American Telecommunications Certification Body Inc.
6731 Whittier Ave, McLean, VA 22101

May 26, 2003

RE: Zebra Technologies FCC ID: I28MD-BTC2TY

I have a few comments on the above referenced Application.

1) The top view of the Bluetooth board without the shield shown in the internal photographs is too dark. Please provide a better photograph. Additionally, please provide clear top and bottom views of the Bluetooth module itself (with and without shield as applicable).

Response: Please refer to the revised Internal and External Photograph exhibits uploaded with this response.

2) The theory of operation mentions that the Bluetooth module is a class 2 Bluetooth device with a 0 dBm output. Note that a typical Class 2 Bluetooth are typically considered to have a +4 dBm output. Please explain.

Response: Please refer to the attestation letter uploaded with this response.

3) RF exposure takes into consideration both conducted and EIRP power. Therefore, please update the RF exposure information to include the worse case power (EIRP) by including the highest antenna gain as well.

Response: Please refer to the revised RF Exposure exhibit uploaded with this response.

4) Please provide a close up photograph of a typical tested configuration showing the standalone portion as tested. Note that from the photos provided, it can not be determined if the device and antenna were both tested as a standalone, if one portion such as the antenna was contained within an actual device, or if the end use device was fully configured or only the "shell" of a device was present to hold the antenna, etc. Information regarding the internal construction of the end use device and any justification vs. stand-alone testing should also be provided. Note that loading conditions due to close proximity of components, shields, etc. from device to device can vary therefore affecting the spurious emissions results. In order to characterize a device and its antennas for a modular approval for use in a variety of devices, it is desirable to see its characteristics in a stand-alone condition. Normally both the device and its antennas should be tested as a standalone configuration. Given that this approval is specific to Zebra devices, we can accept an explanation regarding the positioning of the antennas for a Limited Modular Approval specific to Zebra devices if adequate information regarding the configuration tested and how it is relevant to all future configurations can be provided.

Response: Please note that this is a limited modular approval application as stated in section 1.3 on page 6 of the test report. The Bluetooth module and antennas were tested in a stand-alone configuration. Specifically, the Bluetooth module was not housed in any enclosure. The antennas were contained in typical end-use enclosures to account for any effect the enclosure would have on emissions from the antennas. An antenna cable was run outside of the end-use enclosures and connected to the standalone Bluetooth module. The end-use enclosures are typical of future housings for the antennas contained in this application. Please refer to the revised Test Configuration Photographs exhibit uploaded with this response.

5) Information regarding conducted emissions was not provided. Can any device this is intended to be installed within work while powered from 120 VAC, or are these adapters only used to charge the device, etc? Additionally, will all such future devices only be battery powered as well and how can this be assured? Note that if conducted emissions results are not provided the grant notes will include the following or similar: "This device may only be used in battery powered devices which do not have any provision for operation while connected to the AC power lines".

Response: Please refer to the conducted emissions data in the revised test report uploaded with this response.

6) The limits on page 42 do not appear to match the limits specified on that page. Please correct.

Response: Please refer to the revised test report uploaded with this response.

7) Spurious emissions are required to be tested for a typical low, middle, and high channel, but the results of harmonics appear to only be provided for the middle channel. Please explain.

Response: The low and high channels were investigated. An engineering justification was made as follows: As shown in the RF exposure exhibit, the average gains for the various antennas are seen to be below the maximum gains measured. These gains represent measurements within the band for which it was designed; it would lack efficiency at the second through fourth harmonics to 10 GHz as compared to those frequencies (78 MHz) within the band. All other frequencies measured were seen as noise floor measurements. The only frequency which is found to be within 20 dB of the limit is the third harmonic, of which the margin was found to be within 20 dB since it falls within the restricted band, and subsequently the 54 dBuV margin is 20 dB higher than the non-restricted band. A comparison of conducted antenna emissions between channels shows small variance; this coupled with low center channel measurements can be used to justify center channel measurements as indicative of those that could be found for out-of-band emissions. This justification, as compared to the time requirements for additional measurements, (6 antennas x 2 additional channels x 9 harmonics = 108 additional measurements in three orthogonal positions) to provide certification in a timely manner mitigated the avidity for center channel measurement.

8) FYI. 6 dB bandwidth tests are not necessary for this type of device.

Response: Noted, thank you.

9) FYI. Note that power spectral density tests are normally required for Bluetooth submissions. However, given that the maximum power of this device is less than the limit for spectral density, further information is not necessary for this particular application.

Response: Noted, thank you.

Timothy R. Johnson
Examining Engineer
mailto: tjohnson@AmericanTCB.com
The items indicated above must be submitted before processing can continue on the above referenced application. Failure to provide the requested information may result in application termination. Correspondence should be considered part of the permanent submission and may be viewed from the Internet after a Grant of Equipment Authorization is issued.