Date: February 12, 2004

Subject: Request for additional information regarding FCC ID: IHDT56EC1 (Portable Cellular/PCS CDMA/AMPS transceiver with embedded Bluetooth)

Reference:

Application Received:	02/06/2004
Correspondence Reference Number:	240211A.IHD
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Questions and responses follow:

Regarding the 15.247 application:

1. Please address the various descriptive requirements for Frequency Hoppers listed in Section 15.247(a)(1): pseudorandom hopping sequence? equal channel use on average? RX has the capability to hop? RX input bandwidth matches the transmitted signal bandwidth?

Response: Bluetooth is implemented with the Silicon Wave single-chip SiW1712(TM) radio modem. This device is a standalone baseband processor with an integrated 2.4 GHz transceiver. It is completely compliant with the Bluetooth 1.1 specification and Part 15.247. The frequency hopping is pseudorandom and average channel usage is equal. The RX has the ability to hop in sync with the TX, and. the RX bandwidth is approximately equal to the TX Bandwidth. Additional details follow:

a) Description of hopping sequence generation.

The generation of the hopping sequence in connection mode depends essentially on two input values:

1. LAP/UAP of the master of the connection
2. Internal master clock

The LAP (lower address part) are the 24 LSB's of the 48-bit BD_ADDRESS. The BD_ADDRESS is an unambiguous number of every Bluetooth unit. The UAP (upper address part) are the 24 MSB's of the 48-bit BD_ADDRESS. The internal clock of a Bluetooth unit is derived from a free running clock which is never adjusted and is never turned off. For synchronization with other units only offsets are used. It has no relation to the time of the day. Its resolution is at least half the RX/TX slot length of 312.5 µs. The clock has a cycle of about one day (23h30). In most case it is implemented as 28 bit counter. For the deriving of the hopping sequence the entire LAP (24 bits) (Input 1) and the 27 MSB's of the clock (Input 2)

are used. With this input values different mathematical procedures (permutations, additions, XOR-operations) are performed to generate the sequence. This will be done at the beginning of every new transmission.

b) Explanation of how each channel is used equally on average.

In total, 5 types of hopping sequences are defined. These sequences are:

* A **page hopping sequence** with 32 unique wake-up frequencies distributed equally over the 79 MHz band, with a period length of 32;
* An **inquiry sequence** with 32 unique wake-up frequencies distributed equally over the 79 MHz band, with a period length of 32;
* A **channel hopping sequence** which has a very long period length, which does not show repetitive patterns over a short time interval, but which distributes the hop frequencies equally over the 79 MHz during a long time interval;

For the generation of the inquiry and page hop sequences the same procedures as described for the data mode are used, but this time with different input vectors:

**For the inquiry hop sequence, a predefined fixed address is always used. This results in the same 32 frequencies used by all devices doing an inquiry but every time with a different start frequency and phase in this sequence.
**For the page hop sequence, the device address of the paged unit is used as input vector. This results in the use of a subset of 32 frequencies which is specific for that initial state of the connection establishment between the two units. A page to different devices would result in a different subset of 32 frequencies.

2. Please address Sections 15.247(g) and (h).

Response: Bluetooth is implemented with the Silicon Wave single-chip SiW1712(TM) radio modem which is completely compliant with the Bluetooth 1.1 specification and Part 15.247.

a) CFR47, 15.247(g): Description of compliance for a true frequency hopping system.

Excerpted from the Bluetooth specification:

"Bluetooth operates in the unlicensed ISM band at 2.4 GHz. A frequency hop transceiver is applied to combat interference and fading. A shaped, binary FM modulation is applied to minimize transceiver complexity. The symbol rate is 1 Ms/s. A slotted channel is applied with a nominal slot length of 625 µs. For full duplex transmission, a Time-Division Duplex (TDD) scheme is used. On the channel, information is exchanged through packets. Each packet is transmitted on a different hop frequency. A packet nominally covers a single slot, but can be extended to cover up to five slots."

