Bandwidth of Band Edge
- Conducted Emission
- Spurious Emission
- Radiated Emission
- Antenna Requirement
- RF Exposure Limit

1.3 Related Submittal(s)/Grant(s)

No Related Submittals.

1.4 Test Methodology

All measurements contained in this report were conducted with ANSI C63.4-1992, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

All radiated and conducted emissions measurement was performed at BACL. The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

1.5 Test Facility

The Open Area Test site used by BACL to collect radiated and conducted emission measurement data is located in the back parking lot of the building at 230 Commercial Street, Sunnyvale, California, USA.

Test site at BACL has been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports has been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997 and Article 8 of the VCCI regulations on December 25, 1997. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-1992.

The Federal Communications Commission and Voluntary Control Council for Interference has the reports on file and is listed under FCC file 31040/SIT 1300F2 and VCCI Registration No.: C-1298 and R-1234. The test site has been approved by the FCC and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL is a National Institute of Standards and Technology (NIST) accredited laboratory, under the National Voluntary Laboratory Accredited Program (Lab Code 200167-0). The scope of the accreditation covers the FCC Method - 47 CFR Part 15 - Digital Devices, CISPR 22: 1997: Electromagnetic Interference - Limits and Methods of Measurement of Information Technology Equipment test methods.

1.6 Test Equipment List

Manufacturer	Description	Model	Serial Number	Cal. Due Date
HP	Spectrum Analyzer	8568B	2517A01610	2003-10-30
HP	Spectrum Analyzer	8593A	29190A00242	2004-05-01
HP	Amplifier	8447E	1937A01054	2004-05-01
HP	Quasi-Peak Adapter	85650A	2521A00718	2004-05-01
Com-Power	Biconical Antenna	AB-100	14012	2004-05-01
Com-Power	Log Periodic Antenna	AL-100	16091	2004-05-01
Com-Power	Log Periodic Antenna	AB-900	15049	2004-05-01
Agilent	Spectrum Analyzer (9KHz – 40GHz)	8564E	08303	2003-08-01
Agilent	Spectrum Analyzer (9KHz – 50GHz)	8565EC	06042	2004-05-03
HP	Amplifier (1-26.5GHz)	8449B	3147A00400	2004-03-14
A.H.System	Horn Antenna (700MHz-18GHz)	SAS-200/571	261	2003-05-31

*** Statement of Traceability: Bay Area Compliance Laboratory Corp.** certifies that all calibration has been performed using suitable standards traceable to the NIST.

1.7 Local Support Equipment List and Details

Manufacturer	Description	Model	Serial Number	FCC ID
HP	PC	Vectra	N/A	DOC
KDS	Monitor	KD-1731	N/A	DOC
HP	Keyboard	5129	N/A	DOC
Compaq	Mouse	B0192	N/A	DOC

1.8 External I/O Cabling List and Details

Cable Description	Length (M)	Port/From	To
Shielded Cable	2.0	RS232 Port/PC	RS232 Port/EUT
Shielded Cable	1.0	Keyboard/PC	Keyboard
Shielded Cable	1.0	Mouse/PC	Mouse
Shielded Cable	1.0	Monitor/PC	Monitor

2 - SYSTEM TEST CONFIGURATION

2.1 Justification

The host system was configured for testing in a typical fashion (as a normally used by a typical user).

The EUT was tested in the normal (native) operating mode to represent *worst*-case results during the final qualification test.

2.2 EUT Exercise Software

The EUT exercising program used during radiated and conducted testing was designed to exercise the various system components in a manner similar to a typical use. The test software provided by the customer, is started the Windows XP terminal program under the Windows XP operating system.

2.3 Special Accessories

As shown in section 2.7, all interface cables used for compliance testing are shielded as normally supplied by their respective support equipment manufacturers.

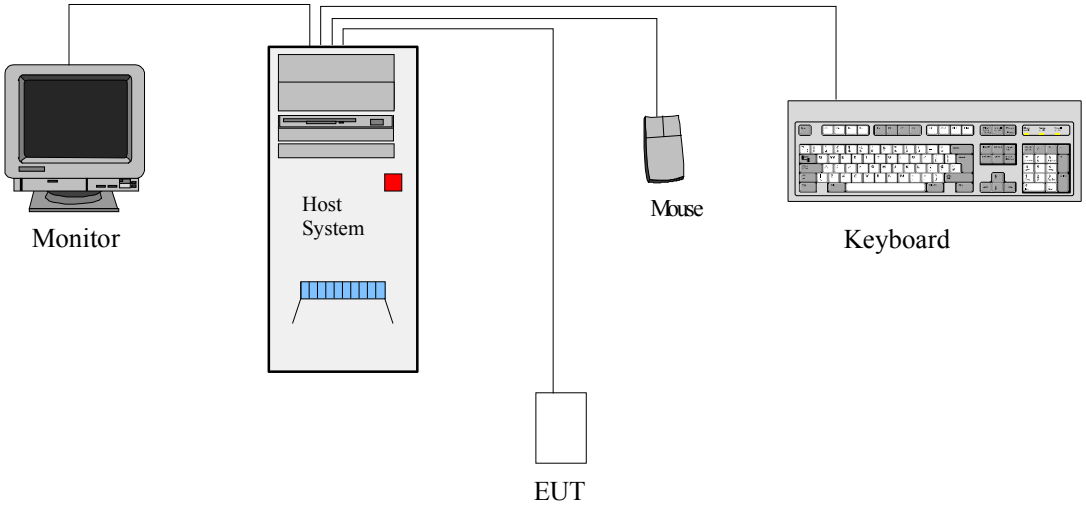
2.4 Schematics / Block Diagram

Please refer to Exhibit D.

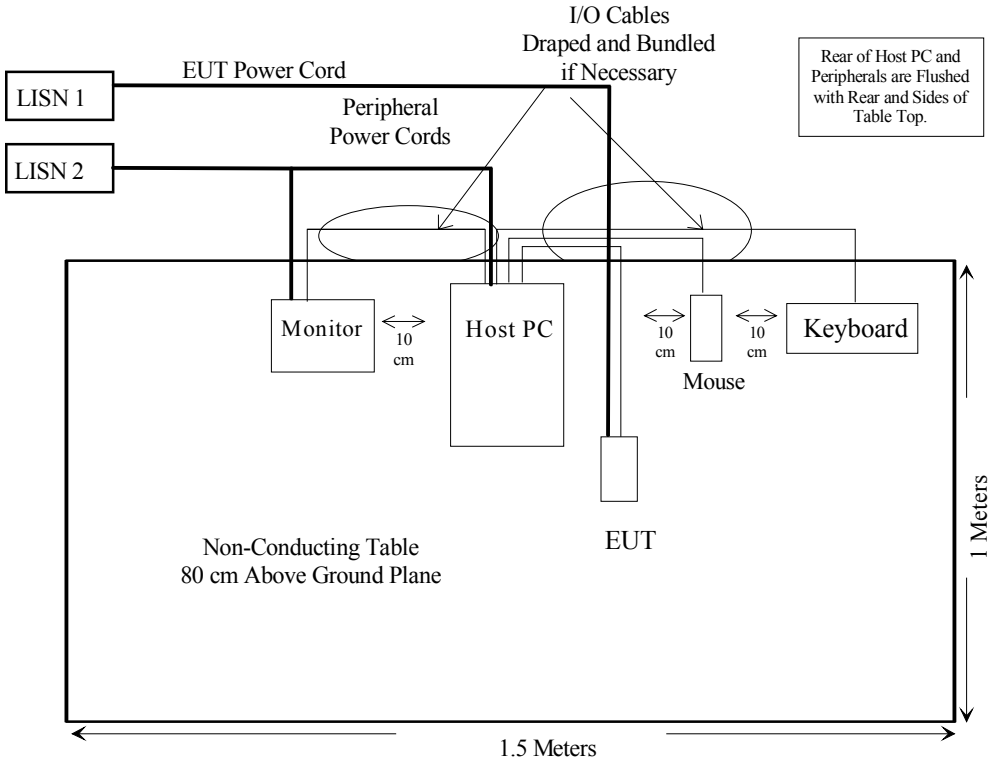
2.5 Equipment Modifications

No modifications were made by BACL Corporation to ensure the EUT to comply with the applicable limits and requirements.

2.6 Configuration of Test System



2.7 Test Setup Block Diagram



3 - SUMMARY OF TEST RESULTS

FCC RULES	DESCRIPTION OF TEST	RESULT	REFERENCE
§ 2.1093	RF Safety Requirements	Compliant	Section 14
§15.203	Antenna Requirement	Compliant	Section 13
§15.207 (a)	Conducted Emission	Compliant	Section 12
§ 15.205	Restricted Bands	Compliant	Section 11
§15.247 (a) (1) (i)	Number of Hopping Frequencies Used	Compliant	Section 6
§15.209	Radiated Emission	Compliant	Section 11
§15.209, §15.33 (a)	Spurious Emission at Antenna Port	Compliant	Section 10
§15.247 (a) (1)	Hopping Channel Separation	Compliant	Section 7
§15.247 (a) (1) (i)	Dwell Time of Each Frequency within a 10 Second Period of time (0.4 x Number of Channel)	Compliant	Section 9
§15.247 (a) (1)	Channel Bandwidth	Compliant	Section 5
§15.247 (b) (2)	Maximum Peak Output Power	Compliant	Section 4
§ 15.247 (c)	100 kHz Bandwidth of Frequency Band Edge	Compliant	Section 8
§ 15.247 (g)	Full and complete compliance with applicable requirements for FHSS. Compliance with the definition of frequency hopping system, distribute transmission over minimum number of hopping channel	Compliant	Technical Manual
§ 15.247 (h)	Limitation on avoidance on hopping on occupied channel	Compliant	Technical Manual

4 - MAXIMUM PEAK OUTPUT POWER

4.1 Standard Applicable

According to §15.247(b) (2), for frequency hopping systems operating in the 902-928MHz band : 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels.

