To: Joe Dichoso
From: Joyce Walker, CKC Laboratories, Inc.
Dave Fry, Intermec Technologies
Date: Oct. 20, 2001

Re: FCC ID EHAABTM3 Reply to request for technical information.
Applicant: Intermec Technologies Corporation
Correspondence Reference Number: 20883
731 Confirmation Number: EA102062

1) The second label should state "This device contains TX FCC ID: EHAABTM3"

Response:

A corrected label for the exterior of end products that use the ABTM3 radio has been sent to the FCC EAS system. The corrected label and information to OEM integrators will specify using the statement "Contains TX FCC ID: EHAABTM3"

2) The SAR test shows that the tissue parameter for Body SAAR is not within 5%.

Response:

Celltech has sent a letter in response to the SAR tissue parameters. The margin for compliance for the SAR is sufficient to tolerate a higher deviation for the tissue parameter. Celltech estimates 10% higher value of SAR if the tissue parameter is corrected. This letter is labeled Response FCC SAR inquiry. It is downloaded to the FCC EAS system.

3) The conducted output power must be measured or calculated from the field strength level at 3 meters. The conducted output power must be listed and placed on the grant.
1 mW was requested but this appears to be EIRP and the device may operate at a higher conducted output power, due to the antenna gain.

Response:

The conducted power as stated within the report is +10 dBm (0.01 watts). Please amend the 731 form as need to place the correct power rating on the FCC Grant. This radio will always use the antenna imbedded on the PC board therefore the power rating for EIRP was the power rating requested. This radio does not provide for the external connection of antennas or test equipment.

4) This Bluetooth transmitter is a Frequency Hopping Spread Spectrum(FHSS) transmitter in the data mode and a Hybrid transmitter in the acquisition mode.

Provide the following with regard to the device operating in the data mode(FHSS)

Section 15.247(a)1.

4A) Pseudorandom hop sequence. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudorandomly ordered list of hopping frequencies. Indicate how the pseudorandom hopping sequence is derived. Provide a list of channel frequencies and a sample of a few sequences.

Response:

Hopping sequence selection for a system is controlled by the master unit within a specific system. The sequence is selected by a combination of address codes and master unit system clock. The pseudo-random sequence is generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage with the result fed back to the input of the first stage. This produces a pseudo-random sequence length of 511 bits.

The following are two examples of possible 79 channel hopping sequences with channels identified as 1 through 79. The channel numbering scheme starts with channel 2 at 2402 MHz with the 79th channel then appearing at 2480 MHz as channel 80.

Sequence a:

2,17,68,55,4,77,56,27,70,80,22,33,57,34,29,79,44,50,3,71,66,36,78,20,67,30,24,11,37,69, 23,7,41,38,63,14,31,59,40,13,6,25,65,15,61,73,58,47,19,28,54,76,74,48,52,75,5,42,64,72, 62,51,60,18,45,53,16,39,46,32,49,43,8,21,9,12,10,26,35

Sequence b:

50,6,41,57,64,14,42,33,79,3,20,38,56,69,75,21,80,23,31,40,45,68,32,28,4,15,34,59,71,61, 70,5,72,13,48,70,39,54,78,7,77,62,30,2,8,55,10,63,12,16,37,11,43,66,25,51,58,74,17,47, 9,29,65,19,53,18,52,36,27,26,44,22,49,24,35,60,73,76,67

4B) Use of each frequency equally on average.

Each frequency must be used equally on the average by each transmitter. Except for voice systems, each new transmission may not start at the same point in the sequence or the frequencies will not be used equally used. Therefore, Describe where the next transmission starts when all frequencies are not used for a previous message. This is required because some transmissions may need only a few frequency hops to be completed. i.e. If the transmission started on the same frequency each time, this frequency would be used more than the others if many short transmissions were sent.

Response:

In data mode the system goes into a pseudo-random 79 channel hopping sequence for data transmission. The master unit system clock selects the pseudo-random sequence and all units within a specific system are synchronized to the same sequence. Since data transmission is not synchronized to initiate on any specific frequency, the random occurrences of request for such transmission and the indeterminate length of such transmissions insure that, on average, each frequency within a hopping sequence is equally used.