"The channel is represented by a pseudo-random hopping sequence hopping through the 79 RF channels. The hopping sequence is unique for the piconet and is determined by the Bluetooth device address of the master; the phase in the hopping sequence is determined by the Bluetooth clock of the master. The channel is divided into time slots where each slot corresponds to an RF hop frequency. Consecutive hops correspond to different RF hop frequencies. The nominal hop rate is 1600 hops/s. All Bluetooth units participating in the piconet are time- and hop-synchronized to the channel."

b) CFR47, 15.247(h): Description of compliance to ability to avoid simultaneous occupancy of individual hopping frequencies by multiple transmitters.

Bluetooth units which want to communicate with other units must be organized in a structure called piconet. This piconet consists of a maximum of eight Bluetooth units. One unit is the master the other seven are the slaves. The master coordinates frequency occupation in this piconet for all units. As the master hop sequence is derived from its BD address which is unique for every Bluetooth device, additional masters intending to establish new piconets will always use different hop sequences. Since the Hop Sequences are determined within the piconet, independent of other piconet's behavior, they do make any effort to avoid hopping frequencies used by other transmitters.

3. What is the gain of the antenna used with the Bluetooth TX? Please describe the antenna.

Response: The Bluetooth module uses a separate antenna internal to the housing of the phone. The maximum antenna gain is approximately 3 dBi. It's a closed loop antenna with a matching section located in the lower portion of the phone.

4. Please address Section 15.203.

Response: CFR47, Part 15.203: Description of how the antenna is attached.

The Bluetooth antenna is attached permanently inside the device. It is heat staked to the internal structure. Per CFR 47, Part 15.203 "Antenna Requirement" "The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section."

Regarding the Part22/24E EMC report:

5. Please provide occupied bandwidth measurement plots for both cellular CDMA and PCS CDMA operation.

Response: Please refer to the attached bandwidth plots.

Regarding the SAR test report:

6. The tissue parameters for PCS SAR head testing taken on 1/24/04 and listed in the Table on p.4 do not match those listed on the following SAR plots: PCS right touch antenna extended; PCS right touch antenna retracted; PCS right tilt antenna retracted. I note that the tissue parameters listed on the SAR plots of other PCS head tests performed on the same day do match the values listed in the Table. It appears as though another line entry of tissue parameters, for those tests listed above, must be added to the Table on p.4. Please address.

Response: Please refer to the supplemental SAR report submitted on February 12, 2004.

OCCUPIED BANDWIDTH

CFR Part 2.1049, 22.917, 24.238

Measurement Procedure

The RF output port of the equipment under test is directly coupled to the input of the EMC analyzer through a specialized RF connector and a 10dB passive attenuator. The amplitude of the spectrum analyzer is corrected for the attenuator and any other applicable losses. The analyzer is set for Peak Detector and each trace is set for Max Hold. A fully charged battery was used for the supply voltage.