4.2 Measurement Procedure

1. Place the EUT on the turntable and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.

4.3 Test Equipment

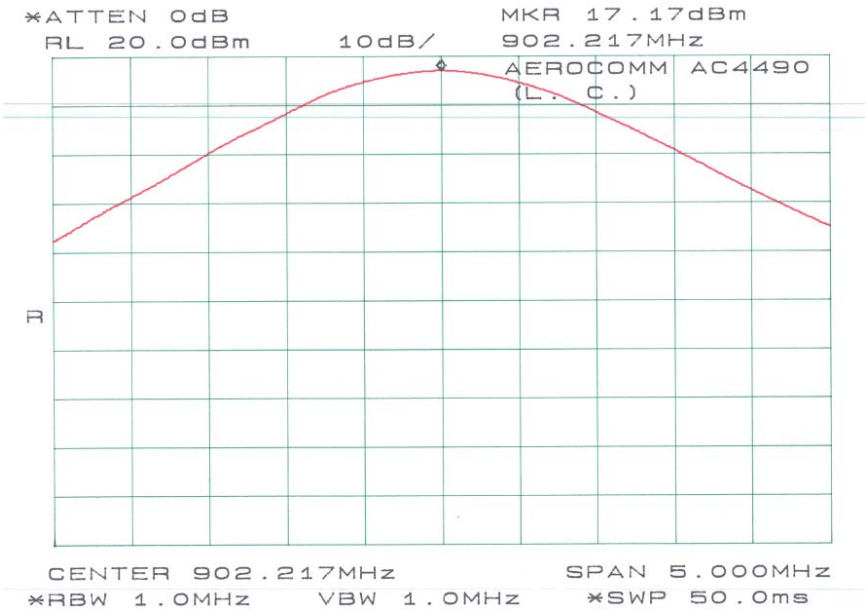
Manufacturer	Model No.	Description	Calibration Due Date
Agilent	8564E	Spectrum Analyzer	2003-08-01

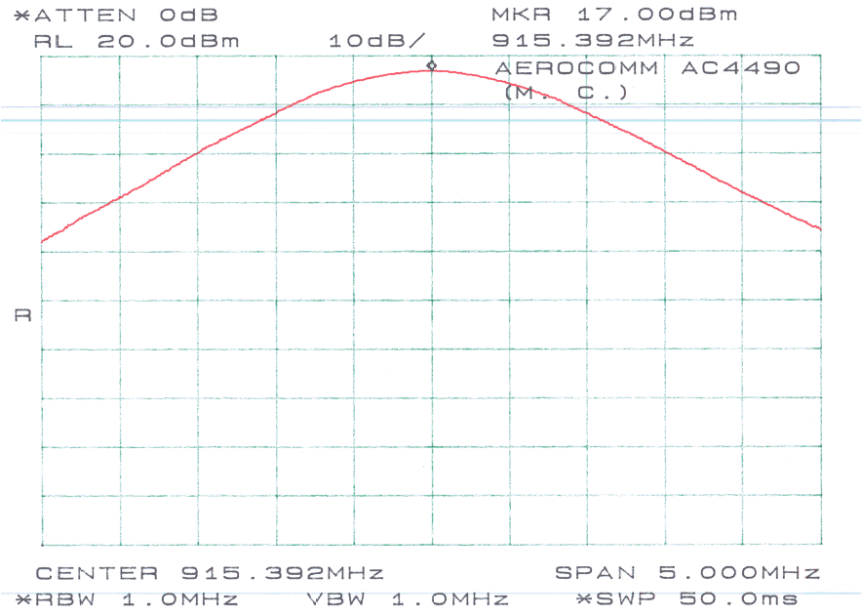
4.4 Measurement Result

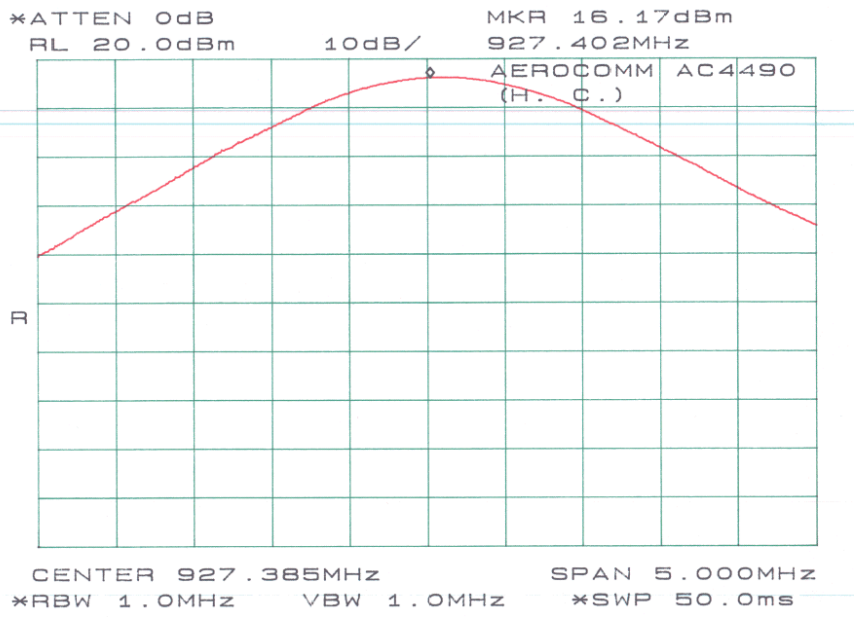
Frequency	Output Power in dBm	Output Power in W	Standard	Result
Low	17.17	0.052	≤ 0.25W	Compliant
Middle	17.00	0.050	≤ 0.25W	Compliant
High	16.17	0.041	≤ 0.25W	Compliant

4.5 Plots of Maximum Peak Output Power

Please refer to following plots.


*ATTEN 0dB
RL 20.0dBm
10dB/
MKR 17.17dBm
902.217MHz
AEROCOMM AC4490
(L. C.)
CENTER 902.217MHz
SPAN 5.000MHz
*RBW 1.0MHz
VBW 1.0MHz
*SWP 50.0ms


*ATTEN 0dB
RL 20.0dBm
10dB/
MKR 17.00dBm
915.392MHz
AEROCOMM AC4490
(M. C.)
CENTER 915.392MHz
SPAN 5.000MHz
*RBW 1.0MHz
VBW 1.0MHz
*SWP 50.0ms


*ATTEN 0dB
RL 20.0dBm
10dB/
MKR 16.17dBm
927.402MHz
AEROCOMM AC4490
(H. C.)
R
CENTER 927.385MHz
SPAN 5.000MHz
*RBW 1.0MHz
VBW 1.0MHz
*SWP 50.0ms

5 - CHANNEL BANDWIDTH

5.1 Standard Applicable

According to §15.247(a)(l), frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. 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.

5.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

5.3 Test Equipment

Manufacturer	Model No.	Description	Calibration Due Date
Agilent	8564E	Spectrum Analyzer	2003-08-01

5.4 Measurement Result

Frequency	Measurement (kHz)	Standard	Result
Low	328	≤ 1MHz	Compliant
Middle	320	≤ 1MHz	Compliant
High	330	≤ 1MHz	Compliant

5.5 Receiver Bandwidth

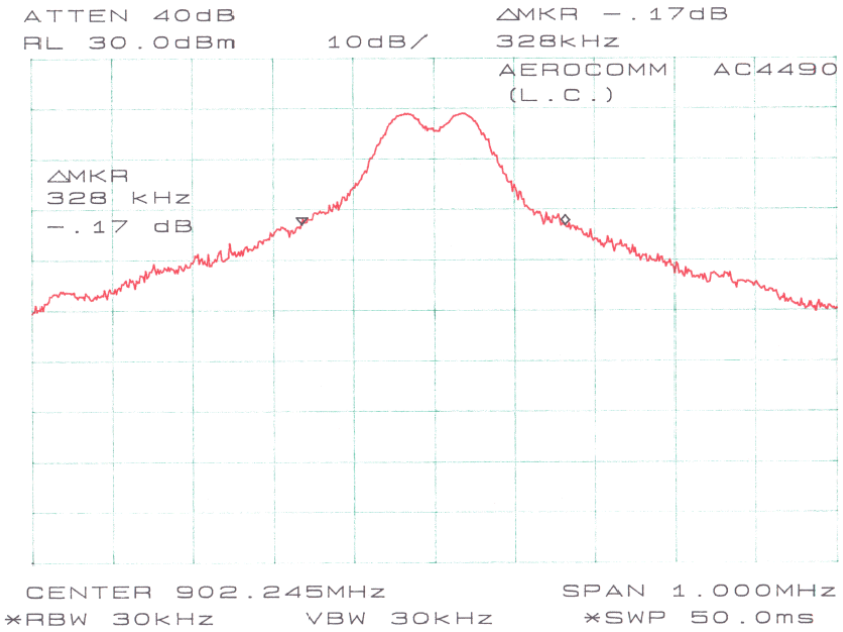
The "RF engine" from which our radio is based, has an internal IF filter as part of the integrated transceiver chip. The width of the IF filter is specified by Chipcon to be 150kHz (See "IF Section" page 9 of Chipcon SmartRF CC1010 PRELIMINARY Datasheet rev1.0 - @www.chipcon.com).

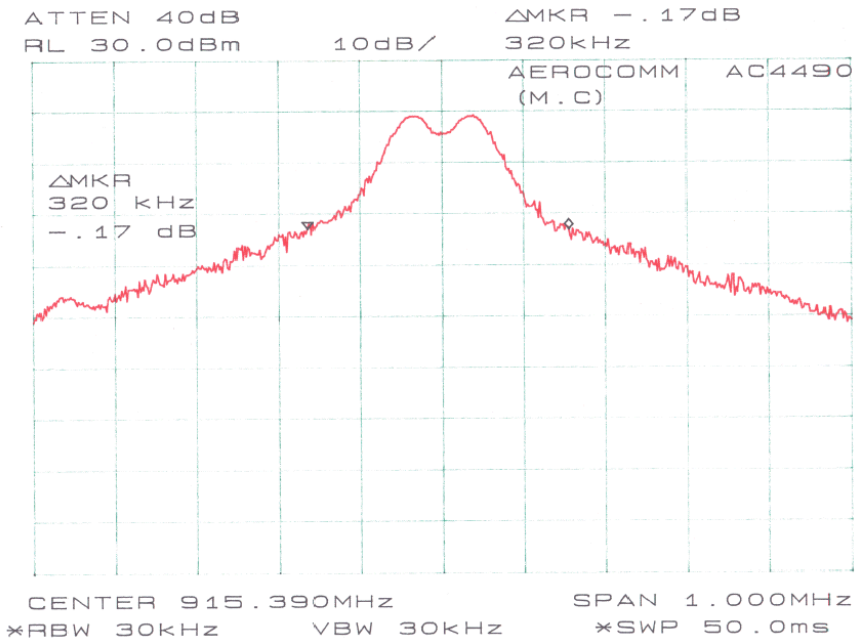
Using FSK frequency deviation of +/- 32kHz, the measured 20dB bandwidth of the transmitter envelope is approximately 145kHz (which nicely matches the receiver's IF Bandwidth of 150 kHz).

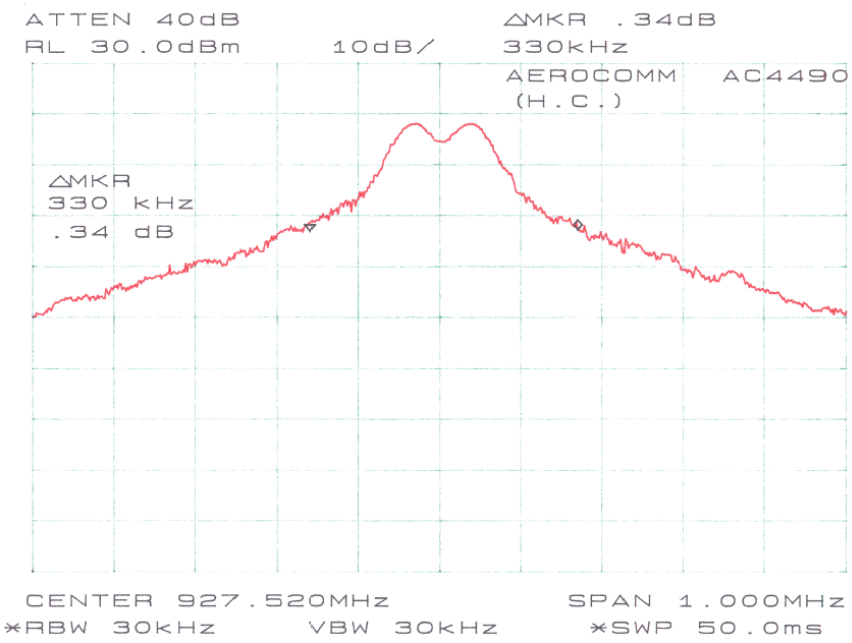
Since our channel spacing is approximately 525kHz, there is no overlap between transmitter channels or receiver bandwidths.

