**TÜV Rheinland**
**Product Safety GmbH**

**Appendix 4**

Am Grauen Stein    D - 51105 Köln

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## 2.1 Description of Circuit Function
### 2.1.1 General Description

Bluetooth operates in the unlicensed ISM band at 2.4 GHz. A frequency hop transceiver is applied to combat interference and fading. A shaped, binary FM modulation is applied to minimize transceiver complexity. The symbol rate is 1 Ms/s. A slotted channel is applied with a nominal slot length of 625 μs. For full duplex transmission, a Time-Division Duplex (TDD) scheme is used. On the channel, information is exchanged through packets. Each packet is transmitted on a different hop frequency. A packet nominally covers a single slot, but can be extended to cover up to five slots. The Bluetooth protocol uses a combination of circuit and packet switching. Slots can be reserved for synchronous packets. Bluetooth can support an asynchronous data channel, up to three simultaneous synchronous voice channels, or a channel which simultaneously supports asynchronous data and synchronous voice. Each voice channel supports a 64 kb/s synchronous (voice) channel in each direction. The asynchronous channel can support maximal 723.2 kb/s asymmetric (and still up to 57.6 kb/s in the return direction), or 433.9 kb/s symmetric. The Bluetooth system consists of a radio unit, a link control unit, and a support unit for link management and host terminal interface functions.

### 2.1.2 Specific Information about the RF module

The Bluetooth Radio PBA 313 05 from Ericsson Microelectronics is a short-range microwave frequency radio transceiver for Bluetooth communication links. Provided in a compact LGA package. No external shield is required. The Bluetooth Radio offers a combination of compact size, low power consumption, and cost effective assembly. The PBA 313 05 forms a complete radio with only the addition of an antenna, a 13 MHz reference frequency crystal, and a digital control functionality. PBA 313 05 is built around an RFCMOS ASIC. Antenna filter, RX and TX baluns are all integrated into the circuit.

### 2.1.3 Modulation technique

The transmitter utilises an IQ modulation architecture where the carrier wave is generated by the local oscillator. The receiver has a near-zero IF heterodyne architecture with IF around 3 MHz.

The receiver consists of a LNA followed by I and Q mixers. The I and Q IF (Intermediate frequency) signals of these mixers are fed to an image rejecting selectivity filter (a bandpass filter). The filter is followed by two limiters (I and Q) fixing the amplitude of the received signal to the required level for the demodulator. The limiters generate an RSSI signal, which is converted to a digital word and is available through the serial interface. The demodulator is an IQ

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quadrature demodulator. A post detection filter and a slicer, which will output the received data to the baseband processor, follow the demodulator.

The local oscillator is an integrated VCO (Synthesizer). The VCO frequency is controlled by means of a phase locked loop. A loop filter is to generate the tuning voltage for the VCO. The same VCO is used when receiving and transmitting.

The transmitter utilises IQ modulation. The bit stream from the baseband radio is digitally processed to generate gaussian shaped I & Q output. A DAC and reconstruction filter is used to generate the IF input to the mixer. This RF input to the mixer comes from the phase locked VCO via phase shifters and buffering. The mixer output is fed to the Power Amplifier, which will deliver the output power at the antenna.

There are a number of other circuit blocks such as the crystal oscillator, low power oscillator, power on reset circuit, control logic and the serial interface.

**Baluns:   Rx balun:** Transformation from unbalanced (single-ended) to balanced (differential) transmission. **Tx balun:** Transformation from balanced to unbalanced transmission. The baluns are integrated in the substrate.

**Antenna switch:**   Directs the power either from the antenna filter to the receive ports or from the external PA output ports to the antenna filter.

**Antenna filter:**   Front end bandpass filter fully integrated in the ceramic substrate.

**Power Supply:**   There is only one supply connection Vdd=2.6Vdc (min=2.5V, max=2.75V), powered by an external regulator.