4C) Receiver matching bandwidth and synchronization.
Section 15.247(a)1 indicates that 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. Please explain how the device complies with this rule when a packet is repeated or when multiple packets are sent. What is the receiver input bandwidth? How does the receiver shift frequencies and determine which frequency to shift to in order to synchronize with this transmitter?

Response:

The receiver bandwidth is 1 MHz in the data mode. During connection establishment, the master identity and clock are transferred to the slave unit so it can synchronize to the channel. The master clock in a slave unit is obtained by adding an offset to the internal clock of the slave. Also see response 4A for details on the master clock and pseudo-random hopping channel selection.

Section 15.247(g)
4D) Compliance with all rules when short bursts are sent. How does the device comply with this requirement?

Response:

This is a repeat of the response in 4B. In data mode the system goes into a pseudo-random 79 channel hopping sequence for data transmission. The master unit system clock selects the pseudo-random sequence and all units within a specific system are synchronized to the same sequence. Since data transmission is not synchronized to initiate on any specific frequency, the random occurrences of request for such transmission and the indeterminate length of such transmissions insure that, on average, each frequency within a hopping sequence is equally used.

Section 15.247(h) Coordination requirement.
4E) The transmitter cannot coordinate its hopping sequence with the hopping sequence of other transmitters, or vice versa, for the purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters. Provide a description on how the device complies with this rule.

Response:

The operation of a Bluetooth system is to allow inquiry by units to join a piconet communication system. Only after the system is established will the units within a piconet coordinate its hopping sequence. In the connection (link) mode the module uses a pseudo-random hopping sequence of 79 channels controlled by the master clock (see response 4B). The master unit within a specific system controls hopping sequence selection for a system. The sequence is selected by a combination of address codes and master unit system clock. There are no provisions for coordination between various systems. Occasional loss of data frames due to collisions on a channel is handled by a retransmission, but the hopping goes on. Acknowledgement of received packets is used to support this feature.

Provide the following information with regard to the device operating in the page and inquiry mode under the Spread spectrum Hybrid requirements in Section 15.247(f) and Section 15.247(a)1.

Hybrid spread spectrum transmitters are authorized under Section 15.247(f) of the Rules. The technical requirements in that Section require:
4F) A minimum processing gain. The processing gain may be demonstrated as a combination of gain from the spreading/despreading function (using, for instance, a jamming margin test- see Section 15.247(e)(2)) and the gain from the hopping function, equal to 10log(number of hopping channels). A copy of the Processing gain measurement can be found at the end of the Rulemaking Order for DSSS transmitters and can be found at
www.fcc.gov/Bureaus/Engineering_Technology/Orders/1997/fcc97114.txt

Response:

Process Gain of the Bluetooth chip set used within this ALPS radio is provided by CSR. See the CSR Process Gain Memorandum in the Hybrid Mode Test Report downloaded to the FCC EAS system.

4G) An average time of channel occupancy limit.

Response:

"Page" and "Inquiry" modes operate by first hopping with 16 channels. This "Train A" sequence repeats every 10 mS. Every 1.28 seconds hopping frequencies change and a second Train A starts using different frequencies resulting in 128 transmissions on a frequency or channel. After a maximum of seven "Train A" sequences of 1.28 seconds, 16 new hopping channels is selected, "Train B". If a same frequency is used in both Train A and B, the resulting worst case conditions occur. First 7 x 1.28 x 10mS, the next 7 sequences with Train B, then with other frequencies. Calculating the results below.

1st 128 events x 7 Train A sequences x 10mS = 8.96 seconds
2nd 128 events x 7 Train B sequences x 10mS = 8.96 seconds
3rd series of events uses a different frequency for 8.96 seconds

Or 8.96 x 3 = total of 26.8 seconds

7 x 128 x 171uS, then 8.96 seconds other frequencies, + 7 x 128 x 171uS = .306 seconds within an average 30 second period considering the random selection of hopping sequences over time.

