EXHIBIT B – Technical Report

FCC ID O2Z-BT1

Measurement/Technical Report

Intel Corporation

Ambler Bluetooth

FCC ID: O2Z-BT1

May 11 ,2000

This report concerns (check one):	Original Grant__*X*	*Class II Change*____
Equipment Type: Unlicensed Spread Spectrum Transmitter Module		
Deferred grant requested per 47 CFR 0.457 (d)(1)(ii)?		Yes_____ no__X__
	If yes, defer until:	______N/A______ date
Intel Corp. agrees to notify the Commission by:	______N/A______	date
of the intended date of announcement of the product so that the grant can be issued on that date.		
Transition Rules Request per 15.37:		yes_____ no__X__
If no, assumed Part 15, Subpart C for intentional radiators – new 47 CFR [10-1-92] provision.		
Report prepared by:	Northwest EMC, Inc. 22975 NW Evergreen Pkwy., Ste 400 Hillsboro, OR 97124 (503) 844-4066 fax: (503) 844-3826	

Report No. INSC0002

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1.0 General Information

1.1 Product Description

Manufactured By .... Intel Corporation

Address........ 2200 Missions College Blvd., Santa Clara, CA 95052-8119

Test Requested By:........ Rick Jessop

Model........ Ambler Bluetooth

FCC ID O2Z-BT1

Serial Number(s) RJ050100

Date of Test .... May 1, 2000 through May 11, 2000

Job Number INSC0002

Prepared By:	**Administrative Review By:**
Vicki Albertson, Technical Report and Documentation Manager	Brenda Wood, Technical Report Writer
Technical Review By:	**Approved By:**
Greg Kiemel, Director of Engineering	Dean Ghizzone, President

1.1 Product Description con't

The Equipment Under Test (EUT) is the Intel Corporation Ambler Bluetooth® module, a spread spectrum transmitter that uses frequency hopping modulation. This device is intended to be sold to Original Equipment Manufacturers (OEMs) for integration into laptop computers only. This device will be integrated with one of four Intel sponsored antennas which are being recommended to be used with this device. A fifth antenna (Antenna "A") was tested with the unit for reference purposes only, it will not be recommended for use with this device. The module will allow laptop computers to communicate with other consumer electronics containing Bluetooth® devices. This will allow a laptop computer to communicate to and share files and data with other devices such as digital cameras, cellular phones, wireless mice, wireless joysticks, wireless keyboards, etc.

Within the Bluetooth® protocol, frequency hopping is governed by one and only one Bluetooth® unit in any given communications group. The master unit determines the pseudo random hopping sequence and conveys this information to other "slave" units that are in the communications group with the master. Because the master unit generates the hopping sequence independently without any external information, there is no coordination with other FHSS systems. The Bluetooth® protocol relies on Forward Error Correction (FEC) along with re-transmissions to accommodate for multiple transmitters and interference on specific frequencies.

Under two specific modes (page mode and inquiry mode) of the Bluetooth® protocol, fewer than 75 hopping frequencies are used for a very short period of time. These two modes are used to search for and acquire new devices in the surrounding area. The amount of time that a Bluetooth® device spends in these two modes represents a very small portion of the overall communications time.

The data transmitted during these two modes is Direct Sequence modulated. Even though the transmitter is still hopping to a pseudo-random hopping sequence (less than 75 frequencies), the data transmitted at each frequency is Direct Sequence modulated. In this regard, the transceiver qualifies as a Hybrid System under the Part 15.247 rules.

Because the Bluetooth? protocol contains these modes, and because these modes do not meet the minimum number of hopping channels specified in Part 15.247 for frequency hopping, the Bluetooth? transmitter is categorized as a hybrid system for these two modes and the hybrid-mode processing gain calculations apply.

