EXHIBIT NN - Response to Item #4

FCC ID O2Z-BT1

Summary of Additional Tests taken at Intel Santa Clara for Modular Approval Of Bluetooth transmitter in Response to FCC Email date 10/6/00

The following is a summary of responses to the referenced email from the FCC on 10/6/00 requesting additional tests to confirm emissions compliance for Intel's application O2Z-BT1 for modular approval of Bluetooth device with 4 antenna configurations. These responses below are in addition to the first set of tests completed at Northwest EMC on 9/27/00 described in the exhibit entitled "Summary of Additional Emissions Tests Taken at NW EMC Sept 25-27, 2000" also submitted as part of this package.

To respond to the items in this email, a series of tests were run in the RF laboratory at Intel Santa Clara. A description of the test setup and results may be found in Appendix A1 of this document.

Test#1. Connect an antenna to the straight microstrip (at resonant length) and compare the level at the fundamental to the level of the fundamental obtained in preliminary run #1 and run#2. (To demonstrate that the microstrip transmission line radiates minimally)

> Response: Table 1, Configuration 3a (wide straight microstrip connected to Antenna "B") produced a level of –49 dBm at the receive spectrum analyzer. When the antenna was replaced with a 50 ohm load (Configuration #4a), the level dropped to –65 dBm. This is a difference of 15 dB, or 32:1. Approximately 3% of the power is being radiated from the microstrip in this configuration.
>
> Table 1, Configuration 3b (narrow microstrip connected to Antenna "B") produced a level of –54 dBm at spectrum analyzer #2. When the antenna was replaced with a 50 ohm load (Configuration 4b), the level dropped to –80 dBm. This is a difference of 26 dB, nearly 400:1. Less than .3% of the power is being radiated from the microstrip in this configuration.
>
> In either configuration, 97% or more of the fundamental power from the source is being radiated by the antenna. Based on these tests, the transmission line is a minimal source of radiation.

Test#2. Compare field strength levels of the fundamental with and without a coaxial cable connected to the straight microstrip line. Any antenna can be used. (To demonstrate that the coax connected to the microstrip radiates minimally.)

> Response: From above, Configuration 3a (wide microstrip connected to Antenna "B") produced a level of –49 dBm at the receiver. Configuration 5a (wide microstrip + coax + antenna "B") produced a level of –50 dBm at the receiver. The difference in levels is 1 dB. In an independent test (Configuration 7b) the loss of the coax was found to be approximately 1 dB (0.89 dB in the measurement). This loss accounts for the difference in levels seen for these two configurations. In another independent test (Table 1, Configuration 6) a 50 ohm termination was connected to the end of just coax. The received signal was in the noise (<-90 dBm) of the spectrum analyzer. The conclusion is that there is no radiation coming from the coax, but that the differences in emission levels with and antenna are a result of the 1 dB loss of the coax.
>
> The same test was done comparing Configuration 3b (narrow microstrip connected to Antenna "B) with Configuration 5b (narrow microstrip + coax + antenna "B") . Configuration #3b produced a level of –54 dBm; Configuration #5b produced a level of –55 dBm. The difference of 1 dB is again the loss of the coax. Again there is no radiation from the coax. The difference is a result of the loss of the coax.

Test#3 (a) and (b). Remains the same as previously requested but submit data only on the fundamental frequency but make sure there are no spurious emissions with a prescan

Response: The purpose of tests 3(a) and (b) were to measure any differences in spurious or radiated emissions using straight and meandered microstrip, wide and narrow lines. In the previous tests (See document entitled Summary of Additional Emissions Tests Taken at NW EMC Sept 25-27, 2000), a full set of emissions tests were conducted on the wide straight microstrip + antenna "B" (highest gain, "worst case"), and on a wide meandered microstrip line + antenna "B" and on antenna "B" alone (See accompanying report). No radio generated spurious emissions were seen on any of these configurations.

To test the fundamental, the following levels (See Table 1) were compared: Note: Level of antenna "B" alone is –44 dBm

1) Wide straight microstrip + Antenna "B"(Configuration 3a). Level at receiver = - 49 dBm
2) Narrow straight microstrip + Antenna "B" (Configuration 3b) Level at receiver = - 53 dBm
3) Wide meandered microstrip + Antenna "B" (Configuration 3c). Level at receiver = -47 dBm
4) Narrow meandered microstrip + Antenna "B" (Configuration 3d). Level at receiver = - 53 dBm

The above measurements indicated no increase in emissions as a result of using any of the above configurations. The narrow lines have more loss (at least 2.5dB), consequently lowering the levels of emissions at the fundamental. The "worst case" level of emission is Antenna "B" (highest gain) with shortest transmission line (in this case 0.5 inches).