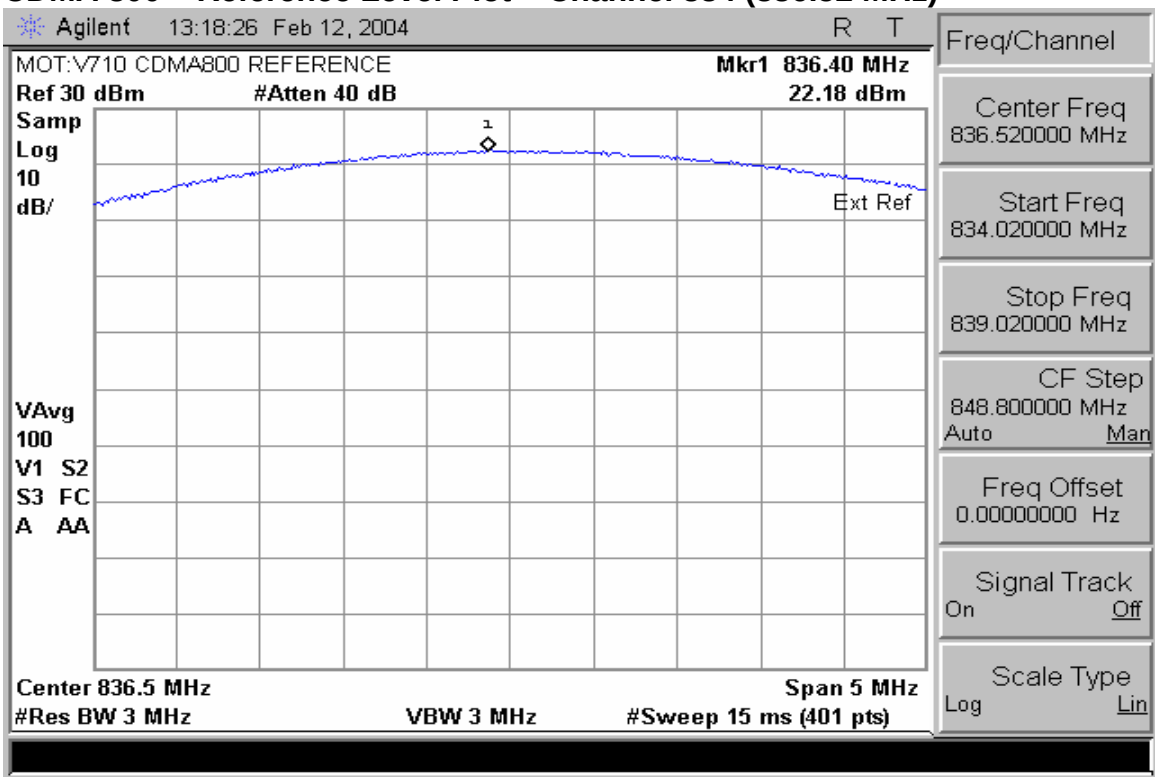
The middle channel within the designated frequency block was measured. For digital modulation, the lower and upper band edge plots are displayed.

