Descrition how the EUT meets the definition of a frequency hopping spread spectrum system.

Bluetooth is a hybrid system that employs a combination of both direct sequence and frequency hopping modulation techniques. In data mode (FHSS) 79 hopping frequencies are used and in inquiry/paging mode (DSSS) 32 hopping frequencies are used.

The Bluetooth baseband and RF IC (BlueMoon Single) has been qualified according the Bluetooth specification.

This specification is based on the established regulations for Europe, Japan and North America.

For the USA:

Approval Standards: Federal Communications Commission, FCC, USA

Documents: CFR47, Part 15, Sections 15.205, 15.209, 15.247

Description how the hopping sequence is generated. Provide an example of the hopping sequence channels, in order to demonstrate that the sequence meets the requirement specified in the definition of a frequency hopping spread spectrum system.

The frequency at a time instant is calculated by the frequency hopping algorithm.

The generation of the hopping sequence in connection mode depends essentially on two input values:

1. LAP/UAP of the master of the connection
2. Internal master clock

The LAP (lower address part) are the 24 LSB's of the 48 BD_ADDRESS. The BD_ADDRESS is an unambiguous number of every Bluetooth unit. The UAP (upper address part) are the 24 MSB's of the 48 BD_ADDRESS.

The internal clock of a Bluetooth unit is derived from a free running clock which is never adjusted and is never turned off. For synchronisation with other units only offsets are used. It has no relation to the time of the day. Its resolution is at least half the RX/TX slot length of 312.5 µs. The clock has a cycle of about one day (23h30). In most case it is implemented as 28 bit counter. For the deriving of the hopping sequence the entire LAP (24 bits), 4 LSB's (4 bits) (Input 1) and the 27 MSB's of the clock (Input 2) are used. With this input values different mathematical procedures (permutations, additions, XOR-operations) are performed to generate the sequence. This will be done at the beginning of every new transmission.

Regarding short transmissions the Bluetooth system has the following behaviour:

The first connection between the two devices is established, a hopping sequence was generated. For transmitting the wanted data the complete hopping sequence was not used. The connection ended. The second connection will be established. A new hopping sequence is generated. Due to the fact that the Bluetooth clock has a different value, because the period between the two transmission is longer (and it cannot be shorter) than the minimum resolution of the clock (312.5 µs). The hopping sequence will always differ from the first one.

The hopping kernel of the Bluetooth baseband and RF IC (BlueMoon Single) has been tested to produce the exact sample data given the Bluetooth Core Specification 1.1 in Appendix IV, section 2. BlueMoon Single has passed all tests for Bluetooth compliance and therefore fulfils all the requirements for a Bluetooth wireless system.

Description how each individual EUT meets the requirement that each of its hopping channels is used equally on average (e.g., that each new transmission event begins on the next channel in the hopping sequence after the final channel used in the previous transmission event).

The Bluetooth baseband and RF IC (BlueMoon Single) is manufactured in mass production using the same productions masks that are used for the engineering samples of the IC, which has been qualified for Bluetooth.

Description how the associated receiver(s) complies with the requirement that its input bandwidth (either RF or IF) matches the bandwidth of the transmitted signal.

The receiver fully fulfills the Bluetooth requirements (certified by Bluetooth acceptance tests) which are inline with the FCC rules. The input bandwidth of the receiver is set by the bandwidth of the channel filter which is 1 MHz and this is internally trimmed with Crystal accuracy. The transmit bandwidth is also limited

to 1MHz by the data rate and the Gaussian shaping of the modulated signal.

Description how the associated receiver(s) has the ability to shift frequencies in synchronization with the transmitted signals.

Bluetooth units which want to communicate with each other must be organised in a structure called piconet. This piconet consist of max. 8 Bluetooth units. One unit is the master the other seven are the slaves. When two Bluetooth devices establish contact for the first time, one device sends an inquiry access code, the other device is scanning for this inquiry access code. If two devices have been connected previously and want to start a new transmission, a similar procedure takes place. The only difference is, instead of the inquiry access code, a special access code, derived from the BD_ADDRESS of the paged device, will be sent by the master of this connection.

Due to the fact that both units have been connected before (in the inquiry procedure) the paging unit has timing and frequency information about the page scan of the paged unit. During the connection the master coordinates to shift frequencies.

The received signal is downconverted to an IF of 1MHz. The synthesizer PLL is programmed in front of every received slot to settle on the required channel with 1 MHz offset to the received signal frequency. The channel frequency is determined by the Bluetooth hopping scheme, which is inline with the FCC rules.