5.6 Plot of Channel Bandwidth

Please refer to following plots.






ATTEN 40dB
RL 30.0dBm
10dB/
ΔMKR .34dB
330kHz
AEROCOMM AC4490
(H.C.)
ΔMKR
330 kHz
.34 dB
CENTER 927.520MHz
SPAN 1.000MHz
*RBW 30kHz
VBW 30kHz
*SWP 50.0ms

6 - NUMBER OF HOPPING FREQUENCY USED

6.1 Standard Applicable

According to §15.247(a)(1)(i), frequency hopping systems operating in the 902-928Mhz band: if the 20 dB bandwidth of the hopping channel is 250kHz or greater, the system shall use at least 25 hopping frequencies.

6.2 Measurement Procedure

1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Position the EUT on the bench without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set the SA on Max-Hold Mode, and then keep the EUT in hopping mode. Record all the signals from each channel until each one has been recorded.
4. Set the SA on View mode and then plot the result on SA screen.
5. Repeat above procedures until all frequencies measured were complete.

6.3 Test Equipment

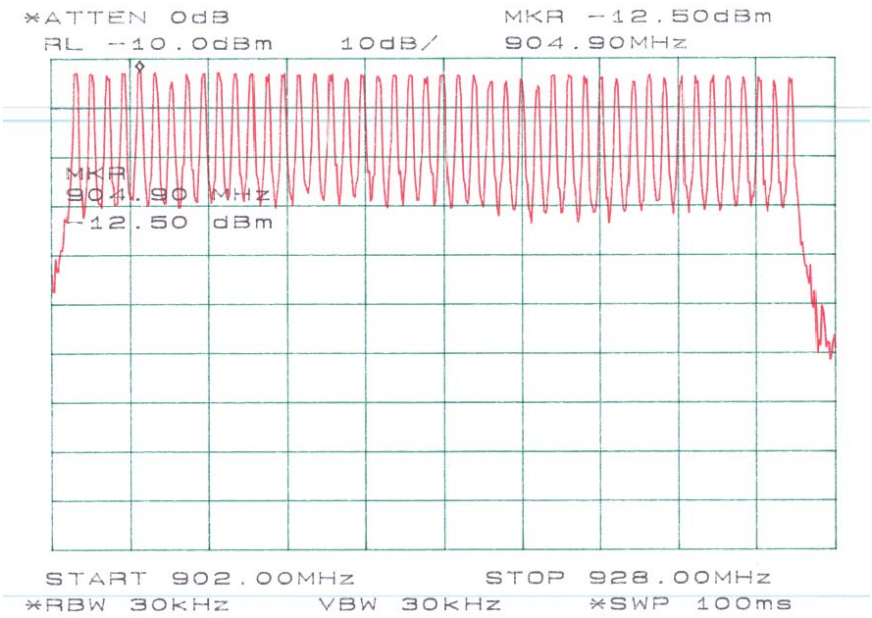
Manufacturer	Model No.	Description	Calibration Due Date
Agilent	8564E	Spectrum Analyzer	2003-08-01

6.4 Measurement Procedure

Measurement	Standard	Result
46	25	Compliant

6.5 Plots of Number of Hopping Frequency

Please refer to the attached plots.


*ATTEN 0dB
MKR -12.50dBm
RL -10.0dBm
10dB/
904.90MHz
MKR
904.90 MHz
-12.50 dBm
START 902.00MHz
STOP 928.00MHz
*RBW 30kHz
VBW 30kHz
*SWP 100ms

7 - HOPPING CHANNEL SEPARATION

7.1 Standard Applicable

According to §15.247(a)(1), frequency hopping system 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.

7.2 Measurement Procedure

1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Position the EUT on a bench without connection to measurement instrument Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range.
3. By using the Max-Hold function record the separation of two adjacent channels.
4. Measure the frequency difference of these two adjacent channels by SA MARK function, and then plot the result on SA screen.
5. Repeat above procedures until all frequencies measured were complete.

7.3 Test Equipment

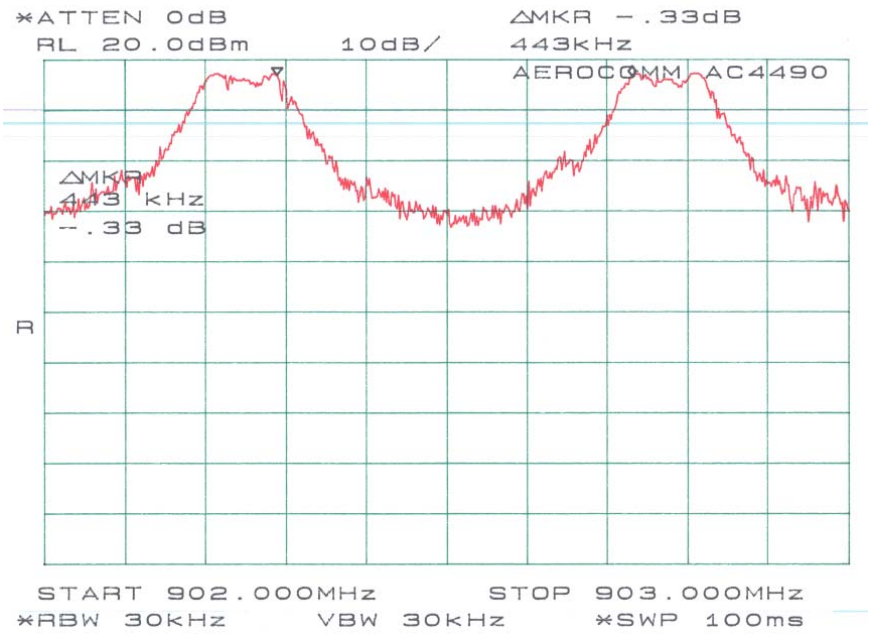
Manufacturer	Model No.	Description	Calibration Due Date
Agilent	8564E	Spectrum Analyzer	2003-08-01

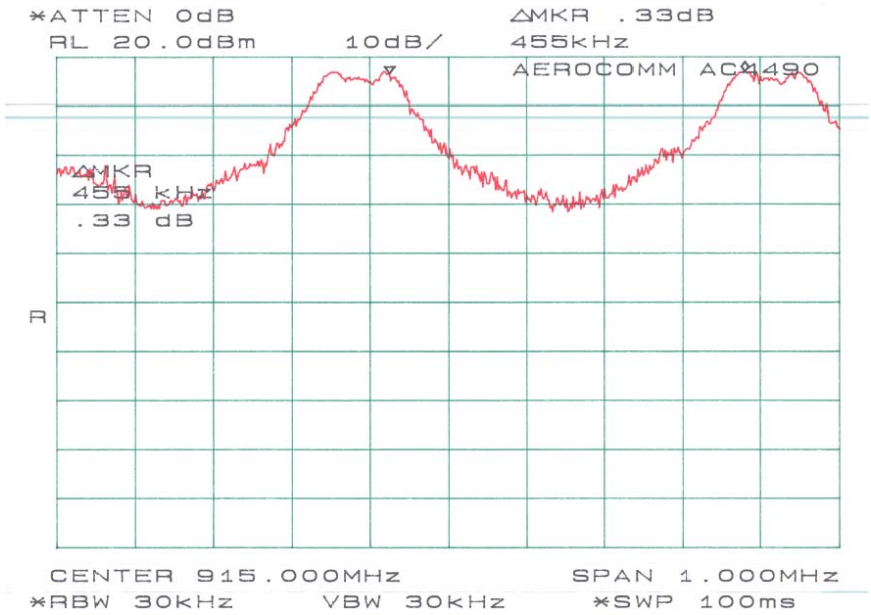
7.4 Measurement Results

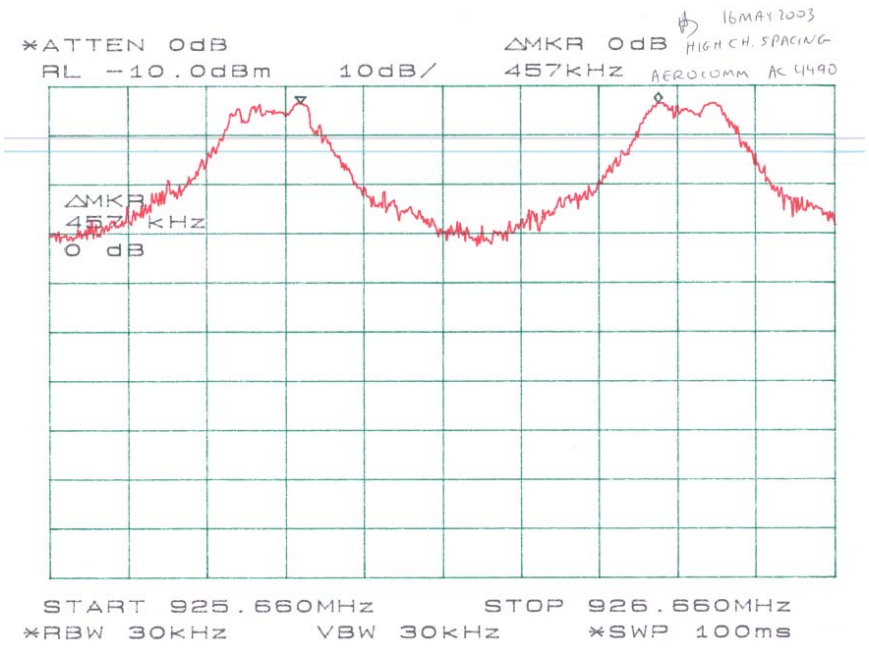
Frequency	Measurement (kHz)	Result
Low	443	Compliant
Middle	455	Compliant
High	457	Compliant

7.5 Plots of Hopping Channel Separation

Please refer to the following plots.


*ATTEN 0dB
RL 20.0dBm
10dB/
ΔMKR -.33dB
443kHz
AEROCOMM AC4490
ΔMKR
443 kHz
-.33 dB
R
START 902.000MHz
STOP 903.000MHz
*RBW 30kHz
VBW 30kHz
*SWP 100ms


*ATTEN 0dB
RL 20.0dBm
10dB/
ΔMKR .33dB
455kHz
AEROCOMM AC4490
ΔMKR
455 kHz
.33 dB
R
CENTER 915.000MHz
SPAN 1.000MHz
*RBW 30kHz
VBW 30kHz
*SWP 100ms


16MAY 2003
HIGH CH. SPACING
AEROCOMM AC 4490
*ATTEN 0dB
RL -10.0dBm
10dB/
ΔMKR 0dB
457kHz
ΔMKR
457 kHz
0 dB
START 925.660MHz
STOP 926.660MHz
*RBW 30kHz
VBW 30kHz
*SWP 100ms

8 - 100 KHZ BANDWIDTH OF BAND EDGES

8.1 Standard Applicable

According to §15.247(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 §15.209(a) is not required.