1.2 Related Submittals/Grants

None

1.3 Tested System Details

EUT and Peripherals

Item	FCC ID	Description and Serial No.
EUT	O2Z-BT1	Intel Ambler Bluetooth Spread Spectrum Transmitter S/N RJ050100.
3.3V DC Power Supply	N/A	Instek PC-3030D, S/N 9565963
Dipole Antenna	N/A	Antenna “A”: * (Reference antenna for testing purposes only)
PIFA	N/A	Antenna “B” *
Multilayer	N/A	Antenna “C” *
Dielectric	N/A	Antenna “D” *
Microstrip	N/A	Antenna “E” *

Cables

Cable Type	Shield	Length (meters)	Ferrite	Connection Point 1	Connection Point 2
USB	No	1.0	No	USB port on EUT	Unterminated
DC	No	1.0	No	DC Input on EUT	DC Power Supply
Antenna Coax	Yes	2 (inches)	No	RF Output on EUT	Antenna

****Additional antenna specifications may be referenced in Exhibit K, file name “Ambler Bluetooth® Antenna Information.pdf”***

1.4 Test Methodology

Radiated testing was performed according to the procedures in ANSI C63.4 (1992), FCC 97-114, and DA 00-705. Radiated testing was performed at an antenna to EUT distance of 3 meters, from 30 MHz to 10 GHz, and at 1 meter from 10 GHz to 25 GHz.

1.5 Test Facility

The semi-anechoic chamber and conducted measurement facility used to collect the radiated and conducted data is located at

Northwest EMC, Inc.
22975 NW Evergreen Pkwy., Ste 400
Hillsboro, OR 97124
(503) 844-4066
Fax: 844-3826

The semi-anechoic chamber, and conducted measurement facility is located in Hillsboro, OR, at the address shown above. This site has been fully described in a report filed with the FCC (Federal Communications Commission), and accepted by the FCC in a letter maintained in our files.

Northwest EMC, Inc. is recognized under the United States Department of Commerce, National Institute of Standards and Technology, National Voluntary Laboratory Accreditation Program (NVLAP) for satisfactory compliance with criteria established in Title 15, Part 285 Code of Federal Regulations. These criteria encompass the requirements of ISO/IEC Guide 25 and the relevant requirements of ISO 9002 (ANSI/ASQC Q92-1987) as suppliers of calibration or test results. NVLAP Lab Code: 200059-0.

3.0 System Test Configuration

3.1 Justification

3.1.1 Operating Modes

All operating modes of the EUT were investigated including: frequency hopping with a modulated carrier, no hopping with a modulated carrier, and direct sequence modulation. For each test, the EUT was configured for low, mid, and high band transmit frequencies except when operated in a frequency hopping mode. During spurious radiated emissions testing, all operating modes were investigated for each of the five antennas at low, mid, and high transmit frequencies.

An additional test was performed to demonstrate the suitability of the EUT as a certified transmitter module. The peak output power was measured across a range of DC input voltages. This provided evidence of the EUTs power supply regulation.

The variable supply voltage data may be referenced in Exhibit "X", file name "CW Output Power vs DC Input.pdf".

3.1.2 Test Configuration

In an email from the Commission's OET Laboratory (see Appendix I), the requirements for module approval were outline. To paraphrase, a module must have its own RF shielding, buffered modulation / data inputs, power supply regulation, permanently attached or unique antenna coupler, and be tested in a stand-alone configuration.

During testing, the EUT was configured to demonstrate compliance with these requirements. The module was tested in a stand-alone configuration. One meter unshielded cables were attached to the USB and DC input ports of the EUT. A short (less than 2 inches) coaxial cable was attached to the RF output port of the EUT for connection of the antennas. A laboratory DC power supply provided power to the EUT.

3.2 EUT Exercise Software

The software used to exercise the EUT is engineering developmental software designed to provide manual control over the transceiver functions. The software operates on a laptop computer and commands the EUT via communication over a USB cable through the USB port of the computer. After the EUT was commanded to a particular state, the USB cable was disconnected from the laptop computer for testing.

The EUT contains a built-in microprocessor and memory storage for processing transceiver instructions in accordance to the Bluetooth® protocols.

This software commands the built-in Bluetooth® protocols within the module in the same manner as the final Bluetooth® end-product (laptop computers are the end-product for this module).

The packets selected for transmission during EUT testing were the maximum packet density allowed in the Bluetooth® protocol to create a worse case emissions.