Test#4 This test was covered by the preliminary test. Intel should confirm that the minimum connection is with a 0.5 inch coax.

Response: This minimum length was confirmed at 0.5 inch.

Test #5 Test the other three antennas in the worst case configuration but only on the fundamental frequency.

Response: The above measurements concluded that the worst case (highest emission) is the operation of the module with the highest gain antenna (Antenna "B") and shortest antenna interconnect (0.5 inch coax)

Measurement of the fundamental with each of the 4 antennas (summarized in Table 3) are shown below.

1) Antenna "A" (reference dipole) = -41 dBm
2) Antenna "B" = -44 dBm
3) Antenna "C" = -45 dBm
4) Antenna "D" = -45.5 dBm
5) Antenna "E" = -47 dBm

Full frequency tests for spurious emissions have already been conducted on all five of these antennas at Northwest EMC Laboratories. However, a two inch piece of coax was used at each antenna. Since no detectable RF spurious emissions were found, and the fact that the difference in loss between a 0.5 inch coax and a 2.0 inch piece of coax is less than 0.2 dB (based on information from the coax supplier), we can conclude that the 0.5 inch configuration should meet compliance requirements.

Finally, you had sent me an e-mail including the option of "sandwiching" the microstrip line between two ground planes. Since you did not include any mention of it or testing in this configuration in the preliminary tests. I am assuming that this is no longer an option.

Stripline is desired for this implementation. The following configurations and test results were tested (See Table 4).

Configuration :

1) Wide straight stripline + Antenna “B” (Configuration 9a). Level at receive S/A #2 = -45 dBm
2) Wide meandered stripline + Antenna “B” (Configuration 9b). Level at receive S/A #2 = -44 dBm
3) Narrow straight stripline + Antenna “B” (Configuration 9c). Level at receive S/A #2 = -47 dBm
4) Narrow meandered stripline + Antenna “B” (Configuration 9d). Level at receive S/A #2 = -46 dBm
5) Wide/narrow/straight/meandered stripline + 50 ohm load (Configuration 9e). Level at receive S/A #2 < -90 dBm

Differences in emission levels between straight and meandered stripline correlate with insertion loss measurements (See Table 5). Emissions were at no time higher than the worst case (Antenna “B” + 0.5 inch coax) configuration. As in the case of microstrip, narrow conductor stripline had more loss than wide conductor. Residual emissions from stripline (when terminated with a 50 ohm load) were better than microstrip due to the presence of both a bottom and top ground plane.

Appendix A1
Test Setup and Results for Additional Emissions Tests

The purpose of these tests was to measure the level of emissions at the fundamental frequency at the transmitter. Levels of emissions with several different transmission line interconnect configurations were to be measured to determine if emissions coming from the interconnect would be of concern.

To perform these tests, two spectrum analyzers with tracking generators were used. The first (using the tracking generator option) was set to transmit at 2.45 GHz. The second, approximately 20 feet away, was used as the receiver. The transmit power of the first spectrum analyzer was set to approximately +3dBm. A 2.4 GHz dipole (Called Antenna "A" in this submittal) was connected to the second spectrum analyzer in a vertically polarized configuration. **Figure 1** illustrates this setup. All antenna/microstrip orientations below were done using vertical polarization. At all times during testing antennas/transmission lines were rotated manually to produced the highest level of emission. Peak hold measurements were taken for each measurement (See example trace in **Figure 2** of this document). All lengths of microstrip, coax, and stripline were designed for 816.66 Mhz (F0/3) per FCC request.

A pictorial with a summary of the test configurations is shown below:

Results of the tests were as follows:

Table 1
Emission Levels with Antennas or 50 ohm load

Configuration at Transmit (Tracking generator)	**Level at receiver (Spec. Anal.)**
1. Initial test: Reference dipole (Antenna “A”)	-41 dBm
2. Antenna "B" only (0.5” coax)	-44 dBm
3. a) Wide straight microstrip + Antenna “B”	-49 dBm
b) Narrow straight microstrip + Antenna “B”	-54 dBm
c) Wide meandered microstrip	-47 dBm
d) Narrow meandered microstrip	-53 dBm
4. a) Wide straight microstrip + 50 ohm load	-65 dBm
b) Narrow straight microstrip + 50 ohm load	-80 dBm
5. a) Wide straight microstrip + coax + Antenna “B”	-50 dBm
b) Narrow straight microstrip + coax + Antenna “B”	-55 dBm
6. Coax + 50 ohm load	<-90 dBm