8.2 Measurement Procedure

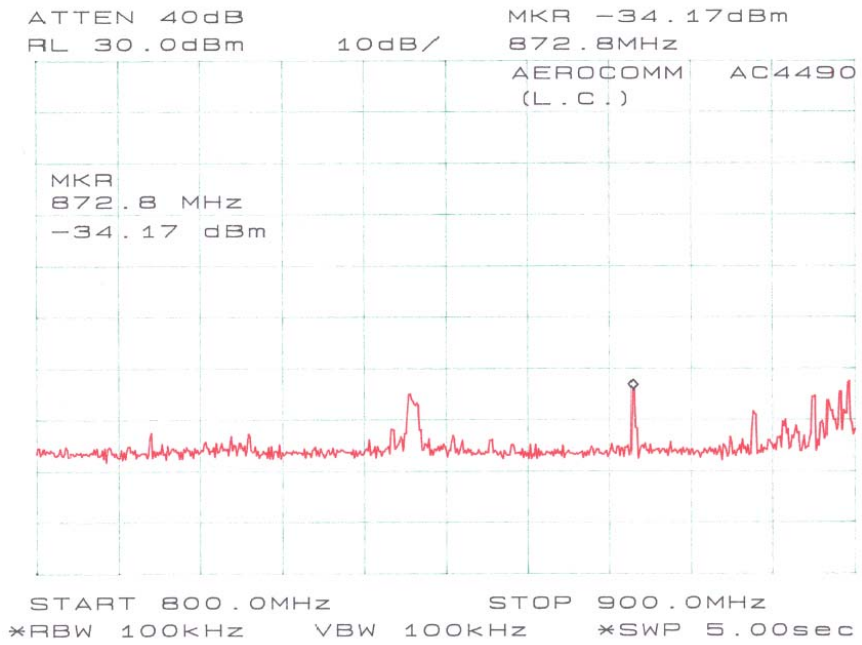
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set both RBW and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

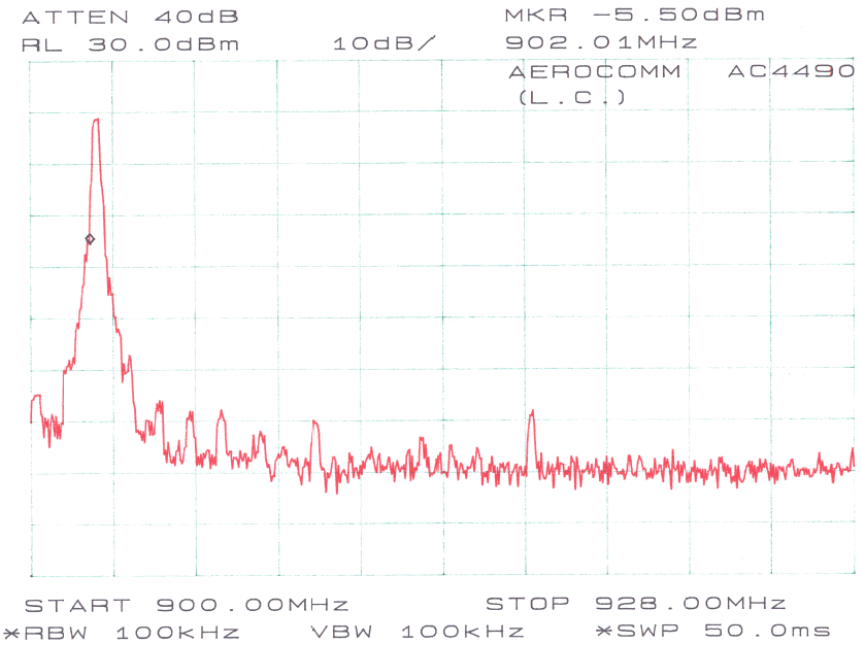
8.3 Test Equipment

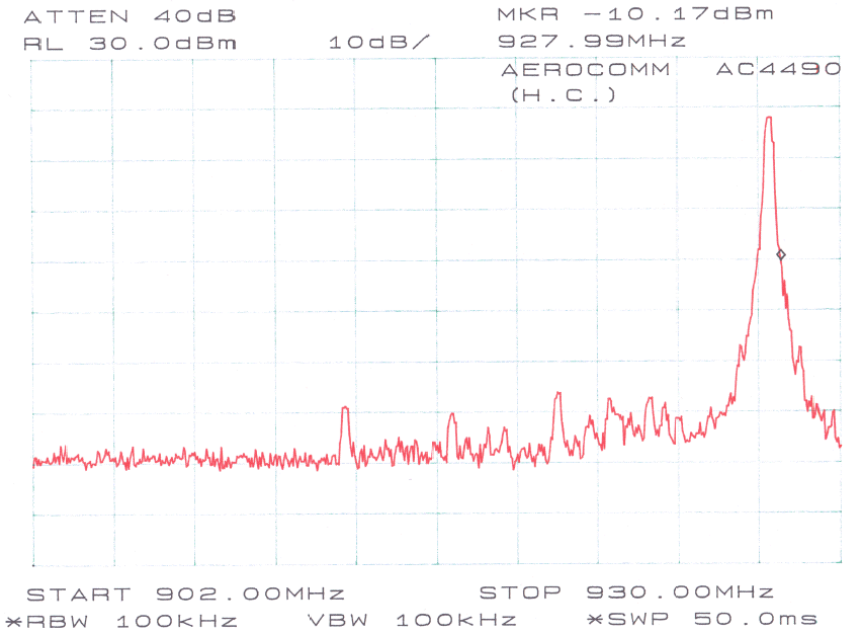
Manufacturer	Model No.	Description	Calibration Due Date
Agilent	8564E	Spectrum Analyzer	2003-08-01

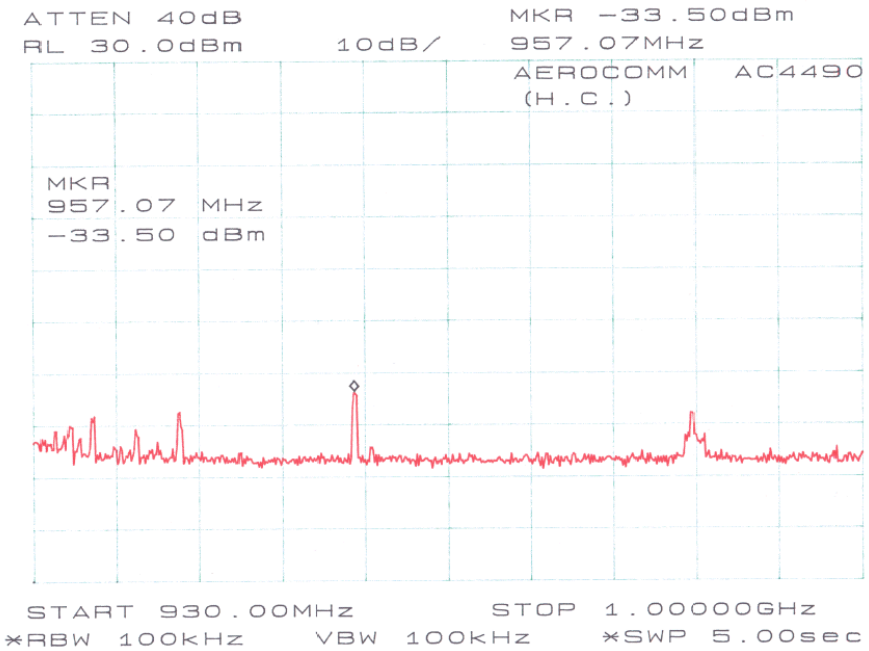
8.4 Measurement Results

Please refer the following plots.


ATTEN 40dB
RL 30.0dBm
10dB/
MKR -34.17dBm
872.8MHz
AEROCOMM AC4490
(L.C.)
MKR
872.8 MHz
-34.17 dBm
START 800.0MHz
STOP 900.0MHz
*RBW 100kHz
VBW 100kHz
*SWP 5.00sec


ATTEN 40dB
RL 30.0dBm
10dB/
MKR -5.50dBm
902.01MHz
AEROCOMM AC4490
(L.C.)
START 900.00MHz
STOP 928.00MHz
*RBW 100kHz
VBW 100kHz
*SWP 50.0ms


ATTEN 40dB
RL 30.0dBm
10dB/
MKR -10.17dBm
927.99MHz
AEROCOMM AC4490
(H.C.)
START 902.00MHz
STOP 930.00MHz
*RBW 100kHz
VBW 100kHz
*SWP 50.0ms


ATTEN 40dB
RL 30.0dBm
10dB/
MKR -33.50dBm
957.07MHz
AEROCOMM AC4490
(H.C.)
MKR
957.07 MHz
-33.50 dBm
START 930.00MHz
STOP 1.00000GHz
*RBW 100kHz
VBW 100kHz
*SWP 5.00sec

9 - DWELL TIME

9.1 Standard Applicable

According to §15.247 (a)(1)(i), the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 10 second period.

9.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT was set without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Adjust the center frequency of SA on any frequency be measured and set SA to zero span mode. And then, set RBW and VBW of spectrum analyzer to proper value.
4. Measure the time duration of one transmission on the measured frequency. And then plot the result with time difference of this time duration.
5. Repeat above procedures until all frequencies measured were complete.

9.3 Test Equipment

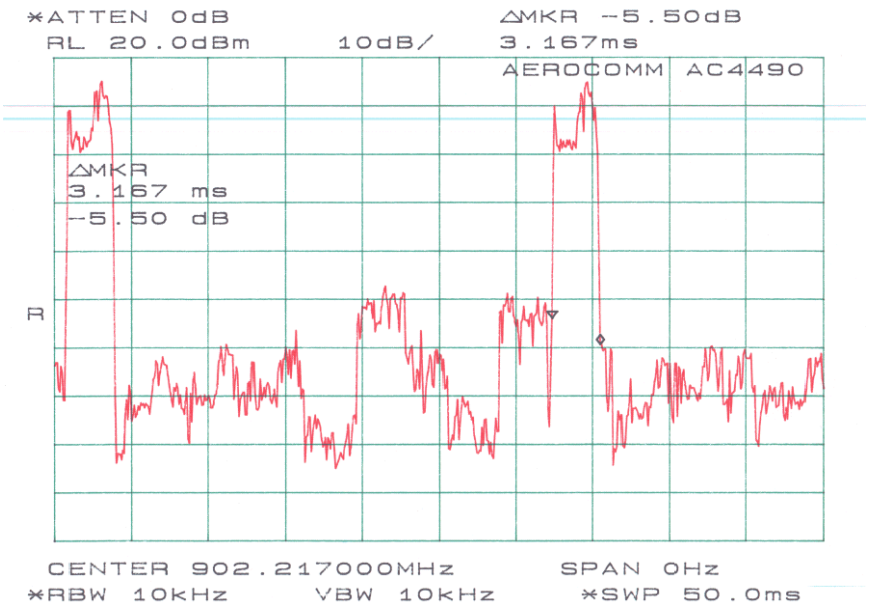
Manufacturer	Model No.	Description	Calibration Due Date
Agilent	8564E	Spectrum Analyzer	2003-08-01