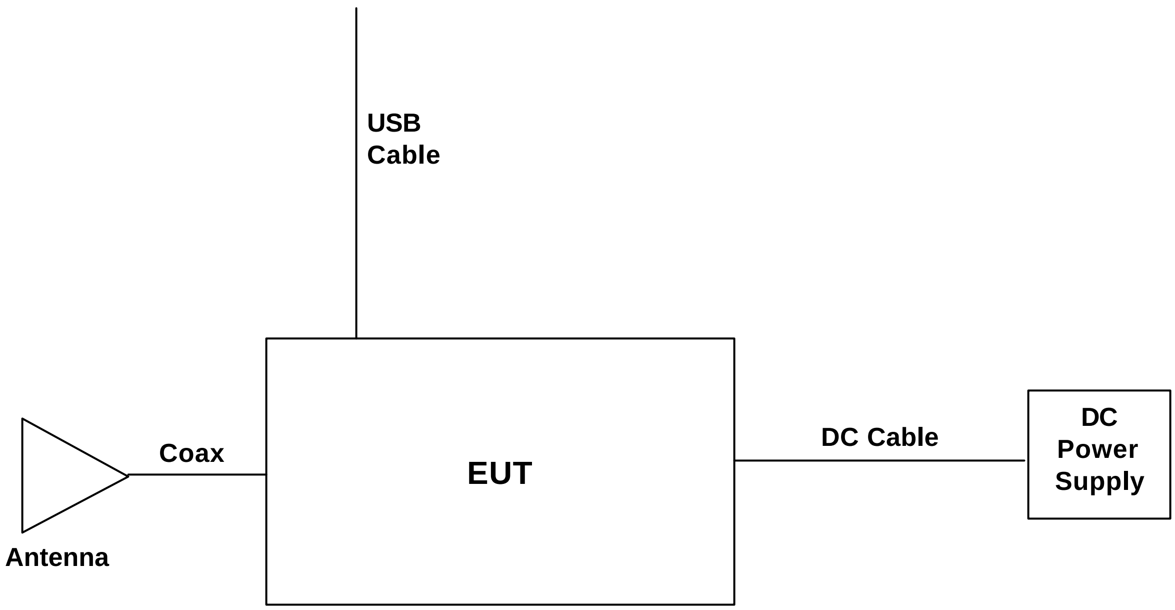
3.3 Special Accessories

None

3.4 Equipment Modifications

None.

Figure 3.1: Configuration of Tested System



4.0 Antenna Requirement

Per 47 CFR 15.203, the EUT uses antennas that are designed to ensure that no other antennas other than those supplied by Intel will be used with the device.

Details about the antenna connection method may be referenced in exhibit "CC", file name "Antenna Connection Method.pdf"

4.1 Antenna Information

Per 47 CFR 15.204 (c), a list of antennas tested with the EUT is provided. The type, manufacturer, model number, and gain with reference to an isotropic radiator is given.

Please reference exhibit "K", file name "Ambler Bluetooth® Antenna Information.pdf" for that information.

Photographs of those antennas are in exhibit "F", file name "Ambler Bluetooth® Antenna Photos.pdf"

4.2 Frequency Hopping System

Per 47 CFR 15.247(a), a description of how the EUT meets the definition (found in 47 CFR 2.1) of a frequency hopping spread spectrum system is provided.

The description includes the number of hopping frequencies, the time of occupancy (dwell time) per hopping channel, and an explanation of how the hopping sequence is generated (an example is provided of the hopping channel sequence). Also, a description of how the EUT's hopping channels are used equally on average is provided.

In an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitters; a description is provided of how the EUT does not have the ability to coordinate with other frequency hopping systems.

Please reference exhibit "J", file name"Description of Frequency Hopping System" for that information

4.3 Frequency Hopping Receiver

Per 47 CFR 15.247 (a)(1), a description is provided of how the EUT's associated receiver complies with the requirement that the input bandwidth matches the hopping channel bandwidth of the transmitter, and shifts frequencies in synchronization with the transmitted signals.

Please reference exhibit "J", file name "Description of Frequency Hopping System" for that information

4.4 De Facto EIRP Limit

Per 47 CFR 15.247 (b)(1-3), the EUT meets the de facto EIRP limit of +36dBm. The peak output power of the EUT is approximately 0 dBm, and the maximum gain of any antennas used with the EUT will be 6 dBi or less. Therefore, the EUT's maximum EIRP is +6dBm.

4.5 RF Exposure Compliance Requirements

Per 47 CFR 15.247 (b)(4), the EUT meets the requirement that it be operated in a manner that ensures the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines (ref . 47 CFR 1.1307, 1.1310, 2.1091, and 2.1093. Also OET Bulletin 65, Supplement C).