Table 2
Insertion Loss of coax and Microstrip

Configuration S/A#1 to S/A#2	**Level at S/A #2**	**Insertion Loss**
7. a) Coax + SMA barrel + coax (to establish reference)	-0.46 dBm	N/a
b) Coax + SMA barrel **+ coax** + SMA barrel + coax	-1.35 dBm	0.89 dB
c) Coax + **wide straight microstrip** + coax	-5.8 dBm	5.34 dB
d) Coax + **narrow straight microstrip** + coax	-9.35 dBm	8.89 dB

Table 3
Emissions of other Antennas with Shortest Coax (0.5”)

Configuration at Transmit (Tracking generator)	**Level at receiver (Spec. Anal.)**
8. a) Antenna “A” (reference, no coax)	-41 dBm
b) Antenna “B”	-44 dBm
c) Antenna “C”	-45 dBm
d) Antenna “D”	-45.5 dBm
e) Antenna “E”	-47 dBm

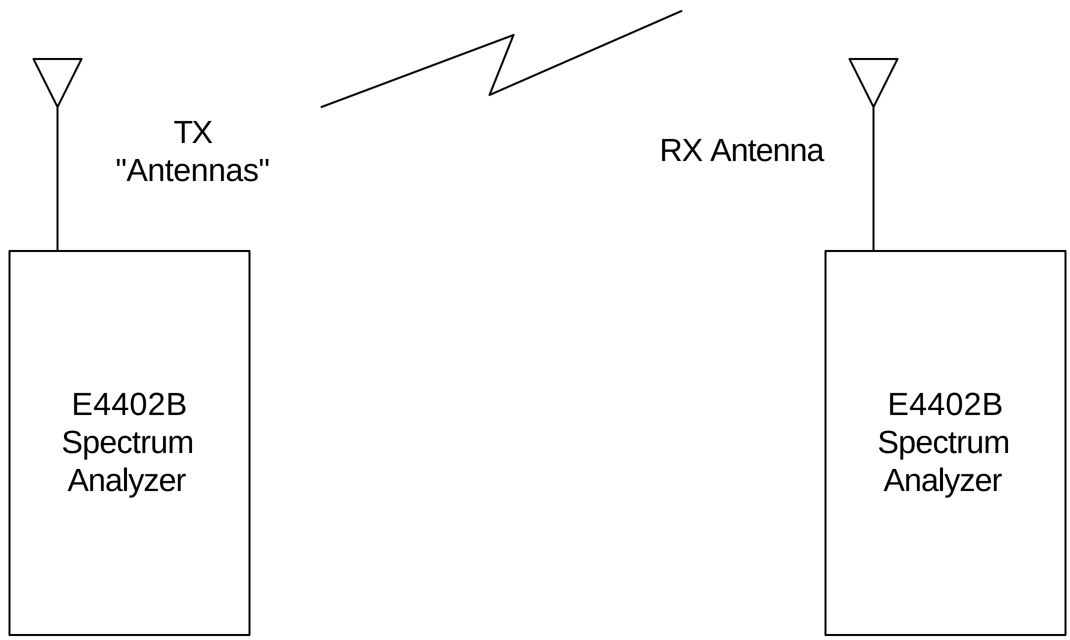
Table 4
Stripline Tests (Emissions)

Configuration at Transmit (Tracking generator)	**Level at receiver (Spec. Anal.)**
9. a) Wide straight stripline + Antenna "B"	-45 dBm
b) Wide meandered stripline + Antenna "B"	-44 dBm
c) Narrow straight stripline + Antenna "B"	-47 dBm
d) Narrow meandered stripline + Antenna "B"	-46 dBm
e) Wide/narrow/straight/meandered stripline + 50 ohm load	<-90 dBm

Table 5
Insertion Loss of Stripline

Configuration S/A#1 to S/A#2	**Level at S/A #2**	**Insertion Loss**
7. a) Coax + SMA barrel + coax (to establish reference)	-0.46 dBm	N/a
b) Coax + **wide straight stripline** + coax	-3.12 dBm	2.66 dB
c) Coax + **wide meandered stripline** + coax	-3.04 dBm	2.58 dB
d) Coax + **narrow straight stripline** + coax	-5.5 dBm	5.04 dB
e) Coax + **narrow meandered stripline** + coax	-4.96 dBm	4.5 dB

Figure 1
Basic Measurement Setup



Measurements taken:

1) **Reference Dipole**
2) **Antenna “B” only**
3) **Microstrip + Antenna “B”**
4) **Microstrip + 50 ohm load**
5) **Microstrip + coax + Antenna “B”**
6) **Coax + 50 ohm load**
7) **Insertion loss measurements (Microstrip)**
8) **Antennas “C”, “D”, “E” in “worst case” configuration**
9) **Stripline +Antenna “B” tests**
10) **Stripline Insertion loss measurements**

Figure 2 Example of Signal Level Measurement (Straight wide Microstrip + Antenna "B")