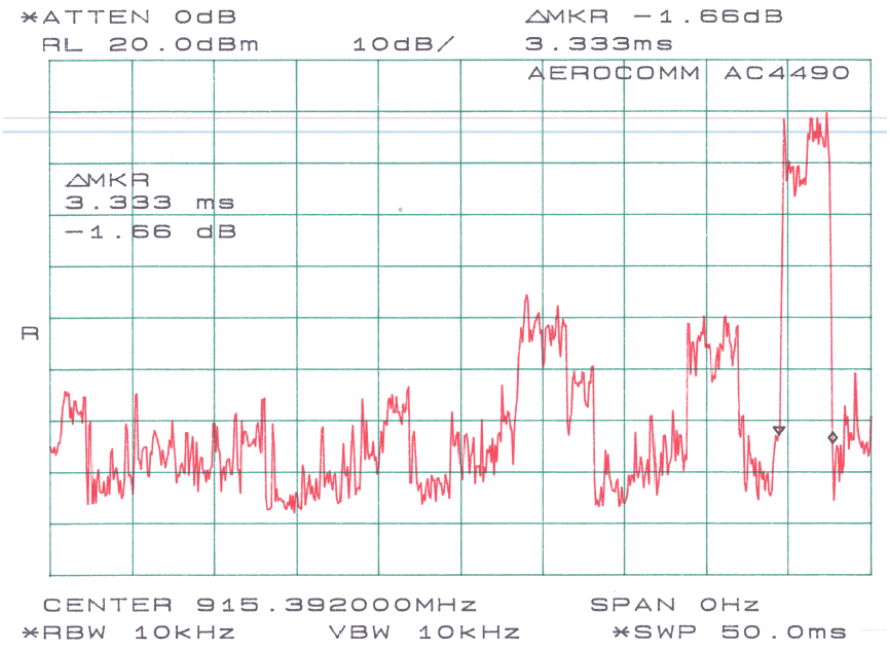
9.4 Measurement Results

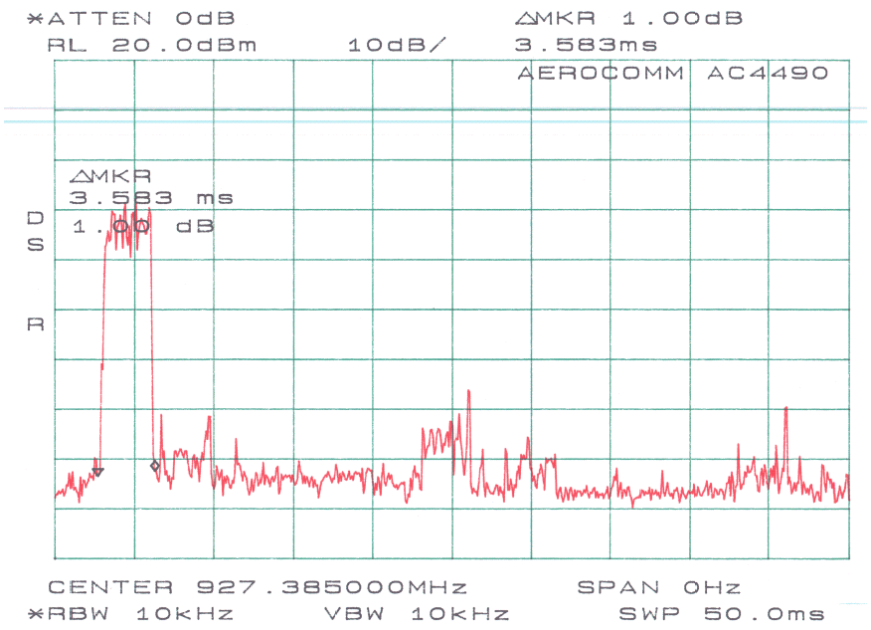
The dwell time is 1.333/46x3.583 = 0.124 (s)

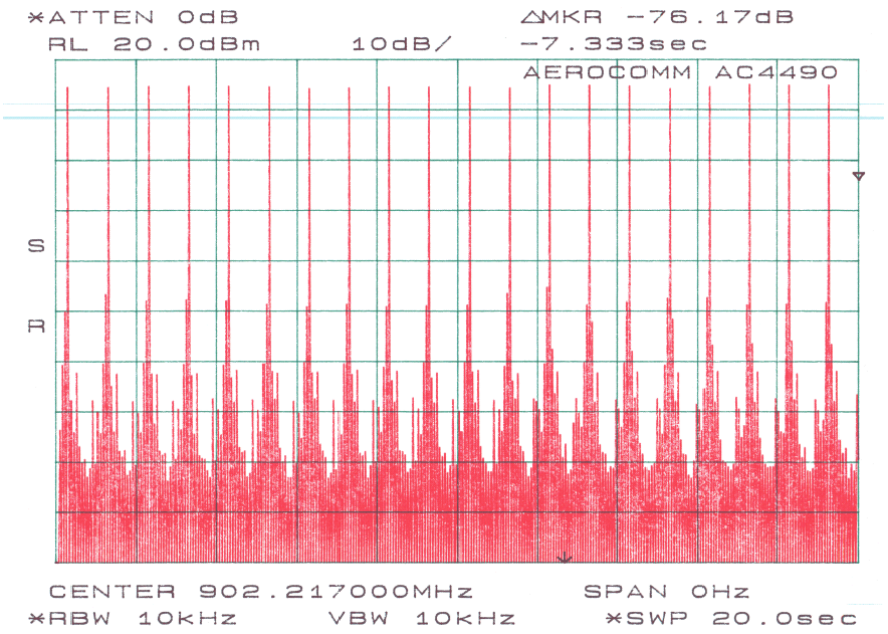
9.5 Plots of Dwell Time

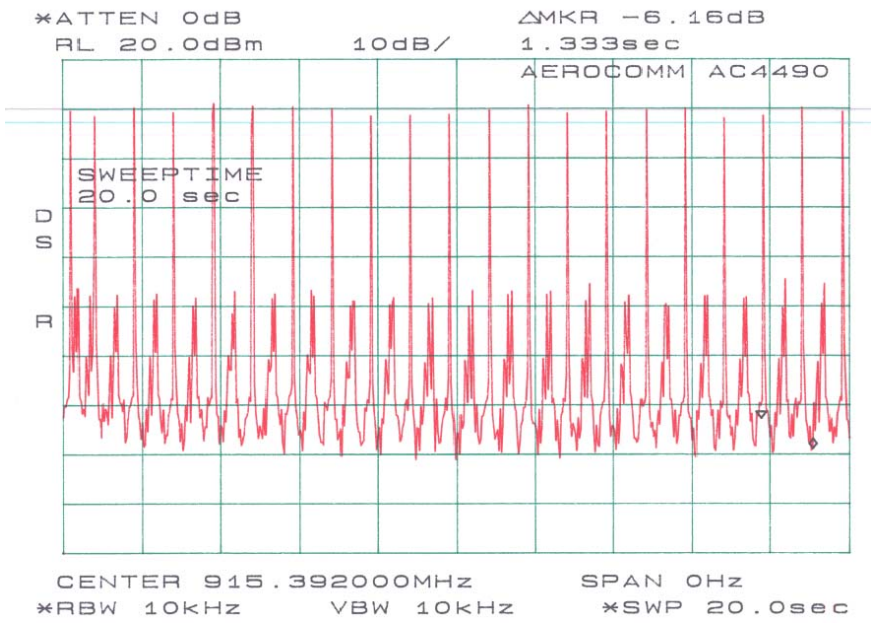
Please refer the following plots.

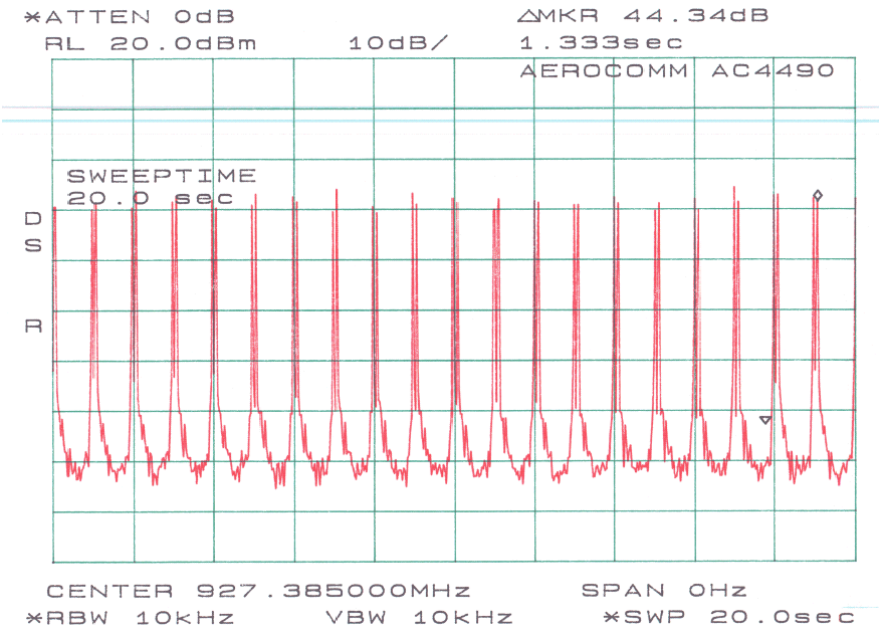

*ATTEN 0dB
RL 20.0dBm
10dB/
ΔMKR -5.50dB
3.167ms
AEROCOMM AC4490
ΔMKR
3.167 ms
-5.50 dB
R
CENTER 902.217000MHz
SPAN 0Hz
*RBW 10kHz
VBW 10kHz
*SWP 50.0ms


*ATTEN 0dB
RL 20.0dBm
10dB/
ΔMKR -1.66dB
3.333ms
AEROCOMM AC4490
ΔMKR
3.333 ms
-1.66 dB
R
CENTER 915.392000MHz
SPAN 0Hz
*RBW 10kHz
VBW 10kHz
*SWP 50.0ms


*ATTEN 0dB
RL 20.0dBm
10dB/
ΔMKR 1.00dB
3.583ms
AEROCOMM AC4490
ΔMKR
3.583 ms
1.00 dB
D
S
R
CENTER 927.385000MHz
SPAN 0Hz
*RBW 10kHz
VBW 10kHz
SWP 50.0ms


*ATTEN 0dB
RL 20.0dBm
10dB/
ΔMKR -76.17dB
-7.333sec
AEROCOMM AC4490
S
R
CENTER 902.217000MHz
SPAN 0Hz
*RBW 10kHz
VBW 10kHz
*SWP 20.0sec


*ATTEN 0dB
RL 20.0dBm
10dB/
ΔMKR -6.16dB
1.333sec
AEROCOMM AC4490
SWEEPTIME
20.0 sec
D
S
R
CENTER 915.392000MHz
SPAN 0Hz
*RBW 10kHz
VBW 10kHz
*SWP 20.0sec


*ATTEN 0dB
RL 20.0dBm
10dB/
ΔMKR 44.34dB
1.333sec
AEROCOMM AC4490
SWEEPTIME
20.0 sec
D
S
R
CENTER 927.385000MHz
SPAN 0Hz
*RBW 10kHz
VBW 10kHz
*SWP 20.0sec

10 - SPURIOUS EMISSION AT ANTENNA PORT

10.1 Standard Applicable

According to §15.209 (f) and §15.33(a), in some cases the emissions from an intentional radiator must be measured to beyond the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator because of the incorporation f a digital device. If measurements above the tenth harmonic are so required, the radiated emissions above the tenth harmonic shall comply with the general radiated emission limits applicable to the incorporated digital device, as shown in §15.109 and as based on the frequency of the emission being measured, or, except for emissions contained in the restricted frequency bands shown in §15.205, the limit on spurious emissions specified for the intentional radiator, whichever is the higher limit.