The EUT will only be used in notebook and desktop computers and can therefore be considered a mobile transmitter per 47 CFR 2.1091. It will not be used in "palm-top" computers or other handheld devices. The EUT supports the connection of only one antenna at a time.

The MPE estimates are as follows:

Table 1 in 47 CFR 1.1310 defines the maximum permissible exposure (MPE) for the general population as 1mW/cm^2. The distance from the EUT's transmitting antenna where the exposure level reaches the maximum permitted level is calculated using the general equation:

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

Where:
S = power density (1mW/cm^2 maximum permitted level)
P = power input to the antenna (1mW)
G = linear power gain relative to an isotropic radiator (6dBi = numeric gain of 4)
R = distance to the center of the radiation of the antenna

Solving for R, the 1mW/cm^2 limit is reached 0.56 cm or closer to the transmitting antenna. Therefore, no warning labels, no RF exposure warnings in the manual, or other protection measures will be used with the EUT.

4.6 AC Powerline Conducted Emissions

Per 47 15.207(d), if the EUT is connected to the AC powerline indirectly, obtaining its power from another device which is connected to the AC powerline, then it should be tested to demonstrate compliance with the conducted limits of 15.207. The EUT will be powered from a host computer that could be connected to the AC power line. Therefore, in accordance with OET laboratory policy, the measurements were made on the laboratory DC power supply used to power the EUT.
The AC powerline conducted emissions were measured with the EUT operating in a frequency hopping mode and in a direct sequence mode – both typical of normal operation. The EUT was transmitting at its maximum data rate. For each mode, the spectrum was scanned from 450 kHz to 30 MHz. The test setup and procedures were in accordance with ANSI C63.4-1992.

Per 47 CFR 15.207, the radio frequency voltage that is conducted back onto the AC power line from the EUT, on any frequency within the 450 kHz to 30 MHz band, does not exceed 250 microvolts.

The AC Powerline conducted emissions data may be referenced in Exhibit "Y", file name "AC Powerline Conducted Emissions.pdf".

4.7 Spurious Radiated Emissions

The field strength of any spurious emissions or modulation products that fall in a restricted band, as defined in 47 CFR 15.205, were measured. The highest gain antenna of each type to be used with the EUT was tested. For each type of antenna and each modulation type, the EUT was configured for low, mid, and high band transmit frequencies. For each configuration, the spectrum was scanned from 30 MHz to 25 GHz.

While scanning, emissions from the EUT were maximized by rotating the EUT, adjusting the measurement antenna height and polarization, and manipulating the EUT antenna in 3 orthogonal planes (per ANSI C63.4:1992). A preamp and high pass filter were used for this test in order to provide sufficient measurement sensitivity.

4.7.1 Results

The peak level complies with the limits specified in 47 CFR 15.35 (b). The average level (taken with a 10Hz VBW) complies with the limits specified in 15.209. Since the dwell time per channel of the hopping signal was less than 100 ms, the reading obtained with the 10 Hz VBW may be further adjusted by a “duty cycle correction factor”, derived from 20log(dwell time/100ms).

An examination of the scan data for all the antennas and operating modes shows that there were no detectable spurious emissions or modulation products. The only detectable radiated emissions were from the digital portion of the module and not from the radio. The final radiated data included with this application contains signals from the digital circuitry, and noise floor measurements in some of the restricted bands to show system sensitivity. Due to the large file size, all 250+ radiated emissions scans were not included, but are available upon request.

The final radiated data may be referenced in Exhibit “Z”,
file name “SpuriousRadiated Emissions.pdf”.

4.8 Occupied Bandwidth

The occupied bandwidth was measured with the EUT set to low, medium, and high transmit frequencies. The measurement was made using a direct connection between the RF output of the EUT and the spectrum analyzer. The EUT was transmitting at its maximum data rate in two modes of operation: no hopping with a modulated carrier, and direct sequence modulation.

Frequency Hopping

Per 47 CFR 15.247(a)(1)(ii), the 20 dB bandwidth of a hopping channel is less than 1 MHz. The spectrum analyzer's resolution bandwidth was ≥1% of the 20dB bandwidth and the video bandwidth was greater than or equal to the resolution bandwidth.