Plots of the inquiry/page mode channel occupancy are shown in the Hybrid Mode Test Report downloaded to the FCC EAS system.

4H) A power spectral density limit. The power spectral density limit is found in Section 15.247(d).

Response:

The power spectral density is measured and shown in Hybrid Mode Test Report downloaded to the FCC EAS system. The highest PSD observed in hybrid mode is –5.3 dBm

Please note that these hopping channels must also comply with the requirements set forth and described in Section 15.247(a)(1). The requirements are:
4I)A Minimum channel separation.

Response:

The channel separation is measured and included in the Hybrid Mode Test Report. The separation is 1 MHz.

4J) Pseudo-random hop sequence.

Response:

Sequence example a:

5,72,13,48,14,39,54,23,7,46,62,30,3,8,55,10,63,12,16,37,11,43,66,25,51,58,24,17,47, 9,29,65

Sequence example b:

41,38,63,14,31,59,40,13,6,25,65,15,61,67,58,47,19,28,54,55,8,48,52,11,5,42,64,17,62, 51,20,30

Response to explanation of derivation.

The pseudo-random sequence is generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage with the result fed back to the input of the first stage. This produces a pseudo-random sequence length of 31 bits for page and inquiry modes and provides for transition to a 51-bit pseudo-random sequence length for data mode of operation.

4K) Use of each frequency equally on average.

Response

The FHS (frequency hop selection) packet is transmitted by a sending unit. It contains UAP (upper address part)/LAP (lower address part) as well as clock information which is updated before retransmission in the inquiry state. When in hybrid substate, the UAP/LAP is used together with the clock to select the sequence. The output from the selection box constitutes a pseudo-random sequence covering 79 hops for US operation. For inquiry mode, the selection scheme chooses a segment of 32 hop frequencies from the 79 hops spanning about 64 MHz and visits these hops once in a random order. Next, a different 32-hop segment is chosen, etc. Refer to chapter 11 of the Bluetooth specification for a more through explanation of the hopping structure.

4L) Receiver matching bandwidth and synchronization.

Responses:

Receiver bandwidth:

The receiver bandwidth in hybrid mode (32 hopping channels) is equal to the receiver bandwidth in the 79 hopping channel mode that is 1 MHz.

Synchronization:

Synchronization within a piconet uses a system of beacon channels generated by the master unit with the remaining slave units periodically waking up and listening on a beacon channel. Beacon channels are designated by the master unit in page mode to identify channels for slave units to listen to. The beacon channel packet also contains the synchronization information required for the slave to sync with the master unit. In page mode the same 32-hop segment is used all the time and the segment is selected by the address with different units having different paging segments. Although they are referred to as beacon channels, they are designated as beacons only for purpose of assisting the listening function for establishing a connection. The master unit is continually hopping through all 32 channels in the page mode. When two Bluetooth devices establish contact for the first time, one of the devices is sending out an inquiry access code, and the other party is scanning for this inquiry access code. If the two devices have been connected previously, and want to start a new session, a similar procedure takes place. The only difference being that instead of the inquiry access code, an access code derived from the paged unit's address is used. If the two Bluetooth devices have exchanged information during the last five hours, the typical time it takes to establish the connection is reduced considerably due to the ability of the paging unit to estimate at what frequency the other unit will perform the page scan. For further information see chapter 10 of the Bluetooth specification.

The items indicated above must be submitted before processing can continue on the above referenced application. Failure to provide the requested information within 60 days of the original e-mail date may result in application dismissal pursuant to Section 2.917 (c) and forfeiture of the filing fee pursuant to section 1.1108.

DO NOT reply to this e-mail by using the Reply button. In order for your response to be processed expeditiously, you must upload your response via the Internet at www.fcc.gov, Electronic Filing, OET Equipment Authorization Electronic Filing. If the response is submitted through Add Attachments, in order to expedite processing, a message which informs the processing staff that a new exhibit has been submitted must also be submitted via Submit Correspondence. Also, please note that partial responses increase processing time and should not be submitted.

Any questions about the content of this correspondence should be directed to the e-mail address listed below the name of the sender.