10.2 Measurement Procedure

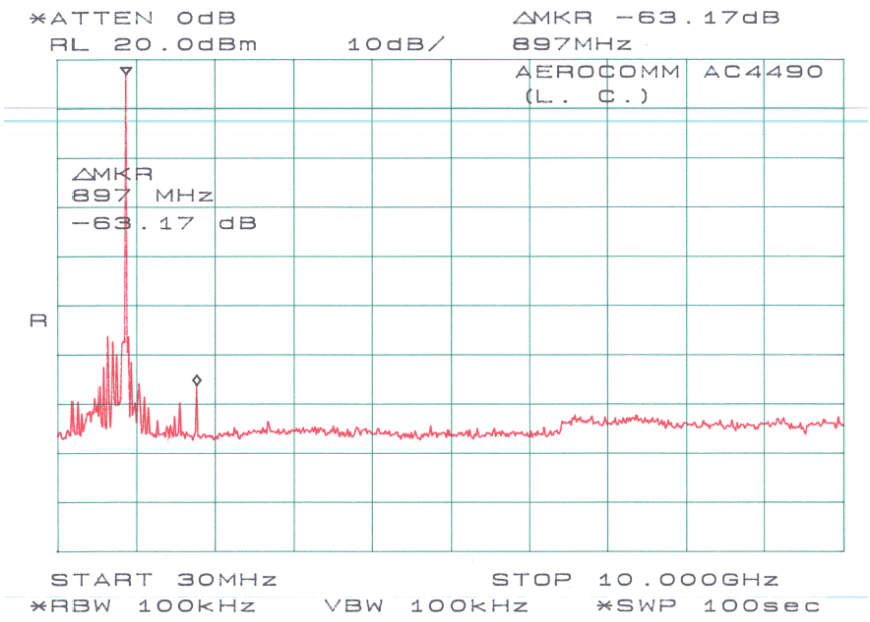
1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Position the EUT on a bench without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set the SA on Max-Hold Mode, and then keep the EUT in transmitting mode. Record all the signals from each channel until each one has been recorded.
4. Set the SA on View mode and then plot the result on SA screen.
5. Repeat above procedures until all frequencies measured were complete.

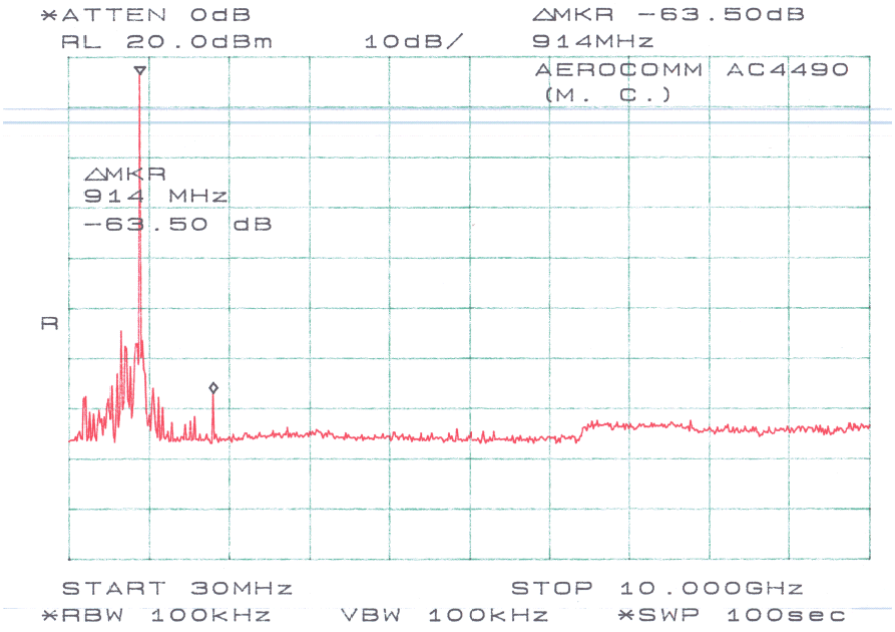
10.3 Test Equipment

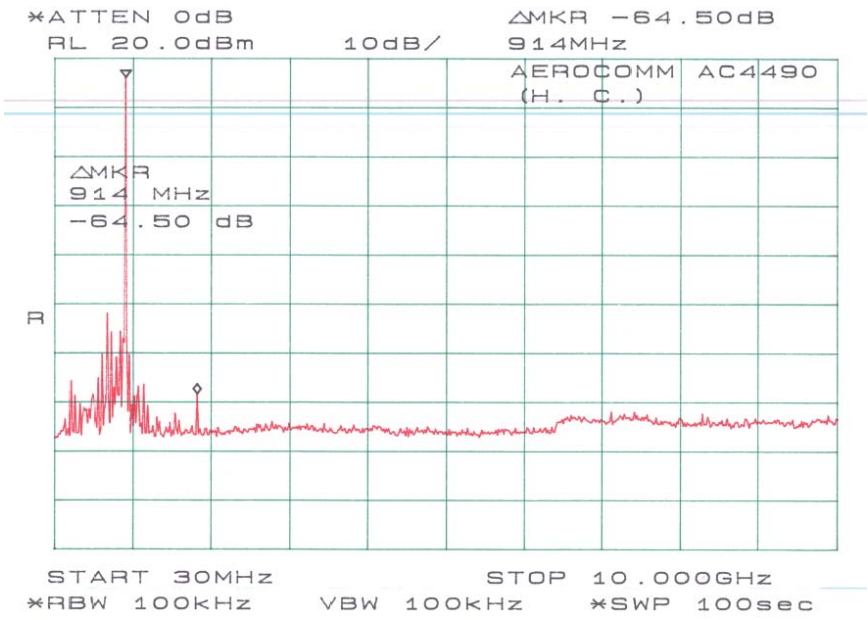
Manufacturer	Model No.	Description	Calibration Due Date
Agilent	8564E	Spectrum Analyzer	2003-08-01
Com-Power	AL-100	Log Periodic Antenna	2004-05-01
Com-Power	AB-100	Biconical Antenna	2004-05-01
Com-Power	AB-900	Log Periodic Antenna	2004-05-01
A.H. System	SAS-200/571	Horn Antenna	2003-05-31

10.4 Measurement Results

Please refer to the following plots.


*ATTEN 0dB
RL 20.0dBm
10dB/
ΔMKR -63.17dB
897MHz
AEROCOMM AC4490
(L. C.)
ΔMKR
897 MHz
-63.17 dB
R
START 30MHz
STOP 10.000GHz
*RBW 100kHz
VBW 100kHz
*SWP 100sec


*ATTEN 0dB
RL 20.0dBm
10dB/
ΔMKR -63.50dB
914MHz
AEROCOMM AC4490
(M. C.)
ΔMKR
914 MHz
-63.50 dB
R
START 30MHz
STOP 10.000GHz
*RBW 100kHz
VBW 100kHz
*SWP 100sec


*ATTEN 0dB
RL 20.0dBm
10dB/
ΔMKR -64.50dB
914MHz
AEROCOMM AC4490
(H. C.)
ΔMKR
914 MHz
-64.50 dB
R
START 30MHz
STOP 10.000GHz
*RBW 100kHz
VBW 100kHz
*SWP 100sec

11 - RADIATED EMISSION

11.1 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of a radiation emissions measurement at BACL is $\pm$4.0 dB.

11.2 Test Setup

The radiated emission tests were performed in the open area 3-meter test site, using the setup in accordance with the ANSI C63.4-1992. The specification used was the FCC 15 Subpart C limits.

The spacing between the peripherals was 10 centimeters.

External I/O cables were draped along the edge of the test table and bundle when necessary.

The EUT was connected with 120Vac/60Hz power source.

11.3 Spectrum Analyzer Setup

According to FCC Rules, 47 CFR §15.33 (a) (1), the system was tested to 10000 MHz.

During the radiated emission test, the spectrum analyzer was set with the following configurations:

Start Frequency	30 MHz
Stop Frequency	10000 MHz
Sweep Speed	Auto
IF Bandwidth	1 MHz
Video Bandwidth	1 MHz
Quasi-Peak Adapter Bandwidth	120 kHz
Quasi-Peak Adapter Mode	Normal
Resolution Bandwidth	1MHz

11.4 Test Procedure

For the radiated emissions test, both the laptop and all peripheral power cords were connected to the AC floor outlet since the power supply used in the laptop did not provide an accessory power outlet.

Maximizing procedure was performed on the six (6) highest emissions to ensure EUT compliance is with all installation combinations.

All data was recorded in the peak detection mode. Quasi-peak readings was performed only when an emission was found to be marginal (within -4 dBμV of specification limits), and are distinguished with a "**Qp**" in the data table.

11.5 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

Corr. Ampl. = Indicated Reading + Antenna Factor + Cable Factor - Amplifier Gain

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7dBμV means the emission is 7dBμV below the maximum limit for Class B. The equation for margin calculation is as follows:

Margin = Corr. Ampl. - Class B Limit

11.6 Test Equipment

Manufacturer	Model No.	Description	Calibration Due Date
Agilent	8564E	Spectrum Analyzer	2003-08-01

11.7 Summary of Test Results

According to the data in section 11.8, the EUT complied with the FCC Title 47, Part 15, Subpart C, section 15.205, 15.207, and 15.247, and had the worst margin of:

For 161AM-915R Antenna

-5.0 dB at **1854.96 MHz** in the **Vertical** polarization, Low Channel.

-4.5 dB at **1830.78 MHz** in the **Vertical** polarization, Middle Channel.

-4.8dB at **1854.96 MHz** in the **Vertical** polarization, High Channel.

-3.0 dB at **208.44 MHz** in the **Vertical** polarization, Unintentional Emission

For Flavus 915 Antenna

-4.8 dB at **1854.96 MHz** in the **Vertical** polarization, Low Channel.

-5.0 dB at **1830.78 MHz** in the **Horizontal** polarization, Middle Channel.

-4.6dB at **1854.96 MHz** in the **Horizontal** polarization, High Channel.

