EXHIBIT N –

REPLIES TO QUERIES RAISED DURING THE INITIAL TECHNICAL REVIEW.

From:	OET [oetech@fccsun07w.fcc.gov]
Sent:	07 May 2001 22:22
To:	mbe@csr.com
To:	Miguel Bravo-Escos, CSR
From:	Joe Dichoso jdichoso@fcc.gov FCC Application Processing Branch
Re:	FCC ID PIWBCES301199-1
Applicant:	Cambridge Silicon Radio Ltd
Correspondence Reference Number:	19155
731 Confirmation Number:	EA100258

a) Provide internal photo's of both sides of the RF module without any shielding.

Please refer to photographs – Module_Photos.pdf, submitted on 11th June 2001.

b) Provide photo's of the antenna.

Please refer to photographs – Antenna_Photos.pdf, submitted on 11th June 2001.

c) Indicate compliance with Section 15.203.

The EUT complies with Section 15.203 as the detachable antenna that it uses employs a unique antenna connector. The RSX connector used is only available from a single source, and therefore can be considered unique under FCC rules.

d) The test report indicates a maximum of 20 dBm with 1 dBi antenna. The measured output is 13.02 dBm. The RF safety calculations list 0 dBm with O dBi antenna. Please explain and correct all appropriate exhibits and calculations.

The calculations presented were erroneous in that they have used theoretical values for both antenna gain and power characteristics for a Class 2 Bluetooth device.

The correct figures should be as expressed on the test report – maximum 20 dBm with 1 dBi antenna. This results in the following update RF exposure compliance requirement.

Table 1 0f 47 CFR 1.1310 defines the maximum permissible exposure (MPE) for the general population as 1 mW/cm^2. The distance from the transmitting antenna where

the exposure level reaches the maximum permitted level is calculated using the equation:

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

Where: **S = Power density**
P = Power input to the antenna
G = linear power gain relative to an isotropic antenna
R = Distance to the centre of the radiation of the antenna

Solving for R, the limit is reached at approximately 2.8cm (0.15 feet) from the antenna. Therefore no warning labels, no RF exposure warnings in the manual or other protection measures are required for the Casira kit.

e) The dwell time in the report of the inquiry mode list 678 mS. This is not in compliance. Please explain.

The dwell time reported in test report 2000_1553.pdf on page 45 is clearly stated as 678 ms for 30 second occupancy time.

FCC part 15.247(f) which deals with Hybrid systems states that the following:

"The frequency hopping operation of the hybrid system, with the direct sequence operation turned off, shall have an average time of occupancy on any frequency not to exceed 0.4 seconds within a time period in seconds equal to the number of hopping frequencies employed multiplied by 0.4."

Thus the correct time period for Bluetooth hybrid operation with 32 hops is 0.4 x 32 = 12.8 seconds. Therefore the dwell time reported simply needs to be multiplied by 30/12.8.

Then, Average time of occupancy = .678 x 12.8/30 = 0.29 ms.

This value of 0.29ms is less than the 0.4ms limit stipulated by FCC part 15.247(f).

PLEASE ADDRESS THESE SPECIFICALLY.

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

Section 15.247(a)1.
1) 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.

The pseudorandom 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 first stage. This produces a pseudorandom sequence length of 31 bits for page and inquiry modes and provides for transition to a 511 bit pseudorandom sequence length for data mode of operation.

For connection state the inputs to the shift register are determined by the address and clock of the Master unit in the connection. The address is a unique 48 bit identifier for the unit, and the clock is a 27 bit counter. This is further described in Exhibit D Operational Description (Extracts from the Bluetooth Specification)

The following is the list of channel frequencies :-

Country	Frequency Range	RF Channels	
Europe & USA	2400-2483.5 MHz	f= 2402 + k MHz	k= 0,……,78

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 2402MHz and with channel the 79th at 2480MHz as channel 80.

Sequence one :-

3,18,69,56,5,78,57,28,71,81,23,34,58,35,30,1,45,51,4,72,67,37,79,21,68,31,25, 12,38,70,24,8,42,39,64,15,32,60,41,14,7,26,66,16,62,74,59,48,20,29,55,77,75,49, 53,76,6,43,65,73,63,52,61,19,46,54,17,40,47,33,50,44,9,22,10,13,11,27,34

Sequence two :-

49,5,40,56,63,13,41,32,78,2,19,37,55,68,74,20,79,22,30,39,44,67,31,27,3,14,33, 58,70,60,69,4,71,12,47,69,38,53,77,6,76,61,29,1,7,54,9,62,11,15,36,10,42,65,22, 50,57,73,16,46,8,28,64,18,52,17,51,35,26,25,43,21,48,23,34,59,72,75,66

2) 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.

The hopping sequence is unique for the connection and is determined by the address of the Master unit in the connection. The clock of the Master determines the phase in the hopping sequence. In any transmission where the whole sequence is not used, the next transmission will start at a random point in the sequence, solely determined solely by time elapsed on the Master clock. This means that in a series of short transmissions the starting frequency (within the fixed repeating sequence unique to the Master) of each transmission is determined by the Master clock, and will normally be different each time. In fact the hop frequency at a fixed time from the start of the connection will be the same whether there is one long transmission or a series of short transmissions. Therefore, on average a series of short transmissions at random times will occupy all channels equally, since the start frequency is determined solely by time elapsed. This is further described in Exhibit D Operational Description (Extracts from the Bluetooth Specification)

3) 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?