Band	Bandwidth (kHz)
Low	712
Mid	790
High	822

Direct Sequence

Per 47 CFR 15.247(a)(2), the 6 dB bandwidth of a hopping channel is at least 500kHz. The spectrum analyzer's resolution bandwidth was 100kHz, and the video bandwidth was greater than or equal to the resolution bandwidth

Band	Bandwidth (kHz)
Low	552
Mid	600
High	682

The occupied bandwidth data may be referenced in Exhibit "N",
file name "DSS Occupied Bandwidth.pdf" and Exhibit "Q", file name "FHSS 20dB Bandwidth.pdf"

4.9 Peak Output Power

The peak output power was measured with the EUT set to low, medium, and high transmit frequencies. The measurement was made using a direct connection between the RF output of the EUT and the spectrum analyzer. The EUT was transmitting at its maximum data rate in two modes of operation: no hopping with a modulated carrier, and direct sequence modulation.

Frequency Hopping

Per 47 CFR 15.247(b)(1), the maximum peak output power does not exceed 1 Watt. The spectrum analyzer's resolution bandwidth was greater than the 20dB bandwidth of the modulated carrier and the video bandwidth was greater than or equal to the resolution bandwidth. The data plots includes the cable loss of 1.5 dB.

Band	Peak Output Power (mW)
Low	1.46
Mid	1.47*
High	1.35

Direct Sequence

Per 47 CFR 15.247(b)(1), the maximum peak output power does not exceed 1 Watt. The spectrum analyzer's resolution bandwidth was greater than the 6 dB bandwidth of the modulated carrier and the video bandwidth was greater than or equal to the resolution bandwidth. The data plots includes the cable loss of 1.5 dB.

Band	Peak Output Power (mW)
Low	1.41
Mid	1.40
High	1.27

*****NOTE: The form 731 reflects this maximum measured output power +2dB (tolerance permitted by the commission)

The Peak Output Power data may be referenced in Exhibit "O", file name "DSS Power Output.pdf" and Exhibit "W", file name "FHSS Output Power.pdf"

5.0 Spurious RF Conducted Emissions

The spurious RF conducted emissions were measured with the EUT set to low, medium, and high transmit frequencies. The measurements were made using a direct connection between the RF output of the EUT and the spectrum analyzer. The EUT was transmitting at its maximum data rate in two modes of operation: no hopping with a modulated carrier, and direct sequence modulation. For each mode, the spectrum was scanned from 0 MHz to 25 GHz.

Per 47 CFR 15.247(c), in any 100 kHz bandwidth outside the authorized band, the maximum level of radio frequency power is at least 20dB down from the highest emission level within the authorized band. The spectrum analyzer's resolution bandwidth was 100 kHz and the video bandwidth was greater than or equal to the resolution bandwidth.

The spurious RF conducted emissions data may be referenced in Exhibit "M", file name "DSS Conducted Spurious Emission.pdf" and Exhibit "T", file name "FHSS Conducted Spurious Emissions.pdf"

5.1 Band Edge Compliance of RF Conducted Emissions

The spurious RF conducted emissions at the edges of the authorized band were measured with the EUT set to low and high transmit frequencies. The measurement was made using a direct connection between the RF output of the EUT and the spectrum analyzer. The EUT was transmitting at its maximum data rate in two modes of operation: no hopping with a modulated carrier, and direct sequence modulation. For each mode, the channels closest to the band edges were selected. The spectrum was scanned across each band edge from 5 MHz below the band edge to 5 MHz above the band edge.

Per 47 CFR 15.247(c), in any 100 kHz bandwidth outside the authorized band, the maximum level of radio frequency power is at least 20dB down from the highest emission level within the authorized band. The spectrum analyzer's resolution bandwidth was 100 kHz and the video bandwidth was greater than or equal to the resolution bandwidth.

The data for spurious RF conducted emissions at the edges of the authorized band may be referenced in Exhibit "L", file name "DSS Band Edge.pdf" and Exhibit "S", file name "FHSS Bandedges.pdf

5.2 Carrier Frequency Separation

The carrier frequency separation was measured between each of 5 hopping channels in the middle of the authorized band. The measurements were made using a direct connection between the RF output of the EUT and the spectrum analyzer. The hopping function of the EUT was enabled.