-4.3 dB at **208.44 MHz** in the **Vertical** polarization, Unintentional Emission

11.8 Radiated Emission Test Data

11.8.1 EUT with S161AM-915R Antenna, 30MHz ~ 10 GHz, 3 Meters

Indicated			Table	Antenna		Correction Factor			FCC 15 Subpart C		
Frequency	Ampl.	Direction	Height	Polar	Antenna	Cable Loss	Amp.	Corr. Ampl.	Limit	Margin	Mode
MHz	dBμV/m	Degree	Meter	H/V	dBμV/m	dBμV/m	dB	dBμV/m	dBμV/m	dB	
Low Channel											
902.22	112.2	180	1.2	V	24.8	3.0	25.0	115.0			FUND
902.22	104.9	110	1.5	H	24.8	3.0	25.0	107.7			FUND
1854.96	51.1	45	1.5	V	25.3	2.6	30.0	49.0	54	-5.0	AVG.
2782.44	45.2	150	1.2	V	29.0	3.7	30.0	47.9	54	-6.1	AVG.
1854.96	47.5	30	1.2	H	25.3	2.6	30.0	45.4	54	-8.6	AVG.
2782.44	42.3	230	1.5	H	29.0	3.7	30.0	45.0	54	-9.0	AVG.
1854.96	53.9	45	1.5	V	25.3	2.6	30.0	51.8	74	-22.2	PEAK
2782.44	48.7	150	1.2	V	29.0	3.7	30.0	51.4	74	-22.6	PEAK
1854.96	51.2	30	1.2	H	25.3	2.6	30.0	49.1	74	-24.9	PEAK
2782.44	45.5	230	1.5	H	29.0	3.7	30.0	48.2	74	-25.8	PEAK
Middle Channel											
915.39	112.7	180	1.2	V	24.6	4.2	25.0	116.5			FUND
915.39	106.5	15	1.2	H	24.6	4.2	25.0	110.3			FUND
1830.78	51.6	60	1.5	V	25.3	2.6	30.0	49.5	54	-4.5	AVG.
2746.17	45.6	150	1.2	V	29.0	3.7	30.0	48.3	54	-5.7	AVG.
1830.78	47.9	30	1.5	H	25.3	2.6	30.0	45.8	54	-8.2	AVG.
2746.17	42.9	210	1.5	H	29.0	3.7	30.0	45.6	54	-8.4	AVG.
1830.78	54.5	60	1.5	V	25.3	2.6	30.0	52.4	74	-21.6	PEAK
2746.17	49.3	150	1.2	V	29.0	3.7	30.0	52.0	74	-22.0	PEAK
1830.78	51.8	30	1.5	H	25.3	2.6	30.0	49.7	74	-24.3	PEAK
2746.17	46.1	210	1.5	H	29.0	3.7	30.0	48.8	74	-25.2	PEAK
High Channel											
927.48	112.3	210	1.5	V	24.7	4.4	25.0	116.4			FUND.
927.48	105.4	0	1.2	H	24.7	4.4	25.0	109.5			FUND.
1854.96	51.3	45	1.5	V	25.3	2.6	30.0	49.2	54	-4.8	AVG.
2782.44	45.3	150	1.2	V	29.0	3.7	30.0	48.0	54	-6.0	AVG.
1854.96	47.7	30	1.2	H	25.3	2.6	30.0	45.6	54	-8.4	AVG.
2782.44	42.6	230	1.5	H	29.0	3.7	30.0	45.3	54	-8.7	AVG.
1854.96	54.2	45	1.5	V	25.3	2.6	30.0	52.1	74	-21.9	PEAK
2782.44	48.9	150	1.2	V	29.0	3.7	30.0	51.6	74	-22.4	PEAK
1854.96	51.5	30	1.2	H	25.3	2.6	30.0	49.4	74	-24.6	PEAK
2782.44	45.7	230	1.5	H	29.0	3.7	30.0	48.4	74	-25.6	PEAK

Unintentional Emission

Indicated			Table	Antenna		Correction Factor			FCC 15 Subpart B	
Frequency	Ampl.	Direction	Height	Polar	Antenna	Cable Loss	Amp.	Corr. Ampl.	Limit	Margin
MHz	dBμV/m	Degree	Meter	H/V	dBμV/m	dBμV/m	dB	dBμV/m	dBμV/m	dB
208.44	48.5	270	1.5	V	12.4	4.6	25.0	40.5	43.5	-3.0
225.90	47.6	225	1.5	H	12.1	3.9	25.0	38.6	46	-7.4
110.73	46.3	45	1.2	V	11.7	1.3	25.0	34.3	43.5	-9.2
460.53	39.5	60	1.2	V	17.8	3.7	25.0	36.0	46	-10.0
195.42	38.1	270	1.0	V	15.0	3.9	25.0	32.0	43.5	-11.5

11.8.2 EUT with Flavus 915 Antenna, 30MHz ~ 10 GHz, 3 Meters

Indicated			Table	Antenna		Correction Factor			FCC 15 Subpart C		
Frequency MHz	Ampl. dBμV/m	Direction Degree	Height Meter	Polar H/V	Antenna dBμV/m	Cable Loss dBμV/m	Amp. dB	Corr. Ampl. dBμV/m	Limit dBμV/m	Margin dB	Mode
Low Channel											
902.22	108.3	90	1.2	V	24.8	3.0	25.0	111.1			FUND
902.22	112.6	110	1.5	H	24.8	3.0	25.0	115.4			FUND
1854.96	51.3	0	1.2	H	25.3	2.6	30.0	49.2	54	-4.8	AVG.
2782.44	45.3	210	1.5	H	29.0	3.7	30.0	48.0	54	-6.0	AVG.
1854.96	47.6	45	1.5	V	25.3	2.6	30.0	45.5	54	-8.5	AVG.
2782.44	42.5	150	1.2	V	29.0	3.7	30.0	45.2	54	-8.8	AVG.
1854.96	57.6	0	1.2	H	25.3	2.6	30.0	55.5	74	-18.5	PEAK
2782.44	48.4	210	1.5	H	29.0	3.7	30.0	51.1	74	-22.9	PEAK
2782.44	46.1	150	1.2	V	29.0	3.7	30.0	48.8	74	-25.2	PEAK
1854.96	50.8	45	1.5	V	25.3	2.6	30.0	48.7	74	-25.3	PEAK
Middle Channel											
915.39	108.2	0	1.2	V	24.6	4.2	25.0	112.0			FUND
915.39	112.5	15	1.2	H	24.6	4.2	25.0	116.3			FUND
1830.78	51.1	30	1.5	H	25.3	2.6	30.0	49.0	54	-5.0	AVG.
2746.17	45.1	210	1.5	H	29.0	3.7	30.0	47.8	54	-6.2	AVG.
1830.78	47.5	60	1.5	V	25.3	2.6	30.0	45.4	54	-8.6	AVG.
2746.17	42.3	150	1.2	V	29.0	3.7	30.0	45.0	54	-9.0	AVG.
1830.78	57.5	30	1.5	H	25.3	2.6	30.0	55.4	74	-18.6	PEAK
2746.17	48.3	210	1.5	H	29.0	3.7	30.0	51.0	74	-23.0	PEAK
2746.17	46.0	150	1.2	V	29.0	3.7	30.0	48.7	74	-25.3	PEAK
1830.78	50.6	60	1.5	V	25.3	2.6	30.0	48.5	74	-25.5	PEAK
High Channel											
927.48	108.4	90	1.5	V	24.7	4.4	25.0	112.5			FUND.
927.48	112.7	70	1.2	H	24.7	4.4	25.0	116.8			FUND.
1854.96	51.5	15	1.2	H	25.3	2.6	30.0	49.4	54	-4.6	AVG.
2782.44	45.4	180	1.5	H	29.0	3.7	30.0	48.1	54	-5.9	AVG.
1854.96	47.7	310	1.5	V	25.3	2.6	30.0	45.6	54	-8.4	AVG.
2782.44	42.7	150	1.2	V	29.0	3.7	30.0	45.4	54	-8.6	AVG.
1854.96	54.7	15	1.2	H	25.3	2.6	30.0	52.6	74	-21.4	PEAK
2782.44	48.5	180	1.5	H	29.0	3.7	30.0	51.2	74	-22.8	PEAK
2782.44	46.2	150	1.2	V	29.0	3.7	30.0	48.9	74	-25.1	PEAK
1854.96	50.9	310	1.5	V	25.3	2.6	30.0	48.8	74	-25.2	PEAK

Unintentional Emission

Indicated			Table	Antenna		Correction Factor			FCC 15 Subpart B	
Frequency	Ampl.	Direction	Height	Polar	Antenna	Cable Loss	Amp.	Corr. Ampl.	Limit	Margin
MHz	dBμV/m	Degree	Meter	H/V	dBμV/m	dBμV/m	dB	dBμV/m	dBμV/m	dB
208.44	47.2	270	1.5	V	12.4	4.6	25.0	39.2	43.5	-4.3
225.90	47.3	225	1.5	H	12.1	3.9	25.0	38.3	46	-7.7
110.73	45.4	45	1.2	V	11.7	1.3	25.0	33.4	43.5	-10.1
460.53	39.2	60	1.2	V	17.8	3.7	25.0	35.7	46	-10.3
195.42	38.6	270	1.0	V	15.0	3.9	25.0	32.5	43.5	-11.0

12 - CONDUCTED EMISSION

12.1 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, and LISN.

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of any conducted emissions measurement at BACL is $\pm$2.4 dB.

12.2 Test Setup

The measurement was performed at shield room, using the same setup per ANSI C63.4 – 1992 measurement procedure. The specification used was FCC Class B limits.

External I/O cables were draped along the edge of the test table and bundle when necessary.

The EUT was connected with 120Vac/60Hz power source.

12.3 Spectrum Analyzer Setup

The spectrum analyzer was set with the following configurations during the conduction test:

Start Frequency	150 kHz
Stop Frequency	30 MHz
Sweep Speed	Auto
IF Bandwidth	10 kHz
Video Bandwidth	10 kHz
Quasi-Peak Adapter Bandwidth	9 kHz
Quasi-Peak Adapter Mode	Normal

12.4 Test Procedure

During the conducted emission test, the power cord of the host system was connected to the auxiliary outlet of the first LISN.

Maximizing procedure was performed on the six (6) highest emissions of each modes tested to ensure EUT is compliant with all installation combination.

All data was recorded in the peak detection mode. Quasi-peak readings were only performed when an emission was found to be marginal (within -4 dBμV of specification limits). Quasi-peak readings are distinguished with a "**Qp**".

12.5 Summary of Test Results

According to the data in section 12.6, the EUT complied with the FCC Conducted margin for a Class B device, with the *worst* margin reading of:

-15.8 dBμV at 0.8 MHz in the Neutral mode

12.6 Conducted Emissions Test Data

LINE CONDUCTED EMISSIONS				FCC CLASS B	
Frequency MHz	Amplitude dBμV	Detector Qp/Ave/Peak	Phase Line/Neutral	Limit dBμV	Margin dB
0.800	30.2	Ave	Neutral	46	-15.8
0.150	45.9	QP	Line	66	-20.1
0.800	34.9	QP	Neutral	56	-21.1
17.200	28.7	Ave	Line	50	-21.3
0.150	44.2	QP	Neutral	66	-21.8
0.800	23.7	Ave	Line	46	-22.3
17.300	37.3	QP	Neutral	60	-22.7
17.300	36.9	QP	Line	60	-23.1
0.800	28.6	QP	Line	56	-27.4
17.200	22.4	Ave	Neutral	50	-27.6
0.150	15.7	Ave	Line	56	-40.3
0.150	13.6	Ave	Neutral	56	-42.4

12.7 Plot of Conducted Emissions Test Data

Plot(s) of Conducted Emissions Test Data is presented in the following page as reference.