Measurement Results

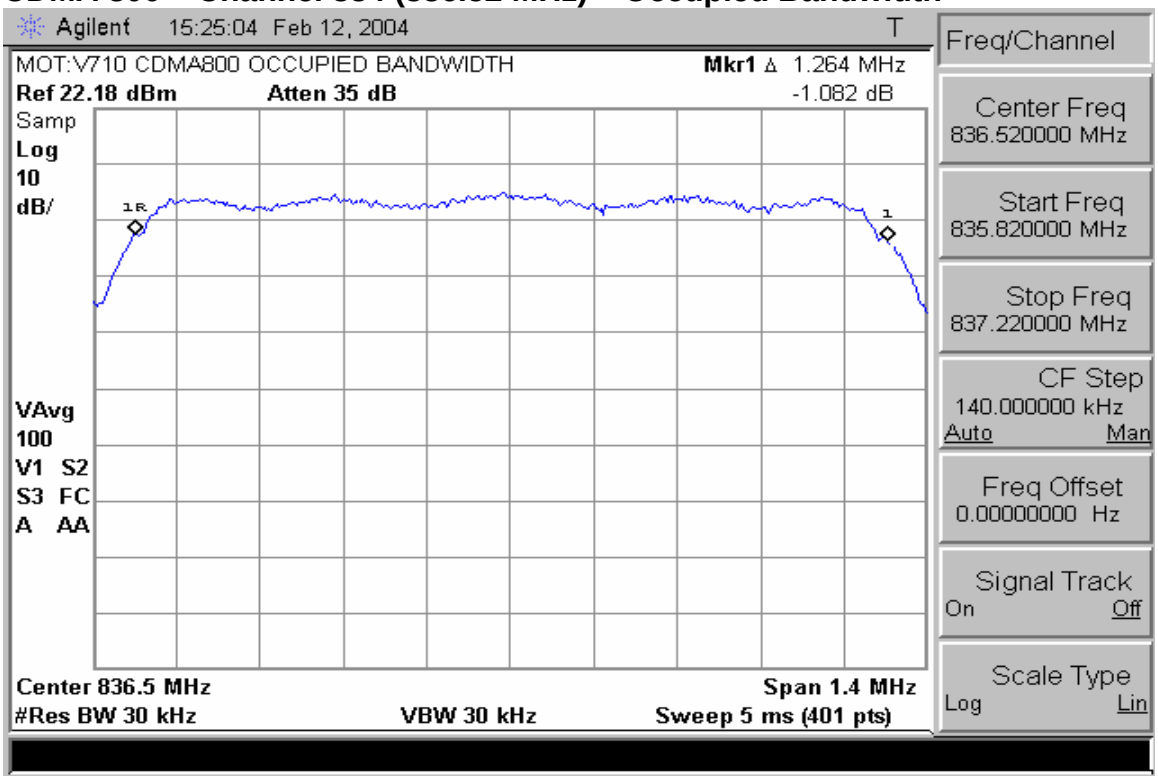
Attached

Measurement Results – CDMA 800

CDMA 800 – Reference Level Plot – Channel 384 (836.52 MHz)

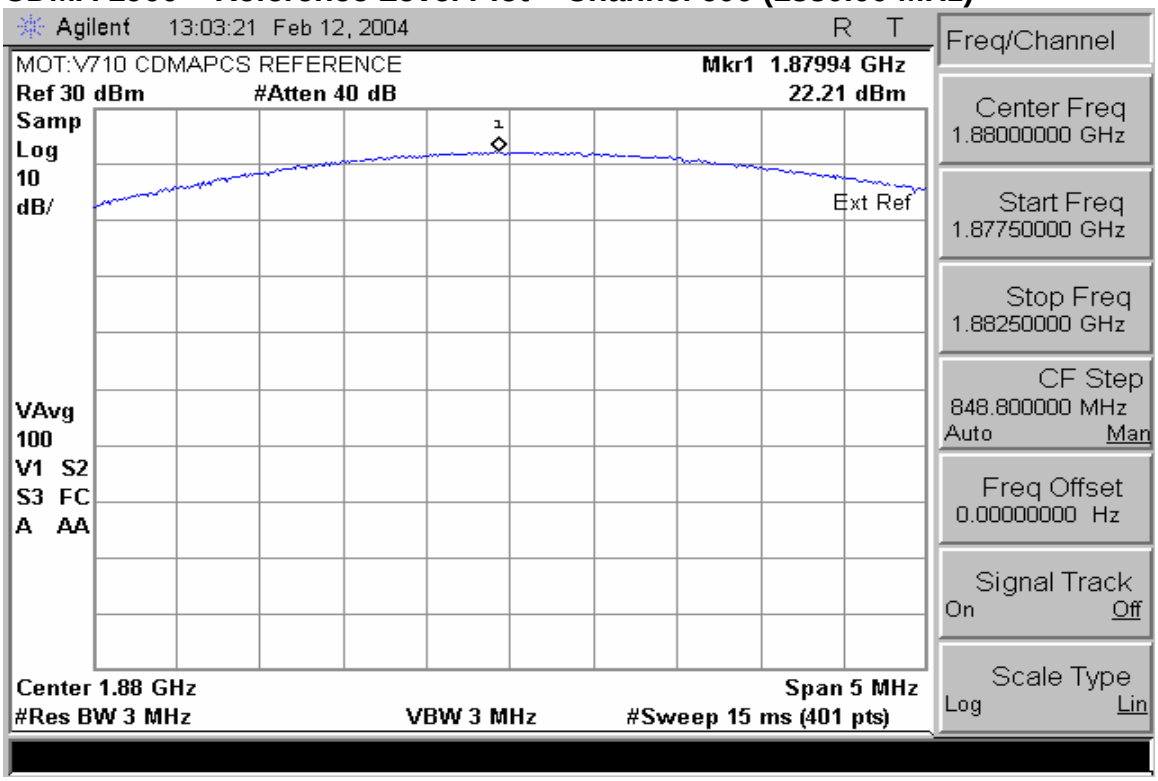


CDMA 800 – Channel 384 (836.52 MHz) – Occupied Bandwidth



Measurement Results – CDMA 1900

CDMA 1900 – Reference Level Plot – Channel 600 (1880.00 MHz)



CDMA 1900 – Channel 600 (1880.00 MHz) – Occupied Bandwidth