The receiver bandwidth (either in hybrid mode (32 hopping channels) or in the 79 hopping channel mode) is 1 MHz.

When a connection is made the Slave device receives information about the Master address and clock state. Periodically during the connection state the Master and Slave clocks are synchronised. The Slave therefore has the same information as the Master for determining the hop sequence and phase. The Master and Slave are therefore able to calculate separately the same hop sequences for their transmitters and receivers throughout the connection. Thus the receiver is able to track the transmitter hops and stay in synchronization.

The transmitter and receivers physically shift frequency by the baseband software controlling a Voltage Controlled Oscillator, which shifts frequency within the allowed channels.

If a packet is corrupted or not received it can be retransmitted, but it is treated as a new packet as far as the hopping sequence is concerned. That is the same hop frequency is not used, the next hop frequency in the sequence is used.

For packets that occupy more than one time slot (of 625 microseconds) the same frequency is used throughout the packet. However, for the reasons given above the hop frequency at the start of the next packet is purely related to elapsed time on the Master clock, so a sequence of multi-slot packets at random times will on average occupy all channels equally.

This is further described in Exhibit D Operational Description (Extracts from the Bluetooth Specification)

Section 15.247(g)

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

The answer to this is described in 2) above.

Section 15.247(h) Coordination requirement.
5) 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.

As explained on page 43 (Section 2.2) of the Bluetooth Specification (contained in Exhibit D Operational Description (Extracts from the Bluetooth Specification)), the hop sequence is generated independently by the Master from its Bluetooth Device Address, and the hopping sequence is determined by the Bluetooth clock of this same Master. As the Bluetooth Device Address is unique to a particular device, there is no mechanism for coordination of hop frequencies to avoid multiple occupancy. No Master unit has any freedom to vary the mechanism by which the hop sequence and phase is determined. The unit address is fixed during manufacture and the clock circuitry and hop sequence generation is performed in hardware, which cannot be controlled by the unit.

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.

6)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.

The pseudorandom 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 first stage. This produces a pseudorandom sequence length of 31 bits for page and inquiry modes and provides for transition to a 511 bit pseudorandom sequence length for data mode of operation.

In inquiry mode the same set of 32 frequencies randomly distributed within the 79 channels are used, but the start point in the sequence selected depends on the inquiring unit's clock.

In page mode a random set of 32 channels are chosen dependent on the address of the unit being paged, and the start point in the sequence selected depends on the paging unit's clock.

The following is the list of channel frequencies :-

Country	Frequency Range	RF Channels	
Europe & USA	2400-2483.5 MHz	f= 2402 + k MHz	k= 0,……,78

The following are two examples of possible 32 channel hopping sequences with channels identified as 1 through 32.

Sequence one :-

4,71,12,47,13,38,53,22,6,45,61,29,2,7,54,9,62,11,15,36,10,42,65,24,50,57,23,16,46,8,28,64

Sequence two :-

43,40,65,16,33,61,42,15,8,27,67,17,63,69,60,49,21,30,56,57,10,50,54,13,7,44,66,19,63,53,22,32

7) 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.

For inquiry mode, the selection scheme used a fixed segment of 32 hop frequencies from the 79 hops spanning about 64 MHz and visits these hops once in a random order. In any subsequent inquiry sequences, the same 32 hop segment is used, but each time a random starting point in the sequence is used dependent on the unit's clock. So for a unit making a series of short inquiry transmissions, each new transmission sequence starts at a random point in the fixed 32 hop sequence, so the inquiring device will on average occupy all of the 32 channels equally.

For page mode, the selection scheme chooses a random segment of 32 hop frequencies dependent on the address of the unit being paged, and visits these hops once in a random order. In any subsequent inquiry sequences to the same unit, the same 32 hop segment is used, but each time a random starting point in the sequence is used dependent on the unit's clock. In any subsequent inquiry sequences to a different unit a different random segment of 32 hop frequencies is selected. So for a unit making a series of short page transmissions, each new transmission sequence starts at a random point in the 32 hop sequence, so the paging device will on average occupy all of the 32 channels equally. Note that in practice this is unlikely to occur as the purpose of the paging mode is to enter connection state, when the unit operates in the full 79 hop sequence (FHSS mode).

8) 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?

The receiver bandwidth (either in hybrid mode (32 hopping channels) or in the 79 hopping channel mode) is 1 MHz.

The transmitter and receivers physically shift frequency by the baseband software controlling a Voltage Controlled Oscillator, which shifts frequency within the allowed channels.

There are no multi-slot packets in inquiry and page modes, and packets are not repeated.

The purpose of inquiry mode is to identify devices available for connection. The inquiring device enters inquiry transmit mode as described in 7) above. A unit

available to be identified will be in receive-only inquiry scan. Both operate on the same set of frequencies, but at the start of the process they are uncoordinated in frequency hop. When the scanning device receives a packet from the transmitting device it responds with a single packet on an offset frequency containing information about the device address and capabilities. From this information the inquiring device can choose to enter page mode in order to make a connection.

The purpose of page mode is to connect to another device. The paging device enters page transmit mode as described in 7) above. A unit available for connection must be in receive-only page scan. Both operate on the same set of frequencies, but at the start of the process they are uncoordinated in frequency hop. When the scanning device receives a packet from the transmitting device it responds with a single packet on an offset frequency containing information about the device address. The scanning device receives the information required to synchronize to the paging unit’s hop sequence in the first packet. There is one further exchange of packets on the now synchronized page hop sequence, and then both units move to the connected state (FHSS mode).