Bay Area Compliance Laboratory Corp 22. May 03 01:16
CISPR CLASS B

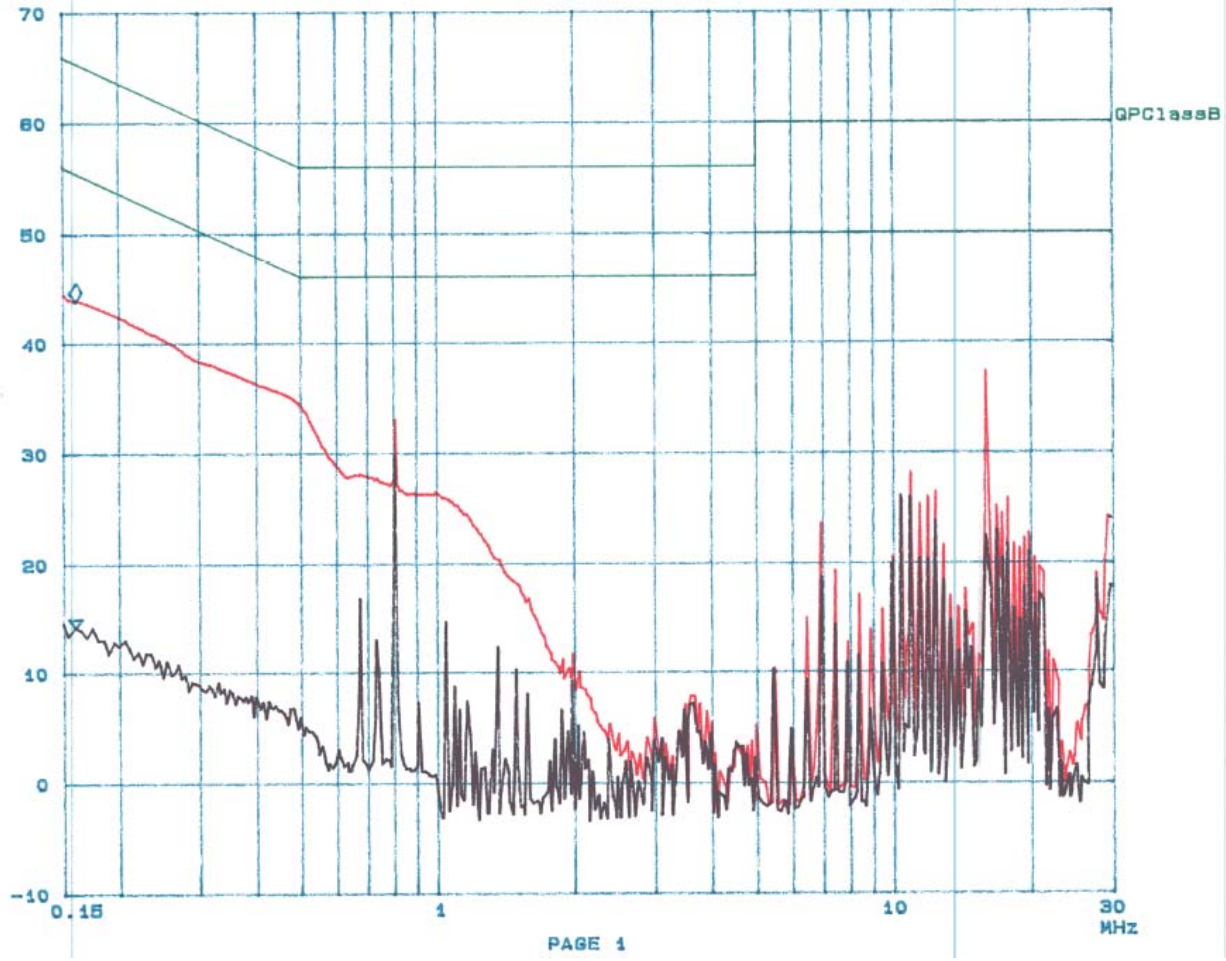
EUT: AC4490 Transceiver
Manuf: Aerocomm
Op Cond: Normal
Operator: Benjamin
Comment: Neutral
File name: SEANIXL.RES

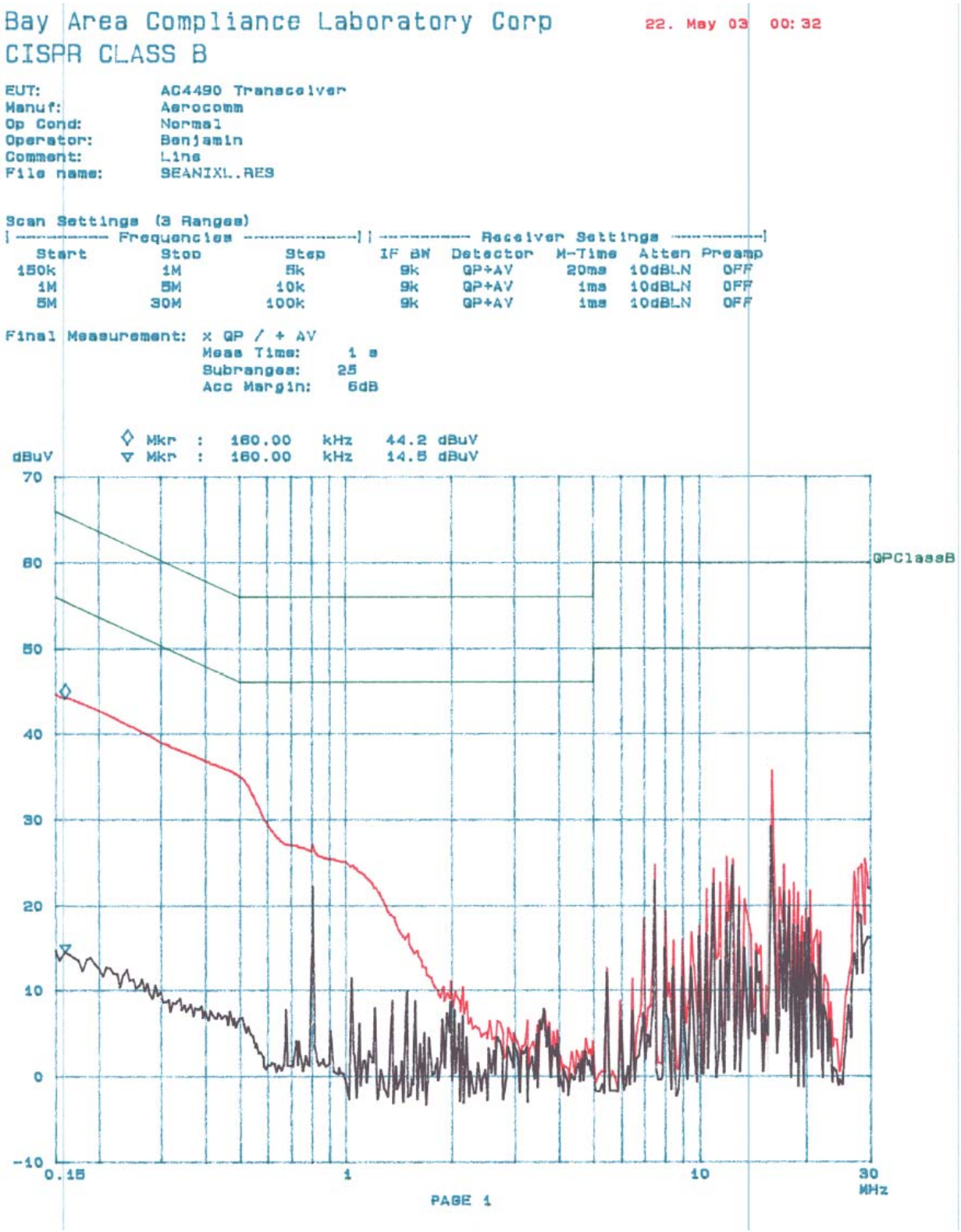
Scan Settings (3 Ranges)

Frequencies			Receiver Settings				
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp
150k	1M	5k	9k	QP+AV	20ms	10dBLN	OFF
1M	5M	10k	9k	QP+AV	1ms	10dBLN	OFF
5M	30M	100k	9k	QP+AV	1ms	10dBLN	OFF

Final Measurement: x QP / + AV
Meas Time: 1 s
Subranges: 25
Acc Margin: 6dB

◊ Mkr : 160.00 kHz 43.9 dBuV
▽ Mkr : 160.00 kHz 14.2 dBuV




Bay Area Compliance Laboratory Corp
22. May 03 00:32
CISPR CLASS B
EUT: AC4490 Transceiver
Manuf: Aerocomm
Op Cond: Normal
Operator: Benjamin
Comment: Line
File name: SEANIXL.RES
Scan Settings (3 Ranges)
Frequencies
Receiver Settings
Start Stop Step IF BW Detector M-Time Atten Preamp
150k 1M 5k 9k QP+AV 20ms 10dBLN OFF
1M 5M 10k 9k QP+AV 1ms 10dBLN OFF
5M 30M 100k 9k QP+AV 1ms 10dBLN OFF
Final Measurement: x QP / + AV
Meas Time: 1 s
Subranges: 25
Acc Margin: 6dB
◊ Mkr : 160.00 kHz 44.2 dBuV
▽ Mkr : 160.00 kHz 14.8 dBuV
dBuV
70
60
50
40
30
20
10
0
-10
0.15
1
10
30
MHz
QPClassB
PAGE 1

13 - ANTENNA REQUIREMENT

According to § 15.203, 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.

And according to § 15.247 (1), if transmitting antennas of directional gain greater than 6 dBi are used the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The gain of antenna used for transmitting is 2.5 dBi for S161AM-915R, and –0.5 dBi for Flavus Antenna. The antenna connector is designed with permanent attachment and no consideration of replacement. Please see EUT photo for details.

14 - RF EXPOSURE

According to §15.247(b)(4) and §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

According to §1.1310 and §2.1093 RF exposure is calculated.

Limits for Maximum Permissive Exposure (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minute)
Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-15000	/	/	1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

MPE Prediction

Predication of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$S = PG/4\pi R^2$

Where: S = power density
P = power input to antenna
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

Maximum peak output power at antenna input terminal: 17.17 (dBm)
Maximum peak output power at antenna input terminal: 52.12 (mW)
Prediction distance: 20 (cm)
Predication frequency: 900 (MHz)

1. S161AM-915R Antenna, Antenna Gain (typical): 2.5 (dBi)
   Maximum antenna gain: 1.78 (numeric)
   Power density at predication frequency at 20 cm: 0.0185 (mW/cm^2)

2. Flavus 915MHz Antenna, Antenna Gain (typical): -0.5 (dBi)
   Maximum antenna gain: 0.89 (numeric)
   Power density at predication frequency at 20 cm: 0.0092 (mW/cm^2)

MPE limit for uncontrolled exposure at prediction frequency: 0.6 (mW/cm^2)

Test Result

The predicted power density level and MPE calculated distance are as following:

1. S161AM-915R Antenna: predicted power density level at 20 cm is 0.0185 cmW/cm²
2. Flavus 915MHz Antenna: predicted power density level at 20 cm is 0.0092 mW/cm²

These are below the uncontrolled exposure limit of 0.6 mW/cm² at 900 MHz.

The EUT is used at least 20 cm away from user's body, it is defined as mobile equipment.