Per 47 CFR 15.247(a)(1), the hopping channel carrier frequencies are separated by a minimum of 25 kHz or the 20dB bandwidth of the hopping channel. The spectrum analyzer's resolution bandwidth was greater than or equal to 1% of the span, and the video bandwidth was greater than or equal to the resolution bandwidth.

Measured value of carrier frequency separation for hopping channels is 1 MHz.

The data for carrier frequency separation may be referenced in Exhibit "R", file name "FHSS Adj. Channel Spacing.pdf"

5.3 Time of Occupancy (Dwell Time)

The average dwell time per hopping channel was measured at one hopping channel in the middle of the authorized band. The measurements were made using a direct connection between the RF output of the EUT and the spectrum analyzer. The hopping function of the EUT was enabled.

Per 47 CFR 15.247(a)(1)(ii), the average time of occupancy on any frequency is not greater than 0.4 seconds within a 30 second period. The spectrum analyzer's span was set to zero, the resolution bandwidth was 1 MHz, and the video bandwidth was 7 MHz. The measurement was made in two steps. First, the sweep speed was adjusted to capture the pulse width or dwell time of a single transmission. Then, the sweep speed was set to 2 seconds to count the number of transmissions during a two second period. (It was difficult to accurately count the number of transmissions for sweep speeds longer than two seconds.) This measurement was repeated 15 times, to determine the average number of transmissions during a two second period.

SWEEP #	# of Transmissions on a Single Channel in a two second period
1	4
2	9
3	8
4	6
5	4
6	7
7	5
8	4
9	10
10	5
11	4
12	6
13	3
14	6
15	3

The dwell time for a single transmission is 2.9mS. The average number of transmissions during a two second period is 5.6. The dwell time, multiplied by the average number of transmissions during a two second period, multiplied by 15, equals the average time of occupancy during a 30 second period.

2.9mS x 5.6 x 15 = .244 seconds

The data for time of occupancy may be referenced in Exhibit "U", file name "FHSS Dwell Time.pdf"

5.4 Number of Hopping Frequencies

The number of hopping frequencies was measured across the authorized band. The measurements were made using a direct connection between the RF output of the EUT and the spectrum analyzer. The hopping function of the EUT was enabled.

Per 47 CFR 15.247(a)(1)(ii), the number of hopping channels is at least 75. The spectrum analyzer's resolution bandwidth was 100 kHz, and the video bandwidth was greater than or equal to the resolution bandwidth.

The data for the number of hopping frequencies may be referenced in Exhibit "V", file name "FHSS Number of Hopping Frequencies.pdf"

5.5 Power Spectral Density

To demonstrate compliance with 15.247(d), power spectral density measurements were made as follows: The emission peak(s) are located and zoom in on within the passband. Set RBW = 3 kHz, VBW>RBW, sweep = (SPAN/3 kHz) e.g., for a span of 1.5 MHz, the sweep should be $1.5 \times 10^6 \div 3 \times 10^3$ = 500 seconds. The peak level measured must be no greater than +8 dBm. External attenuation is used and added to the reading. If necessary, the following FCC procedure is used for modifying the power spectral density measurements:

"If the spectrum line spacing cannot be resolved on the available spectrum analyzer, the noise density function on most modern conventional spectrum analyzers will directly measure the noise power density normalized to a 1 Hz noise power bandwidth. Add 34.7 dB for correction to 3 kHz."

Data was taken using the 1 Hz noise power bandwidth on an Tektronix 2784 spectrum analyzer. The data summary shown below includes the 34.7 dB correction to 3 kHz. The cable loss and external attenuation of 1.5 dB were corrected internal to the spectrum analyzer.

Low	-6.2 dBm
Mid	-5.2 dBm
High	-6.5 dBm

The data for Power Spectral Density may be referenced in Exhibit "P", file name "DSS Power Spectral Density.pdf"

5.6 Processing Gain

Processing gain measurements were performed in accordance with the definitions, calculations, and explanation in the test report provided by Intel Corp., found in Exhibit AA, file name “Ambler Bluetooth® Processing Gain Report.pdf” .

