5. Theory of Operation/Technical Description

The Intelli-Connect earpiece is designed to operate as a wireless remote accessory device for the H200W hand rehabilitation system. It is designed to give patients with upper extremity problems (such as reduced hand function), the ability to control the opeining and closing of their hands with the aid of their teeth clicks. The Intelli-Connect earpiece can detect small vibrations caused by teeth clicks. When the Intelli-Connect Earpiece is correctly placed behind the ear and its vibration detection sensor (a digital accelerometer embedded in silicone material) makes a contact with the Tragus part of the ear, the unit can dtetct teeth clicks and relay this information to a remote H200W Orthosis unit using an RF radio. All the sensors thatare necessary to detect teeth click, as well as the radio unit that is used to send the information over an RF channel, are contained in the plastic enclosure of the Earpiece.

The transducer that is used to detect teeth-clicking is a three axes linear digital accelerometer manufactured by STMicroelectronics. Teeth clicking creates vibrations in the jaw bone which are detected by the accelerometer as tiny accelerations in three axes. The accelerometer continually samples the accelerations and stores the data for three axes in its internal memory. Once its internal memory is full, the data is transferred to the microprocessor for processing. The algorithm running on the IC Earpiece then decide if a valid teeth clicking event has occurred or not.

The unit consists of the following units:

- Intelli-Connect Earpiece
- Intelli-Connect Charge Cradle
- Intelli-Connect W cable

The trigger requests are send in the form of RF packets using FSK modulation with a data rate of 250 kbps. The packet duration is 0.7 ms. When Earpiece needs to transmit a trigger request, it first listens for packets from the Orthosis unit. It transmits only after a successful reception of a packet from the Orthosis unit.

When Earpiece is put into the charge cradle it enters to the charging mode. Charging mode concludes when the earpiece is fully charged.

The Earpiece circuit consists of the following units.

1-Power Management – consists of lithium Ion battery which supplies the power for the device.
   Fuel Gauge IC, monitors the battery capacity and reports to the microprocessors.
   Charger IC which manages the charging process.
2-The Tooth click detection unit which consist of digital accelerometers and the algorithms running on the primary microprocessor unit.
3-The RF packet transport unit, consists of CC2500 transceiver and CC2590 PA.
4-UI section which is composed of an LED and a buzzer.