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Additional declaration part according to FCC 15.247 for Bluetooth[TM] devices

1. Output power and channel separation of a Bluetooth device in different operating modes

The different operating modes (data mode, acquisition mode) of a Bluetooth device don't influence the output power and the channel spacing. There is only one transmitter which is driven by identical input parameters concerning these two parameters.
Only a different hopping sequence will be used.
For this reason the check of these RF parameters in one operating mode is sufficient.

2. Frequency range of a Bluetooth device

Hereby we declare that the maximum frequency of this device is : 2402 – 2480 MHz. This is according to Bluetooth Core Specifications (+ critical errata) for devices which will be operated in the USA.
This was checked during the Bluetooth Qualification tests (Test Case: TRM/CA/04-E).
Other frequency ranges (e.g. Spain, France, Japan) which are allowed according the Core Specification are not supported by this device.

3. Co-ordination of the hopping sequence in data mode to avoid simultaneous occupancy by multiple transmitters

Bluetooth units, which want to communicate with other units must be organised in a structure called piconet. This piconet consists of max. 8 Bluetooth units. One unit is the master and the other seven are slaves. The master co-ordinates the frequency occupation in this piconet for all units. As the master hop sequence is derived from this BD address which is unique for each Bluetooth device, additional masters intending to establish new piconets will always use different hop sequences.

4. Examples of hopping sequences

Example of a 79 hopping sequence in data mode:
40, 21, 44, 23, 42, 53, 46, 55, 48, 33, 52, 35, 50, 65,
54, 67, 56, 37, 60, 39, 58, 69, 62, 71, 64, 25, 68, 27,
66, 57, 70, 59, 72, 29, 76, 31, 74, 61, 78, 63, 01, 41,
05, 43, 03, 73, 07, 75, 09, 45, 13, 47, 11, 77, 15, 00,
64, 49, 66, 53, 68, 02, 70, 06, 01, 51, 03, 55, 05, 04

5. Equally average use of frequencies in data mode and behaviour for short transmissions

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_ADRESS. The BD_ADRESS is an unambiguous number of every Bluetooth unit. UAP (upper address part) are the 24 MSB´s of the 48 BD_ADRESS.

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 offset are used. It has no relation to 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 a 28 bit counter. For the deriving of the hopping sequence the entire LAP (24 bits), 4 LSB´s (4 bits) (Input1) and the 27 MSB´s of the clock (Input2) are used. With this input values different mathematic 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 established, a hopping sequence was generated. For transmitting the wanted data the complete sequence was not use. 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 transmissions is longer (and cannot be shorter) than the minimum resolution of the clock (312.5µs). The hopping sequence will always differ from the first one.

6. The receiver input bandwidth and behaviour for repeated single and multiple packets

The input bandwidth of the receiver is 1 MHz.
In every connection one Bluetooth device is the master and the other one is the slave. The master determines the hopping sequence (see Clause 5.). The slave follows this sequence. Both devices shift between RX and TX time slot according to the clock of the master.
Additionally the type of connection (e.g. single or multislot packet) is set up at the beginning of the connection. The master adapts its hopping frequency and its TX/RX timing according to the packet type of the connection. Also the slave of the connection will use these settings.
Repeating of a packet has no influence on the hopping sequence. The hopping sequence generated by the master of the connection will be followed in any case. That means, a repeated packet will not be send on the same frequency, it is send on the next frequency of the hopping sequence.

7. Dwell time in data mode

The dwell time of the 0.3797 s with in a 30 second period in data mode is independent from the packet tape (packet length). The calculation for a 30 second period is a follows:

Dwell time = time slot length * hop rate / number of hopping channels * 30 s
Dwell time = 625 µs * 1600 1/s / 79 * 30 s = 0.3797 s (in a 30 s period)

For multislot packet the hopping is reduced according to the length of the packet.
Example for a DH5 packet (with a maximum length of 5 timeslots)
Dwell time = 5 * 625 µs * 1600 1/5 * 1/s / 79 * 30 s = 0.3797 s (in a 30 s period)

This is according the Bluetooth Core Specifications V 1.0B (+critical errata) for all Bluetooth devices. Therefore all Bluetooth devices comply with the FCC dwell time requirement in data mode.
This was checked during the Bluetooth Qualification tests.

The dwell time in hybrid mode is measured and stated in the test report.

8. Channel separation in hybrid mode

The nominal channel spacing of the Bluetooth system is 1 MHz independent of the operating mode.
The maximum “initial frequency tolerance“, which is allowed for Bluetooth is fcenter = 75 kHz.
This was checked during the Bluetooth Qualification tests (Test Case: TRM/CA/07-E) for three frequencies (2402, 2441, 2480 MHz).
Additionally an example for the channel separation is given in the test report.

9. Derivation and examples for a hopping sequence in hybrid mode

For the generation of the inquiry and page hop sequences the same procedures as described for the data mode are used (see Clause 5.), but this time with different input vectors:

- For the inquiry hop sequence, a predefined fixed address is always used. This results in the same 32 frequencies used by all devices doing an inquiry but every time with a different start frequency and phase in this sequence.
- For the page hop sequence, the device address of the paged unit is used as input vector. This results in the use of a subset of 32 frequencies which is specific for that initial state of the connection establishment between the two units. A page to different devices would result in a different subset of 32 frequencies.

So it is ensured that also in hybrid mode the frequency use equally averaged.

Example for a hopping sequence in inquiry mode:
48, 50, 09, 13, 52, 54, 41, 45, 56, 58, 11, 15, 60, 62, 43, 47, 00, 02, 64, 68, 04, 06, 17, 21, 08, 10, 66, 70, 12, 14, 19, 23

Example for a hopping sequence in paging mode:
08, 57, 68, 70, 51, 02, 42, 40, 04, 61, 44, 46, 63, 14, 50, 48, 16, 65, 52, 54, 67, 18, 58, 56, 20, 53, 60, 62, 55, 06, 66, 64

10. Receiver bandwidth and synchronisation in hybrid mode

The receiver input bandwidth is the same as in the data mode (1 MHz). 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, an special access code, derived from the BD_ADRESS of the paged device will be, 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. For this reason the time to establish the connection is reduced considerable.

11. Spread rate / date rate of the direct sequence signal

The Spread rate / Data rate in inquiry and paging mode can be defined via the access code. The access code is the only criterion for the system to check if there is a valid transmission or not. If you regard the presence of a valid access code as one bit of information, and compare it with the length of the access code of 68 bits, the Spread rate / Data rate will be 68/1.

12. Spurious emissions in hybrid mode

The dwell time in hybrid mode is shorter than in data mode. For this reason the spurious emissions average level in data mode is worst case. The spurious emissions peak level is the same for both modes.

13. Peak power spectral density measurement

Since the transmitter is only active for some milliseconds on one channel you would get a result with many interruptions if using a sweep time of e.g. 1 s as stated in the FCC rules. Therefore a fast sweep in maxhold function is used instead and the EUT is activated several times until the measurement curve has stabilized.