5.7 Field Strength Calculations

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured level. The basic equation with a sample calculation is as follows:
FS = RA + AF + CF - AG

where : FS = Field Strength

RA = Measured Level

AF = Antenna Factor

CF = Cable Attenuation Factor

AG = Amplifier Gain

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

FS = 52.5 + 7.4 + 1.1 - 29 = 32 dBuV/meter
Level in uV/m = Common Antilogarithm [(32 dBuV/m)/20] = 39.8 uV/m

5.8 Measurement Bandwidths

Peak Data

150 kHz - 30 MHz .... 10 kHz
30 MHz - 1000 MHz..100 kHz
1000 MHz - 25000 MHz ....1000 kHz

Quasi-peak Data

150 kHz - 30 MHz .... 9 kHz
30 MHz - 1000 MHz..120 kHz

6.0 Measurement Equipment

Instrument	Manufacturer	Model	Serial No	Cal Due
Spectrum Analyzer	Hewlett-Packard	8566B	2747A05213	1/19/2001
Pre-Amplifier	Amplifier Research	LN1000A	25660	7/18/2000
Antenna, Biconilog	EMCO	3141	9906-1146	6/15/2000
Spectrum Analyzer	Hewlett-Packard	8566B	2747A05213	1/19/2001
Antenna, Horn	EMCO	3115	9804-5441	7/10/2000
Pre-Amplifier 0.5-18 GHz	Miteq	AMF-4D-005180-24-10P	621707	7/18/2000
Spectrum Analyzer	Tektronix	2784	B010105	12/18/2000
Pre-Amplifier 18-26 GHz	Miteq	JSD4-18002600-26-8P	577858	4/10/2001
Antenna, Horn	EMCO	3160-09	9911-1189	01/05/2001
Pre-Amplifier	Miteq	JSD4-18002600-26-8P	577858	1/17/2001
High Pass Filter	Microlab	FXR HD-40N	8402	4/10/2001

Appendix I: FCC Policy on Modular Transmitters

There are no official FCC Rules that permit authorization of a transmitter as a module but the following standards have been uniformly applied as a Commission policy in support of industry needs. For a module to be approved, it must satisfy the following requirements:
(1) a modular transmitter must have its own RF shielding,
(2) a modular transmitter must have buffered modulation/data inputs (if such inputs are provided),
(3) a modular transmitter must have it own power supply regulation,
(4) a modular transmitter must have an antenna which complies with the requirements of Section 15.203 to be permanently attached or employ a "unique" antenna coupler. Except for Limited Module Approvals where the module is limited for use in specific enclosures to incorporate a final product, modules cannot be approved for devices that require professional installation to meet the requirements in Section 15.203. , Limited Module Approval may

(5) a modular transmitter must be tested in a stand-alone configuration, i.e., the antenna, AC or DC power and data input/output lines must be connected to the module but, the module must not be inside another case during testing, and
(6) a modular transmitter must be labelled with its own FCC ID number, and if the FCC ID is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following: "Contains Transmitter Module FCC ID: XYZMODEL1" or "Contains FCC ID: XYZMODEL1." The exact wording is not specified in our Rules (since modules are not specifically addressed), so you may use similar wording which expresses the same meaning.

The only other issue that may need to be addressed for approval of a modular transmitter is compliance with the Commission's RF exposure limits in Sections 1.1310 and 2.1093. Unlicensed PCS devices operating under Subpart D of Part 15, UNII devices operating under Subpart E of Part 15, and millimeter wave devices operating under Sections 15.253 and 15.255 require routine environmental evaluation for RF exposure prior to equipment authorization in accordance with Sections 15.319(i), 15.407(f), 15.253(f) and 15.255(g), respectively. Therefore, routine RF evaluation is required for these transmitters. In addition, spread spectrum transmitters operating under Section 15.247 are required to address RF exposure compliance in accordance with Section 15.247(b)(4). If it cannot be demonstrated that a spread spectrum transmitter will meet these requirements with proper installation, operating/ warning statements or labels, routine RF evaluation must be used to demonstrate compliance. In short, demonstrating compliance with the RF exposure limits for a modular transmitter will be handled on a case-by-case basis, with the knowledge of final usage ultimately determining the possibility of approval for the module.

A grant of equipment authorization for a transmitter module will have either the word "module" or "modular" in the description of the device on the grant. This is so you can be certain that the transmitter was approved as a module.

I trust that this has answered your questions. However, if you have any additional questions about this matter, please contact me at the telephone numbers listed above.