a. The complete program of research and experimentation proposed including description of equipment and theory of operation.

General Description

A low power and small form factor transmitter and receiver device is being developed for potential use by athletes in order to monitor their activities while using the device. The device uses the Dialog Semiconductor DA14531 Bluetooth 5 System on Chip for RF communication while using low power physical sensors (acceleration, temperature, etc.) to obtain information about the athlete and their activity. The sensor enabled device then transmits this data to a connected Bluetooth capable device where the data can be evaluated. The sensor device will be capable of receiving instructions from that connected device to change the sampling rate of its sensors or other operational parameters.

Equipment Specifications

The transceiver hardware has a maximum capable transmitting power of +3.5 dBm operating within the 2.400-2.4835GHz ISM frequency bands using Bluetooth LE technology. The device has been independently tested to be compliant with FCC Part 15.247 by CTC Advanced GmbH. During use, the device will be operating at an average transmitting power of 50 microwatts (-13 dBm) by transmitting sensor data intermittently at an output power no greater than +3.5dBm, limited in hardware. But the transmission power will likely be much lower, limited in software to reduce power consumption to the lowest level without deterioration of the signal. The device is currently designed to have a total average power consumption of 5mW. The device is less than 25 grams in mass and smaller than a US quarter.

Electro-Magnetic Compliance (EMC) Considerations

Good mechanical and EMC practices have been used throughout and EMC is the leading consideration in the design of the device. Appropriate pre-compliance testing will be performed on prototypes initially with test equipment up to 6 GHz. After approximately 9 months of iterating designs, the prototypes will be pre-compliance tested up to the 10th harmonic of the transmitter, at 25 GHz for more rigorous pre-compliance testing. It is not convenient to test initial prototypes for compliance at these higher frequencies due to availability of test equipment. But test equipment which can measure up to 25 GHz can be attained and these tests can be performed if deemed to be necessary by the commision in order to obtain an experimental license.

Experimental Locations

The test environments are isolated such that there will be approximately 100 meter diameter zones with a limited amount of equipment which could be affected by spurious emissions in the event of a catastrophic hardware failure. Additionally, no life-critical systems are present in the test environments. The location of the potential test environments are scattered across the University of Minnesota athletics facilities in Minneapolis, Minnesota. If deemed appropriate by the commission, more remote sites can be selected to more severely limit potential interference caused by catastrophic hardware failures.

b. The specific objectives sought to be accomplished.

The purpose of attaining this experimental license is in order to legally conduct tests of athletes interacting with prototypes of the device in order to determine ways to revise the design and functionality of the device. This will be after performing the appropriate pre-compliance testing, but before performing official EMC testing, in order to finalize the design before official certification.

c. How the program of experimentation has a reasonable promise of contribution to the development, extension, expansion or utilization of the radio art, or is along line not already investigated.

To date, no device of such size has been produced with the ability to remotely provide the sensor data this device is capable of. The ability to attain the sensor data in a small form factor would prevent affecting the athlete's motions. Wired approaches not utilizing RF transmission techniques could physically alter the athletes' activity leading to exaggerated movements and even potential injury. But even currently available wireless devices have not attempted to design such a device with the form factor I have achieved.